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

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| **Course Code** | **18RO2002** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Which property is constant in first law of thermodynamics? | | CO1 | U | 1 |
| 2. | Define thermodynamic system. | | CO1 | R | 1 |
| 3. | State Boyle’s law. | | CO2 | R | 1 |
| 4. | Constant temperature process is also called as \_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 5. | Constant volume air standard cycle is also known as \_\_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 6. | Constant pressure air standard cycle is also known as \_\_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 7. | Define pressure and write its SI unit. | | CO4 | R | 1 |
| 8. | Continuity equation is also called as \_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 9. | Define centre of gravity of the body. | | CO5 | R | 1 |
| 10. | Write SI unit of energy and power. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A system undergoes a process in which the heat transfer is 60 kJ. The work transfer is 110 kJ. Calculate the change in internal energy of the system. | | CO1 | An | 3 |
| 12. | Derive an expression for workdone during a polytropic process. | | CO2 | A | 3 |
| 13. | The momentum of a body of mass 7 kg is 12 kg m/s. A force of 3 N acts on the body in the direction of motion for 7 s. Find the increase in the kinetic energy. | | CO3 | An | 3 |
| 14. | Distinguish between potential energy and kinetic energy. | | CO4 | U | 3 |
| 15. | A piston and cylinder device operates 5 kg of fluid at 10 bar. The initial volume is 0.07 m³. The final volume is 0.02 m³. Calculate the workdone during the process. | | CO5 | An | 3 |
| 16. | Write down the Kinematics equations for a uniform accelerated motion. | | 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 types of thermodynamic system with suitable examples. | CO1 | A | 6 |
|  | b. | A metallic body floats at the interface of mercury and water such that 30% of its volume is submerged in mercury and 70% in water. Estimate the density of the metal? The specific gravity of mercury is 13.6. | CO1 | An | 6 |
| 18. | a. | Derive an expression for workdone during aisothermal, constant volume and constant pressure processes and draw the p-v diagram. | CO2 | A | 6 |
|  | b. | A domestic refrigerator operates between -30°C and 30°C Calculate the C.O.P of the refrigerator. Show that the COP of a heat pump is greater than the COP of a refrigerator by unity. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | What is Carnot cycle? Explain with the help of a p-v diagram. | CO3 | A | 6 |
|  | b. | Explain the two statements of the second law of thermodynamics with source and sink diagram. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Derive the continuity equation. What is its significance? | CO4 | A | 6 |
|  | b. | Derive an expression for hydrostatic force on a submerged curved surface. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | What are the types of thermodynamic equilibrium? Explain. | CO5 | A | 6 |
|  | b. | Determine the flow rate of a fluid passing through a horizontal pipe of 75 mm diameter at inlet and 25 mm diameter at outlet. The velocity of the fluid at inlet is 13.5 m/s. The density of the fluid is 1.6 kg/m³. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | The particle of mass 50 kg is at rest. Find the work done to accelerates it by 20 m/s in 10 s. | CO6 | E | 6 |
|  | b. | Derive following equations for a uniformly accelerated motion :  (i) v = u+at (ii) S = ut+at2 (iii) v2=u2+2aS | CO6 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | What is Otto cycle? Explain with the help of a p-v diagram and derive the air standard efficiency of the cycle. | CO3 | An | 6 |
|  | b. | Explain the first law of thermodynamics applied to a cyclic process and the change of state. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A body of mass 2 kg travels according to the law  x(t) = pt + qt² + rt³ where, p = 3 m/s and q = 4 m/s² and r = 5 m/s³. Find the force acting on the body at t = 2 s. | CO5 | E | 6 |
|  | b. | A reversible heat engine operates between two reservoirs at temperatures of 1000°C and 300°C. Calculate the maximum efficiency of the heat engine cycle. The heat transfer to the heat engine is 1500 kilo joule. Calculate the work done during the process. | CO6 | E | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the fundamentals of systems. |
| CO2 | State the laws of thermodynamics. |
| CO3 | Describe the air standard cycles and their significance. |
| CO4 | Discuss about the principles of fluid mechanics. |
| CO5 | Construct free body diagrams to analyze static equilibrium. |
| CO6 | Apply the knowledge of Dynamics in Mechanical System Design |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | 6 | 9 | - | - | 17 |
| CO2 | 1 | 1 | 15 | - | 6 | - | 23 |
| CO3 | - | 2 | 12 | 9 | - | - | 23 |
| CO4 | 1 | 4 | 12 | - | - | - | 17 |
| CO5 | 1 | - | 6 | 3 | 12 | - | 22 |
| CO6 | 1 | - | 3 | 6 | 12 | - | 22 |
|  | | | | | | | **124** |



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

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| **Course Code** | **18RO2003** | **Duration** | **3hrs** |
| **Course Name** | **AUTOMATIC CONTROL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write Masons Gain formula. | | CO1 | U | 1 |
| 2. | List the basic elements of translational mechanical systems. | | CO1 | R | 1 |
| 3. | Define type of a system. | | CO2 | R | 1 |
| 4. | How the system is classified depending on the value of damping ratio? | | CO2 | U | 1 |
| 5. | Define state variable? | | CO3 | U | 1 |
| 6. | List the main properties of STM. | | CO3 | U | 1 |
| 7. | What is frequency response? | | CO4 | R | 1 |
| 8. | What is bandwidth? | | CO4 | R | 1 |
| 9. | How will you find root locus on real axis? | | CO5 | U | 1 |
| 10. | Sketch the polar plot of **.** | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the differential equation governing the mechanical rotational system shown in Fig. 1 and draw the electrical equivalent analogy circuits.    **Fig. 1** | | CO1 | An | 3 |
| 12. | Explain the effects of P, PI and PID controller on the system dynamics. | | CO2 | An | 3 |
| 13. | Draw the State model of a linear single input Single output and obtain its corresponding Equations. | | CO3 | An | 3 |
| 14. | Write the expression for resonant peak, resonant frequency and bandwidth. | | CO4 | An | 3 |
| 15. | What is the relation between stability and coefficient of characteristic polynomial? | | CO5 | An | 3 |
| 16. | How phase margin determined from bode plot? | | 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. |  | Using mason gain formula find the transfer function C /R for the signal flow graph shown in Fig. 2.    **Fig. 2** | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Consider a unity feedback system with a closed loop transfer function.  Calculate open loop transfer function G(s). | CO2 | A | 6 |
|  | b. | Derive an expression to find steady state error of a closed loop control system. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | The state space representation of a system is given below  and  Check for controllability and observability. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Given ξ = 0.7 and = 10 rad/sec. Calculate resonant peak, resonant frequency and bandwidth. | CO4 | A | 6 |
|  | b. | Explain the correlation between time response and frequency response. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | With the help of Routh’s stability criterion find the stability of the systems represented by the characteristic equation **.** Comment on the location of roots of the characteristic equation. | CO5 | E | 6 |
|  | b. | Find state variable representation of an armature controlled D.C. motor. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Describe the Nyquist contour and its various segments. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | Draw the Bode plot for the following transfer function.  **.** Mark the following on the Bode diagram,  a) Gain cross over frequency, b) Phase margin, c) Phase cross over frequency,  d) Gain margin | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A unity feedback control system has an open loop transfer function  . Sketch the root locus. | CO5 | An | 12 |

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

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|  | **COURSE OUTCOMES** | | | | | | | | | |
| **CO1** | Develop mathematical models of control components and physical systems | | | | | | | | | |
| **CO2** | Determine the time domain responses of LTI systems | | | | | | | | | |
| **CO3** | Derive equivalent differential equation, transfer function and state space model for a given system | | | | | | | | | |
| **CO4** | Examine the frequency domain specifications of the LTI systems | | | | | | | | | |
| **CO5** | Evaluate stability of the linear systems with respect to time domain | | | | | | | | | |
| **CO6** | Analyze the stability of systems based on frequency domain by using different techniques | | | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 12 | 3 |  |  | 17 |
| **CO2** | 1 | 1 | 12 | 3 |  |  | 17 |
| **CO3** | 1 | 1 | 6 | 3 | 12 |  | 23 |
| **CO4** | 2 |  | 6 | 9 |  |  | 17 |
| **CO5** | 1 |  |  | 15 | 6 | 12 | 34 |
| **CO6** |  | 1 |  | 15 |  |  | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **18RO2005** | **Duration** | **3hrs** |
| **Course Name** | **SENSOR SIGNAL CONDITIONING CIRCUITS** | **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. | A differential amplifier has a differential voltage gain of 1000 and common mode gain of 0.1. Determine CMRR. | | CO1 | A | 1 |
| 2. | Illustrate the pin diagram of IC 741. | | CO1 | U | 1 |
| 3. | List the features of an instrumentation amplifier. | | CO2 | R | 1 |
| 4. | Enumerate the advantages of active filter over passive filter. | | CO2 | R | 1 |
| 5. | Draw the diagram for a Positive clipper circuits. | | CO3 | R | 1 |
| 6. | What is zero crossing detector and how does it work? | | CO3 | R | 1 |
| 7. | Voltage Controlled Oscillator is called as voltage to frequency converter? Why? | | CO4 | R | 1 |
| 8. | Choose the frequency and duty cycle for a 555 timer astable multivibrataor with R1=10Kohm, R2= 5K ohm and C-0.01 µF. | | CO4 | R | 1 |
| 9. | List the advantages of integrating type ADC | | CO5 | R | 1 |
| 10. | Draw a sample and hold circuit diagram. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Develop the internal block diagram of an Op-amp. | | CO1 | A | 3 |
| 12. | State the two conditions for Oscillation. | | CO2 | R | 3 |
| 13. | Sketch the basic circuit using op amp to perform the mathematical operation of Integrator and explain. | | CO3 | A | 3 |
| 14. | Draw the block diagram for Phase locked loop. | | CO4 | U | 3 |
| 15. | Find the number of resistances required for an 8 bit weighted DAC converter. Consider the smallest resistance is R and obtain those resistance values. | | CO5 | R | 3 |
| 16. | Explain the applications of PLL using for FSK modulation. | | 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. | Discuss the DC characteristics of an operational amplifier. i) input bias current, ii) input offset current, iii)input offset voltage and iv) output offset voltage. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Draw an instrumentation amplifier whose gain is controlled by adjustable gain and explain its working concept. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Sketch the circuit diagram for the Wien bridge oscillator and derive an expression for the frequency of oscillation of the circuit. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | With the help of circuits and necessary equations, explain how logarithmic amplifier computations are performed using IC741 and derive an expression for the same. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the working of IC 741 operational amplifier as an astable multivibrator with a neat functional diagram, and derive an expression for the frequency of oscillation with relevant waveforms. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | With a neat functional diagram, explain the working of 555 timers as a mono-stable multivibrator and derive an expression for the frequency of oscillation with relevant waveforms. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | With a neat internal diagram explain the following i) Weighted resistor method ii) R-2R Ladder type methods for digital to analog converter techniques. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss in detail about the grounding and shielding effects in strain gauge and thermocouple sensors. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Define the characteristics of operational amplifiers |
| CO2 | Describe the linear applications of op-amp |
| CO3 | Design circuits for non-linear applications of op-amp |
| CO4 | Apply the knowledge of special ICs like IC 555 to design circuits |
| CO5 | Discuss about the types of ADCs and DACs |
| CO6 | Analyze the parameters to be considered for interfacing. |

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



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

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| --- | --- | --- | --- |
| **Course Code** | **18RO2008** | **Duration** | **3hrs** |
| **Course Name** | **ROBOT KINEMATICS AND DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State Asimov’s laws of robotics | | CO1 | R | 1 |
| 2. | Specify the degree of freedom of the robot shown in Fig.1.  2 DOF Serial Flexible Link - Quanser  Fig.1. | | CO1 | U | 1 |
| 3. | Write the general form of Homogeneous Transformation Matrix. | | CO2 | R | 1 |
| 4. | Identify the coordinate transformation that is done in Fig.2 below, where re represents the cartesian coordinates and θ represents the joint angles.    Fig.2 | | CO2 | U | 1 |
| 5. | List the factors that determine the work volume of a robot. | | CO3 | U | 1 |
| 6. | Specify the primary functions of robot vision system. | | CO3 | U | 1 |
| 7. | Outline the concept of interior singularity in robot manipulator. | | CO4 | U | 1 |
| 8. | Relate the Coriolis forces acting at a joint with the equations of motion of a robot. | | CO4 | U | 1 |
| 9. | Mention the two approaches of robot dynamic analysis. | | CO5 | U | 1 |
| 10. | Differentiate path and trajectory of a robot. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish serial and parallel manipulators with examples. | | CO1 | A | 3 |
| 12. | If a square matrix R is orthogonal, then R-1 = RT. Justify the statement. | | CO2 | U | 3 |
| 13. | Specify the need for structured illumination techniques for robot. | | CO3 | A | 3 |
| 14. | Illustrate the concept of resolved motion rate control with relevant sketches. | | CO4 | U | 3 |
| 15. | Derive the force-acceleration relationship of a simple cart spring system using Newtonian Mechanics. | | CO5 | U | 3 |
| 16. | Specify the characteristics of Cartesian space trajectory planning. | | 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 industrial robots with necessary diagrams and explanations. | CO1 | U | 6 |
|  | b. | Mention the performance parameters that characterize a robot and specify the significance of each parameter. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | With relevant diagrams and explanations, derive the forward and inverse kinematic equations of a 2 link RR Manipulator. | CO2 | A | 6 |
|  | b. | Compute the cartesian coordinates for the end of the arm, given that the length of joints L1 = 15 in, L2 = 12 in, angles θ1 = 600 and θ2 = 450. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Draw the building blocks of machine vision system and briefly discuss about the function of each block. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Mention the significance of Jacobian matrix for differential kinematic analysis and hence derive the Jacobian of 3R planar manipulator. | CO4 | A | 6 |
|  | b. | Illustrate the concept of resolved motion rate control with relevant sketches. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Derive the force-acceleration relationship of the cart spring system shown in Fig.3. using Lagrange Mechanics.    Fig. 3 | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | A point P in space is defined as P (2, 3, 5) T relative to frame B which is attached to the origin of the reference frame A and is parallel to it. Apply the following transformations to frame B and find P with respect to A frame.  1. Rotate 90 0 about x-axis,  2. Then Rotate 90 0 about local a-axis  3. Then Translate 3 units about y-, 6 units about z-, and 5 units about x-axes. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Elaborate the steps to arrive at the Denavit-Hartenberg representation for forward kinematic analysis of robots. | CO3 | U | 6 |
|  | b. | Specify the four kinematic parameters used in kinematic analysis of a robot | CO3 | U | 6 |
|  | | | | | |
| 24. | a. | Highlight the basic concepts of joint space trajectory planning with relevant diagrams. | CO6 | A | 6 |
|  | b. | The second joint of a 6-axis robot is to go from an initial angle of 20 degrees to an intermediate angle of 80 degrees in 5 seconds and continue to its destination of 25 degrees in another 5 seconds. Calculate the coefficients for third-order polynomials in joint-space. Assume the joint stops at intermediate points. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Select and classify various robotic systems |
| **CO2** | Utilize kinematics analysis of robotic manipulators |
| **CO3** | Perform Workspace analysis of a Robotic System |
| **CO4** | Describe the Differential Motion and Statics of robotic manipulators |
| **CO5** | Describe the construction of robotic manipulators and analyze dynamics and force of robotic manipulators |
| **CO6** | Plan off-line Robot trajectories to meet desired End-Effector tasks |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | 3 |  |  |  | 17 |
| **CO2** | 1 | 4 | 18 | 6 |  |  | 29 |
| **CO3** |  | 14 | 15 |  |  |  | 29 |
| **CO4** |  | 11 | 6 |  |  |  | 17 |
| **CO5** |  |  | 4 | 12 |  |  | 16 |
| **CO6** |  | 4 | 6 | 6 |  |  | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **18RO2009** | **Duration** | **3hrs** |
| **Course Name** | **VISION SYSTEMS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Spell the key features of the illumination technique in machine vision system. | | CO1 | R | 1 |
| 2. | Name the membranes of human vision system. | | CO1 | R | 1 |
| 3. | Define sharpening in a spatial domain image enhancement technique. | | CO2 | R | 1 |
| 4. | State the role of a digitizer in digital image processing. | | CO2 | R | 1 |
| 5. | Name the techniques involved in region-based segmentation. | | CO3 | R | 1 |
| 6. | Define histogram of an image. | | CO3 | R | 1 |
| 7. | Recall the fundamental machine vision approaches to human object recognition. | | CO4 | R | 1 |
| 8. | Define a feature. | | CO4 | R | 1 |
| 9. | Reproduce the basic layout of parallel stereo imaging. | | CO5 | R | 1 |
| 10. | State the ROS library to interface between ROS and OpenCV. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define the range of subjective brightness adaptation and discrimination for vision system. | | CO1 | R | 3 |
| 12. | Describe the role of sampling and quantization in a digital image. | | CO2 | R | 3 |
| 13. | Illustrate the basic morphological operators for extracting image components with examples. | | CO3 | U | 3 |
| 14. | Summarize the factors that make it difficult to recognize objects. | | CO4 | U | 3 |
| 15. | Examine the process of camera calibration. | | CO5 | R | 3 |
| 16. | List the three pillars of computer vision in the ROS community. | | 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. | With the help of a neat block diagram, discuss the components of a general-purpose image processing system. | CO1 | U | 10 |
|  | b. | Distinguish between the rods cells and the cone cells in human vision system. | CO1 | U | 2 |
|  |  |  |  |  |  |
| 18. | a. | Categorize the edge detection operators used in image processing applications. | CO2 | An | 8 |
|  | b. | Justify the need of gray scaling in image processing. | CO2 | E | 4 |
|  |  |  |  |  |  |
| 19. | a. | Discuss in detail the concepts of boundary descriptors in object recognition. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain in detail the fundamental machine vision approaches to recognize the object in an image. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the procedure to map sonar data using neat sketches. | CO5 | U | 4 |
|  | b. | Illustrate the applications of Digital Image Processing in sensor readings for a vision system with an example. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Describe the digital image in a 2D discrete space and interpret the relationship between pixels with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Apply the histogram equalization for the gray levels of an 8 X 8 image given below and plot the histogram of the original and the processed image.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Gray levels | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | No. of pixels | 4 | 5 | 12 | 10 | 4 | 11 | 8 | 9 | | CO2 | A | 10 |
|  | b. | Summarize the importance of histogram equalization. | CO2 | U | 2 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain in detail the Gazebo and Stage simulators to run the robots to venture into the real-world. | CO6 | U | 12 |

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basic components of specific visual system |
| CO2 | Discuss the effect of low-level vision algorithms |
| CO3 | Explain the use of high-level vision algorithms for specific purpose |
| CO4 | Assess the identification of objects using a specified technique |
| CO5 | Explain the applications of vision and tracking algorithms |
| CO6 | Discuss the basics of ROS and OpenCV for Robotic vision |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 24 | - | - | - | - | 29 |
| CO2 | 5 | 2 | 10 | 8 | 4 |  | 29 |
| CO3 | 2 | 15 | - | - | - | - | 17 |
| CO4 | 2 | 15 | - | - | - | - | 17 |
| CO5 | 4 | 12 | - | - | - | - | 16 |
| CO6 | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **18RO2010** | **Duration** | **3hrs** |
| **Course Name** | **PROGRAMMABLE LOGIC CONTROLLERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Before PLC’s was created many industries used \_\_\_\_\_\_\_\_\_\_ | | CO1 | U | 1 |
| 2. | \_\_\_\_\_\_\_\_\_ are the components that are required to change or create a program. | | CO1 | R | 1 |
| 3. | List all the elements in ladder logic. | | CO2 | R | 1 |
| 4. | \_\_\_\_\_\_\_\_ is an example of output device to PLC. | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_ is the largest integer number that a PLC counter function can reach if it uses a 16 bit register. | | CO3 | U | 1 |
| 6. | Name the timer that is used to start the escalator 3sec after the sensor senses the person. | | CO3 | R | 1 |
| 7. | \_\_\_\_\_\_\_\_\_ instruction in a PLC program allows the portion of PLC program to be bypassed. | | CO4 | U | 1 |
| 8. | \_\_\_\_\_\_instruction is used to enable or disable a section of rungs within a ladder logic diagram. | | CO4 | R | 1 |
| 9. | HMI stands for \_\_\_\_\_\_\_\_\_ | | CO5 | U | 1 |
| 10. | Name the communication protocol that is commonly used by PLCs for industrial networking. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Develop the Ladder logic program for starting a motor using a START push button switch and stop the motor using STOP push button switch. | | CO1 | An | 3 |
| 12. | Briefly explain the control elements used in Industrial automation. | | CO2 | U | 3 |
| 13. | Draw a ladder diagram for 2 Motor operations for the following conditions.  i) Start Pushbutton starts Motor M1 and M2  ii) Stop pushbutton stops Motor M1 first and then after 10 Sec Motor M2. | | CO3 | An | 3 |
| 14. | With neat diagram, explain the UP/DOWN Counter in PLC. | | CO4 | U | 3 |
| 15. | Identify the role of HMI in industries. | | CO5 | An | 3 |
| 16. | Compare process bus and Ethernet. | | 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. | Briefly explain the historical developments in industrial automation. | CO1 | R | 6 |
|  | b. | What is meant by scan cycle of PLC? Explain with neat diagram. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | With Neat Sketch, Explain the architecture of PLC. | CO2 | R | 6 |
|  | b. | Explain the Working Principle of output Module of PLC with neat diagram. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Write the Ladder logic diagram for the following conditions:   1. When a start button is pressed, Motor M1 is started. 2. After 5 sec Motor M1 stops and Motor M2 starts. 3. After 5 sec Motor M2 stops and Motor M3 starts 4. When stop button is pressed Motor M3 stops. | CO3 | E | 6 |
|  | b. | Write a Ladder logic diagram for the following conditions:  The startup system includes three conveyor belts in a sequence with a delay of 5sec between each startup C1, C2 and C3. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare and contrast the different types of timers available in PLC. | CO4 | A | 6 |
|  | b. | Develop a ladder logic diagram for STAR -DELTA Starter. | CO4 | C | 6 |
|  |  |  |  |  |  |
| 21. | a. | Briefly explain the various types of HMI Panels. | CO5 | U | 6 |
|  | b. | How to interface PLC with HMI? | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the sequencer function available in PLC. | CO3 | A | 6 |
|  | b. | Explain the Master control relay (MCR) instruction in PLC. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | List out the advantages and disadvantages of using PLC. | CO2 | U | 6 |
|  | b. | Enumerate the factors to be considered while selecting a PLC. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | What are the parameters to be considered while installing the PLC? Explain any two. | CO6 | A | 6 |
|  | b. | Explain the field bus architecture with neat sketch. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Identify and understand the automation concepts for Industries. |
| **CO2** | Apply PLC architecture knowledge to select PLC for specific problems. |
| **CO3** | Use PLC Ladder diagram for simple applications |
| **CO4** | Design real time application using PLC. |
| **CO5** | Create prototype for the real time application Using PLC, with HMI |
| **CO6** | Recognize the faults and identify the protocol to be used for the applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 7 |  | 3 |  |  | 17 |
| **CO2** | 8 | 21 |  |  |  |  | 29 |
| **CO3** | 1 | 7 | 6 | 3 | 12 |  | 29 |
| **CO4** | 1 | 4 | 6 |  |  | 6 | 17 |
| **CO5** |  | 7 | 6 | 3 |  |  | 16 |
| **CO6** | 4 |  | 6 | 6 |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Course Code** | **18RO2011** | **Duration** | **3hrs** |
| **Course Name** | **AUTOMATION SYSTEM DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List all the types of process variables. | | CO1 | R | 1 |
| 2. | Interpret the term control system. | | CO1 | R | 1 |
| 3. | Sketch the graph that indicates lifecycle of an electric motor. | | CO2 | R | 1 |
| 4. | Identify the given mechanical component.  PROGRESSIVE AUTOMATIONS Mini Linear Electric Actuator 12V (12", 150 lbs.)  Innovative High-Speed Motor & Durable Stroke. for Outdoor, Agriculture,  Track, Solar, Robotics, Home Automation. PA-14-12-150 : Amazon.in:  Industrial & Scientific | | CO2 | R | 1 |
| 5. | Name the rolling elements utilized by linear guideway for linear motion. | | CO3 | R | 1 |
| 6. | Mention the recommended viscosity of lubricant oil. | | CO3 | R | 1 |
| 7. | State the ergonomic principle of material handling. | | CO4 | R | 1 |
| 8. | Expand NIOSH. | | CO4 | R | 1 |
| 9. | Specify the need of nip guard. | | CO5 | R | 1 |
| 10. | Indicate the type of conveyors which are capable of handling a wide variety of bulk materials. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write short notes on transfer function. | | CO1 | U | 3 |
| 12. | Illustrate the need of motor sizing. | | CO2 | U | 3 |
| 13. | Explain the concept of fatigue flaking in the linear guideway. | | CO3 | U | 3 |
| 14. | Distinguish between dolly and two wheeled hand truck. | | CO4 | U | 3 |
| 15. | Describe the concept of plies in belts. | | CO5 | U | 3 |
| 16. | Discuss the need of effective planning for automation system design. | | 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 necessary diagram, describe the key elements in the mechatronic system. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the art of selecting the optimal motor for the motion control application.Top of Form | CO2 | U | 6 |
|  | b. | Clarify the process of choosing the ideal mechanical components tailored to meet the demands of the motion control applications. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Sketch the flow chart to select the suitable linear guideways and explain its procedure in detail. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Demonstrate the different approaches for managing dry bulk materials by applying principles of unit and bulk material handling, with relevant diagrams. | CO4 | U | 6 |
|  | b. | With necessary diagrams, explain the following material handling equipment: Crates, strapping/tape/glue and tote pans. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the safety protection at pulleys in belt conveyors with essential diagrams. | CO5 | R | 6 |
|  | b. | Explain the construction and working of skirtboards in the belt conveyors. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the concept and functionality of weigh larries in detail. | CO5 | U | 6 |
|  | b. | Describe the working of various types of AGV in detail. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the working of various positioning equipment in the automation industry with necessary diagrams. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the design and simulation of automated system using CIROS software. | CO6 | A | 6 |
|  | b. | Demonstrate the importance of ASRS in the logistics management industries. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Specify the automation elements and requirements |
| **CO2** | Select the appropriate precision motion components based on the application |
| **CO3** | Analyze the motion control with more precise arrangements |
| **CO4** | Describe the basic design considerations of material handling equipment |
| **CO5** | Design and select a belt conveyor for real world applications |
| **CO6** | Analyze the integrating automation components |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 15 |  |  |  |  | 17 |
| **CO2** | 2 | 15 |  |  |  |  | 17 |
| **CO3** | 2 | 15 |  |  |  |  | 17 |
| **CO4** | 2 | 21 | 12 |  |  |  | 35 |
| **CO5** | 8 | 15 |  |  |  |  | 23 |
| **CO6** |  | 3 | 12 |  |  |  | 15 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **18RO2013** | **Duration** | **3hrs** |
| **Course Name** | **TOTALLY INTEGRATED AUTOMATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give one example of horizontal integration. | | CO1 | U | 1 |
| 2. | Mention the main goal of Industrial automation. | | CO1 | U | 1 |
| 3. | Define tag logging. | | CO2 | R | 1 |
| 4. | Define the function of TCP/IP. | | CO2 | U | 1 |
| 5. | Define Acquisition Cycle. | | CO3 | R | 1 |
| 6. | Two options to display the tag logging are \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 7. | The newly adopted standard for Distributed Control System is \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | DCS is replacement of\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| 9. | Define plant layout. | | CO6 | R | 1 |
| 10. | Give one example of static product plant layout. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare PAC and PLC. | | CO1 | U | 3 |
| 12. | List out the applications of SCADA system. | | CO2 | R | 3 |
| 13. | Define OPC protocol and mention its types. | | CO3 | U | 3 |
| 14. | Write the advantages of DCS. | | CO4 | U | 3 |
| 15. | Mention the role of General purpose computers in Distributed Control system. | | CO5 | U | 3 |
| 16. | List out the different software used for Plant layout modeling. | | 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 various levels of components in TIA with relevant diagrams. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain hardware and software architecture of SCADA. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the procedure to configure User Administration feature in SCADA. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the functions of Local Control unit in detail with relevant diagram. | CO4 | U | 6 |
|  | b. | Elaborate the role Redundancy in distributed control system in detail. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the low level and high level operator interface in detail. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Can we use VB scripts in SCADA systems? Explain with relevant examples. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the architecture of DCS in detail. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | With relevant flow diagram, explain the process sequencing of cement production process. | CO6 | A | 6 |
|  | b. | Elaborate the factors to be considered before selecting cables for Industrial automation. | CO6 | A | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Outline the selection, and application of various TIA control elements |
| CO2 | Discuss the configuration of SCADA functionalities with Tags, Screens, and Trends |
| CO3 | Compare various communication protocols for automation system |
| CO4 | Identify and differentiate various sub systems of DCS |
| CO5 | Describe various functions of Interfaces in DCS |
| CO6 | Analyze and design an appropriate system for the industrial applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 17 |  |  |  |  | 17 |
| **CO2** | 4 | 13 | 12 |  |  |  | 29 |
| **CO3** | 1 | 4 | 12 |  |  |  | 17 |
| **CO4** | 1 | 21 |  | 6 |  |  | 28 |
| **CO5** |  | 16 |  |  |  |  | 16 |
| **CO6** | 1 | 4 | 12 |  |  |  | 17 |
|  | | | | | | | **124** |



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

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| **Course Code** | **18RO2015** | **Duration** | **3hrs** |
| **Course Name** | **FIELD AND SERVICE ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two applications of Service Robots. | | CO1 | R | 1 |
| 2. | Define AMR. | | CO1 | R | 1 |
| 3. | Specify the primary challenge in Autonomous Mobile Robotics. | | CO2 | R | 1 |
| 4. | Write the concept of Mobility. | | CO2 | R | 1 |
| 5. | Define SLAM. | | CO3 | R | 1 |
| 6. | Write the Markov’s assumption. | | CO3 | U | 1 |
| 7. | Define Histogram filter. | | CO4 | U | 1 |
| 8. | List the state estimation algorithms. | | CO4 | U | 1 |
| 9. | Define Local Path planning. | | CO6 | U | 1 |
| 10. | Specify the controllers used in Humanoid Robot. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Express how Autonomous Mobile Robot systems are categorized based on their field of application. | | CO1 | R | 3 |
| 12. | Write the Degrees of Freedom (DOF) in Mobile Robots. | | CO2 | U | 3 |
| 13. | Write the Localization techniques used in AMR. | | CO3 | R | 3 |
| 14. | Distinguish Grid and Sector Maps. | | CO4 | U | 3 |
| 15. | What do you mean by tactile sensing? | | CO5 | U | 3 |
| 16. | Distinguish Cell Decomposition and Potential Path Planning. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the classification of service robot based on their application areas. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Specify an overview of the historical development of Field and Service Robotics. | CO1 | U | 6 |
|  | b. | Explain the general schematic diagram of mobile robot localization. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 19. |  | Summarize the Mobile Robot Maneuverability and Workspace. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the Kalman filter algorithm with a suitable example. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the Grid Mapping method with an example. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the topological mapping method with its merits and demerits. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the cell decomposition approach path planning with an example. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the methods of transduction in Tactile Sensor. | CO5 | A | 6 |
|  | b. | Explain the Lower body controlling mechanism in Humanoid Robot. | CO5 | An | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the applications and current trend in field and service robot |
| **CO2** | Explain about the kinematic modeling of mobile robots |
| **CO3** | Identify, formulate and solve algorithm related to localization, obstacle avoidance, and mapping |
| **CO4** | Apply and program robot for reactive concepts for robot interaction with human, between machines and among robots |
| **CO5** | Analyze the concepts of balancing legged robots and interaction interface concepts for humanoid robot |
| **CO6** | Implement path planning algorithms inside a field/service robot for navigation |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 17 | 6 | - | - | - | - | 23 |
| **CO2** | 2 | 15 | - | - | - | - | 17 |
| **CO3** | 10 | 1 | 12 | - | - | - | 23 |
| **CO4** | - | 17 | - | 12 | - | - | 29 |
| **CO5** | - | 4 | 6 | 6 | - | - | 16 |
| **CO6** | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **22RO1001** | **Duration** | **3hrs** |
| **Course Name** | **MATERIAL SCIENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Distinguish between Face centered cubic and Body centered cubic in crystal structure. | | CO1 | U | 1 |
| 2. | Define Coordination number in crystal structures. | | CO1 | R | 1 |
| 3. | Identify at what temperature Iron changes its structure from BCC to FCC? | | CO2 | R | 1 |
| 4. | State the principle of Conduction band in semiconductor material. | | CO2 | R | 1 |
| 5. | Define the term Electron ballistic principle. | | CO3 | U | 1 |
| 6. | Identify the mechanism involved in atomic dislocation of materials. | | CO3 | R | 1 |
| 7. | Explain the solid solution strengthening principle. | | CO4 | U | 1 |
| 8. | Enumerate any one properties of Dielectric Fluid used in electric discharge machining process. | | CO4 | R | 1 |
| 9. | Indicate an example for strong magnetic material. | | CO5 | U | 1 |
| 10. | State the any two applications of nano composite material. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain in short the simple crystal structures found in most of the common metals. | | CO1 | A | 3 |
| 12. | Illustrate the principle solubility limits in materials with an example. | | CO2 | U | 3 |
| 13. | Define the principle of Magnetostrictive principle and state its example for Magnetrostrictive materials. | | CO3 | R | 3 |
| 14. | Write a short note on deformation by twinning. | | CO4 | U | 3 |
| 15. | Explain about Fatigue behavior of metals. | | CO5 | A | 3 |
| 16. | Differentiate retentivity and coercivity in hysteresis curve. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain Ionic bonding and Van Der Waals Bonding with a neat sketch of their bonding structure. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the development of Microstructure in Iron-Carbon Alloys with a neat diagram. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the salient features in classical free electron theory. | CO3 | A | 4 |
|  | b. | Indicate the importance of stress-strain curve for ductile material and it’s salient features with a simple sketch. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 20. |  | Explain the working principle and construction of Electron Beam Machining with a neat sketch. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the details involved in Vickers hardness test in analyzing the hardness of a given material with necessary diagram. | CO4 | U | 8 |
|  | b. | List the types Ferroelectric materials and write their advantages with few applications. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. |  | Explain with neat sketch the different stages of creep. Which stage of creep is considered during designing a product? | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain in detail the concept of Super conductivity. | CO5 | U | 6 |
|  | b. | Explain the hysteresis curve of ferromagnetic materials using domain theory. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain thrermotropic liquid crystal in detail and its applications. | CO6 | A | 6 |
|  | b. | Illustrate biomimetic materials properties and applications in detail. | CO6 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the various phase diagrams and their applications |
| **CO2** | Explain the applications of Ferrous alloys |
| **CO3** | Discuss about the electrical properties of materials |
| **CO4** | Summarize the mechanical properties of materials and their measurement |
| **CO5** | Differentiate magnetic, dielectric and superconducting properties of materials |
| **CO6** | Outline the application of modern engineering materials |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | 3 | - | - | - | 17 |
| **CO2** | 14 | 3 | - | - | - | - | 17 |
| **CO3** | 4 | 1 | 16 | - | - | - | 21 |
| **CO4** | 8 | 12 | 12 | - | - | - | 32 |
| **CO5** | 4 | 13 | 4 | - | - | - | 21 |
| **CO6** | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **19RO1002** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING PRACTICES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate the other name wooden hammer. | | CO1 | R | 1 |
| 2. | Mention the process of originating a hole. | | CO1 | R | 1 |
| 3. | Expand PCB. | | CO2 | R | 1 |
| 4. | State the specific operation of boring. | | CO2 | R | 1 |
| 5. | Indicate the chemical used for PCB etching process. | | CO3 | R | 1 |
| 6. | Specify any one application of PCB. | | CO3 | R | 1 |
| 7. | Name the parameters which are measured using multimeter. | | CO4 | R | 1 |
| 8. | Identify the type of steel used for making scriber. | | CO4 | R | 1 |
| 9. | Interpret the term iteration in for loop of virtual instrumentation software. | | CO5 | R | 1 |
| 10. | Identify any one application of robotics in healthcare industry. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write short notes on the necessity of carpentry in robot designing. | | CO1 | U | 3 |
| 12. | Discuss on the use of steel rule in fitting shop. | | CO2 | U | 3 |
| 13. | Interpret the term reaming. | | CO3 | U | 3 |
| 14. | Briefly explain the concept of measurement. | | CO4 | U | 3 |
| 15. | Distinguish between front panel and block diagram in LabVIEW software. | | CO5 | R | 3 |
| 16. | Illustrate any one application of automation in healthcare industries. | | 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. |  | Demonstrate the working of various fitting tools in detail with necessary diagrams. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the construction and working of various carpentry tools in detail with necessary diagrams. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Demonstrate the working of drilling machine operations in detail with necessary diagrams. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the procedure of PCB etching process in detail. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | State the significance of signal analysis. Also explain the construction and working of digital storage oscilloscope | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the various elements available in the front panel of the LabVIEW software. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the concept of case structure, flat sequence and while loop with necessary diagrams. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the requirement of signal conditioning in healthcare applications. | CO6 | U | 6 |
|  | b. | Describe the step-by-step procedure of PCB designing software. | CO6 | U | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Assemble mechanical devices and equipment by applying carpentry and fitting practices |
| CO2 | Apply welding and drilling skills to fabricate useful products. |
| CO3 | Design simple electric circuits and apply different types of wiring |
| CO4 | Identify the operation and handling of measuring instruments |
| CO5 | Perform troubleshooting of electric motors |
| CO6 | Fabricate PCB boards for specific applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 2 | 15 |  |  |  |  | 17 |
| CO3 | 2 | 15 | 12 |  |  |  | 29 |
| CO4 | 2 | 15 |  |  |  |  | 17 |
| CO5 | 5 | 24 |  |  |  |  | 29 |
| CO6 |  | 15 |  |  |  |  | 15 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2001** | **Duration** | **3hrs** |
| **Course Name** | **THEORY AND PROGRAMMING OF CNC MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | State any four advantages of CNC. | | | | CO1 | R | 1 |
| 2. | Work piece zero point is specified by the Programmer. [True/False] | | | | CO1 | R | 1 |
| 3. | List the axis that is aligned parallel to the working spindle or coincides with it. | | | | CO2 | U | 1 |
| 4. | Which proximity sensor detects metal objects? | | | | CO2 | An | 1 |
| 5. | Identify the auxiliary code used to represents spindle stop. | | | | CO3 | R | 1 |
| 6. | List the function of interpolator in a CNC machine controller. | | | | CO3 | An | 1 |
| 7. | List out any four commonly used CNC controllers. | | | | CO4 | E | 1 |
| 8. | What is Circuit Breaker? | | | | CO4 | An | 1 |
| 9. | What is meant by tool nose radius compensation: how is it programmed? | | | | CO5 | An | 1 |
| 10. | In a CNC milling operation, the tool has to machine the circular arc from point (20, 20) to (10, 10) at sequence number 5 of the CNC part program. If the center of the arc is at (20, 10) and the machine has incremental mode of defining position coordinates. Determine the correct tool path command? | | | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | | | Explain different types of zeros used in NC programming. | | CO1 | An | 3 |
| 12. | | | Explain the role PLC unit in CNC machine. | | CO2 | R | 3 |
| 13. | | | State any four requirements of spindle drives for CNC machine tools. | | CO3 | A | 3 |
| 14. | | | List out the types of CNC controller and explain. | | CO4 | An | 3 |
| 15. | | | A drill is positioned at point P and it has to proceed to point Q. Find the coordinates of point Q in the incremental system of defining position of a point in CNC part program? | | CO5 | A | 3 |
| 16. | | | Describe the role of Total Productive maintenance in CNC machine floor. | | CO6 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | | | |
| 17. | | a. | | Enumerate the salient features of CNC machining center. | CO1 | An | 4 |
|  | | b. | | Discuss the classification of CNC machines based on type of tool motion. | CO1 | U | 8 |
|  | |  | |  |  |  |  |
| 18. | | a. | | Explain the Functions of CNC. | CO2 | A | 6 |
|  | |  | | From a functional point of view, list out the units present in CNC systems and explain its significance. | CO2 | An | 6 |
|  | |  | |  |  |  |  |
| 19. | | a. | | List out various feed drives. Compare the advantages and limitations of them. | CO3 | E | 12 |
|  | |  | |  |  |  |  |
| 20. | | a. | | Distinguish between open loop and closed loop control system in the context of CNC control system. | CO4 | U | 6 |
|  | | b. | | Explain the working principle of CNC controller. | CO4 | U | 6 |
|  | |  | |  |  |  |  |
| 21. | | a. | | Generate part program for the job as shown in the figure. Assume suitable data for cutting operations. All dimensions are in mm.  C:\Users\SWAPNIL09\Desktop\cad exam\Capture.JPG | CO5 | E | 12 |
|  | |  | |  |  |  |  |
| 22. | | a. | | Describe with neat block diagram and suitable example various steps involved in the development of proven part program in CNC machining. | CO5 | An | 12 |
|  | |  | |  |  |  |  |
| 23. | | a. | | Describe the structural configuration of CNC machining and turning centre. | CO3 | R | 6 |
|  | | b. | | Explain various design criteria to be considered in the design of spindle for CNC applications. | CO2 | An | 6 |
|  | |  | | **Compulsory:** | | | |
| 24. | | a. | | State the factors influencing in the selection of CNC Machines. | CO6 | A | 8 |
| b. | | Describe the eight Pillars of TPM. | CO6 | An | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Classify the types of CNC machines and read their electrical circuit diagram |
| CO2 | Select the parameters for optimum performance and read the PLC ladder diagram with reference to the PLC I/O s |
| CO3 | Perform the sizing of servomotors and do drive optimization. |
| CO4 | Design electrical power, and control circuits for a CNC machine and interface various sensors to CNC/PLC |
| CO5 | Develop CNC programs for lathes, select the right tools, take offsets and do machining of acomponent. |
| CO6 | Estimate the machine hour rate of a CNC machine and do the regular and preventive maintenance. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 8 | - | 7 | - | - | 17 |
| CO2 | 3 | 1 | 6 | 13 | - | - | 23 |
| CO3 | 7 | - | 3 | 1 | 12 | - | 23 |
| CO4 | - | 6 | - | 10 | 1 |  | 17 |
| CO5 | - | - | 4 | 13 | 12 | - | 29 |
| CO6 | - | - | 8 | 4 | 3 | - | 15 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2005** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL ROBOTICS AND MATERIAL HANDLING 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. | Write the establishment year of the SCARA robot. | | CO1 | A | 1 |
| 2. | Describe the maximum load-carrying capacity of the FANUC robot. | | CO1 | R | 1 |
| 3. | Illustrate the formula for calculating the image description details | | CO2 | U | 1 |
| 4. | Write the maximum measuring length of the Fiberscope. | | CO2 | A | 1 |
| 5. | Describe the working depth of heavy work class remotely operated underwater vehicles ROVs. | | CO3 | U | 1 |
| 6. | Summarize the short-term side effects of Robotic painting. | | CO3 | U | 1 |
| 7. | Write the use of adhesive grippers. | | CO4 | A | 1 |
| 8. | Illustrate the importance of industrial robots. | | CO5 | U | 1 |
| 9. | Write the stacking load height of the mini load ASRS. | | CO6 | A | 1 |
| 10. | List any two types of conveyor systems. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write short notes on Robotic material handling. | | CO1 | A | 3 |
| 12. | Write short notes segmentation of images. | | CO2 | U | 3 |
| 13. | List the different types of cleaning robots. | | CO3 | R | 3 |
| 14. | List the different types of robotic grippers. | | CO4 | R | 3 |
| 15. | Write short notes on the impact of the robot on society. | | CO5 | A | 3 |
| 16. | Discuss industrial trucks. | | 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. |  | Write the detailed procedure of Robot centered cell. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Discuss the detailed procedure of the visual inspection system. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Write the detailed working procedure of Robotic welding. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Discuss the design procedure of grippers. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the detailed procedure of robot performance testing. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Write the detailed working procedure of the spray painting Robot; also mention its highlights. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss the various types of industrial robots with neat sketches. | CO1 | U | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain automated storage and retrieval systems (ASRS). | CO6 | U | 6 |
|  | b. | Explain the detailed procedure of bar code technology. | CO6 | U | 6 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Differentiate the various types of Industrial Robots and their architecture. |
| CO2 | Apply the concepts of image processing for robotic inspection systems. |
| CO3 | Analyze the applications of robots in various industrial application. |
| CO4 | Design and fabricate simple grippers for pick and place application. |
| CO5 | Identify the right Robot for a given industrial application. |
| CO6 | Select the right material handling system for a given application |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 12 | 16 | - | - | - | 29 |
| CO2 | - | 16 | 13 | - | - | - | 29 |
| CO3 | 3 | 2 | 12 | - | - | - | 17 |
| CO4 | 3 | 12 | 1 | - | - | - | 16 |
| CO5 | - | 13 | 3 | - | - | - | 16 |
| CO6 | 1 | 15 | 1 | - | - | - | 17 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2010** | **Duration** | **3hrs** |
| **Course Name** | **MACHINE LEARNING FOR ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Describe about ‘training Set’ and ‘test Set’ in a Machine Learning Model. | CO1 | R | 1 |
| 2. | List out the three stages of building a model in machine learning. | CO1 | R | 1 |
| 3. | Define Perceptron. | CO2 | U | 1 |
| 4. | Which algorithm is better in the case of outliers present in the dataset i.e., Logistic Regression or SVM? | CO2 | An | 1 |
| 5. | Describe Supervised Learning techniques. | CO3 | R | 1 |
| 6. | What is ‘Naive’ in a Naive Bayes? | CO3 | An | 1 |
| 7. | Explain Unsupervised Machine Learning Techniques. | CO4 | E | 1 |
| 8. | Explain K means Clustering Algorithm. | CO4 | An | 1 |
| 9. | What is the difference between Epoch, Batch, and Iteration in Neural Networks? | CO5 | An | 1 |
| 10. | State the role of the Activation functions in Neural Networks. | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | State the different types of machine learning algorithms. | CO1 | An | 3 |
| 12. | Discuss the advantages of support vector machine algorithm. | CO2 | R | 3 |
| 13. | Compare Classification with regression with an example. | CO3 | A | 3 |
| 14. | Explain the Curse of Dimensionality. | CO4 | An | 3 |
| 15. | What is the difference between Forward propagation and Backward Propagation in Neural Networks? | CO5 | A | 3 |
| 16. | List out the difference between simple linear and multiple linear regressions. | CO6 | U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. |  | Discuss the concepts of machine learning, its types and applications with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Define decision tree learning. List and explain appropriate problems for decision tree learning. | CO2 | A | 6 |
| b. | Define inductive bias. Explain inductive bias in decision tree learning. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | State the mathematical formulation of the SVM problem. Give an outline of the method for solving the problem. | CO3 | E | 6 |
| b. | Explain Gradient Descent and its types. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare Feature Extraction and Feature Selection techniques. Explain how dimensionality can be reduced using subset selection procedure. | CO4 | U | 8 |
| b. | State the reason to prefer Euclidean distance over Manhattan distance in the K means Algorithm. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain Biological Neural Network and Artificial Neural network. | CO5 | E | 6 |
| b. | List down the names of some popular Activation Functions used in Neural Networks. | CO5 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Elaborate and explain about Backpropagation. | CO5 | U | 6 |
| b. | Compare K means clustering with Hierarchical Clustering Technique. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe the Logistic Regression machine learning process. | CO2 | R | 4 |
| b. | Explain the Impact of Outliers on Logistic Regression. | CO2 | A | 4 |
| c. | Discuss the space complexity of Logistic Regression. | CO2 | U | 4 |
|  |  | **COMPULSORY** | | | |
| 24. |  | Write the logic and flow chart for obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network. | CO6 | A | 12 |
|  |  |  |  |  |  |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Discuss about the concepts of machine learning. |
| CO2 | Describe the types of trees and bias. |
| CO3 | Outline the supervised learning methods with various case studies. |
| CO4 | Compare the learning methodologies and dimensionality concepts. |
| CO5 | Summarize the applications of neural networks in robotic applications. |
| CO6 | Illustrate the applications of machine learning using case studies. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | - | 3 | - | - | 17 |
| CO2 | 7 | 5 | 10 | 7 | - | - | 29 |
| CO3 | 1 | 6 | 3 | 1 | 6 | - | 17 |
| CO4 | - | 8 | - | 8 | 1 |  | 17 |
| CO5 | 6 | 6 | 4 | 7 | 6 | - | 29 |
| CO6 | - | 3 | 12 | - | - | - | 15 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2012** | **Duration** | **3hrs** |
| **Course Name** | **ARTIFICIAL INTELLIGENCE IN ROBOTICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | | **BL** | | **M** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | Name the environment where the agent’s next state is determined by the current state and the selected action. | | CO1 | | R | | 1 | |
| 2. | Enumerate the sensors and actuators of a human and a robot. | | CO1 | | R | | 1 | |
| 3. | Define the term unification. | | CO2 | | R | | 1 | |
| 4. | List the components that are used to define a problem. | | CO2 | | R | | 1 | |
| 5. | Convert the given clause to a predicate logic statement:  “There does not exist someone who likes garlic”. | | CO3 | | U | | 1 | |
| 6. | Define conditional probability of an uncertain event. | | CO3 | | R | | 1 | |
| 7. | Give example for the process of lemmatization in language processing. | | CO4 | | U | | 1 | |
| 8. | List the advantage of Bayesian view of learning. | | CO4 | | R | | 1 | |
| 9. | State the statistical hidden Markov model. | | CO5 | | R | | 1 | |
| 10. | Indicate the importance of cognition. | | CO6 | | U | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Tabulate the PEAS description for a Part-Picking robot. | | CO1 | | R | | 3 | |
| 12. | Summarize the backward chaining mode in inference engine to update the knowledge base with a suitable example. | | CO2 | | U | | 3 | |
| 13. | State the conditions of total-order plan for the shoes and socks problem. | | CO3 | | R | | 3 | |
| 14. | Distinguish between semi-supervised and unsupervised learning. | | CO4 | | U | | 3 | |
| 15. | Enumerate the fundamental problems for prediction using hidden Markov model. | | CO5 | | R | | 3 | |
| 16. | Explain the process of robotic perception with a neat diagram. | | CO6 | | U | | 3 | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | | | | |
| 17. | a. | Describe the human-centered and rationalist approach to define artificial intelligence. | | CO1 | | R | | 6 |
|  | b. | Discuss the state-of-the-art of artificial intelligence in robotics. | | CO1 | | U | | 6 |
|  |  |  | |  | |  | |  |
| 18. | a. | Illustrate the A\* search and Greedy search strategies for the given state space representation to find the shortest path from the initial state S to the goal state I. | | CO2 | | A | | 6 |
|  | b. | Summarize the syntax and semantics of First Order Logic. | | CO2 | | U | | 6 |
|  |  |  | |  | |  | |  |
| 19. |  | Apply the progression and regression state space search planning algorithm for an AI system designed for cargo loading and unloading operations. | | CO3 | | A | | 12 |
|  |  |  | |  | |  | |  |
| 20. |  | Examine how the game environment influences the learning process and decision making in reinforcement learning algorithm. | | CO4 | | A | | 12 |
|  |  |  | |  | |  | |  |
| 21. | a. | Discuss the concepts of dynamic Bayesian network with suitable examples. | | CO5 | | U | | 9 |
|  | b. | List the applications of hidden Markov statistical model. | | CO5 | | R | | 3 |
|  |  |  | |  | |  | |  |
| 22. | a. | Explain the utility-based agents and learning-based agents with suitable block diagram. | | CO1 | | U | | 6 |
|  | b. | Solve the given blocks puzzle to reach the goal state by applying hill climbing algorithm. | | CO2 | | A | | 6 |
|  |  |  | |  | |  | |  |
| 23. | a. | Identify the causes of uncertainty by an agent to occur in the real world. | | CO3 | | U | | 2 |
|  | b. | Apply Baye’s rule to predict the flavor of the next piece of candy using statistical learning method. | | CO4 | | A | | 10 |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. |  | Discuss the ethical guidelines that determine the development and deployment of artificial intelligent technologies. | | CO6 | | U | | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Identify problems that are amenable to solution by AI methods. |
| **CO2** | Identify appropriate AI methods to solve a given problem. |
| **CO3** | Formalize a given problem in the language/framework of different AI methods. |
| **CO4** | Summarize the learning methods adopted in AI. |
| **CO5** | Design and perform an empirical evaluation of different algorithms on a problem formalization. |
| **CO6** | Illustrate the applications of AI in Robotic Applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 11 | 12 | - | - | - | - | 23 |
| **CO2** | 2 | 9 | 12 | - | - | - | 23 |
| **CO3** | 4 | 3 | 12 | - | - | - | 19 |
| **CO4** | 1 | 4 | 22 | - | - | - | 27 |
| **CO5** | 7 | 9 | - | - | - | - | 16 |
| **CO6** | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2013** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL ENERGY MANAGEMENT SYSTEM** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the unit of calorific value. | | CO1 | R | 1 |
| 2. | Indicate the percentage of energy used by industries. | | CO1 | U | 1 |
| 3. | Define hydraulic efficiency. | | CO2 | A | 1 |
| 4. | State the minimum wind speed required to operate the windmill. | | CO2 | U | 1 |
| 5. | Write the reason for electric distribution losses. | | CO3 | An | 1 |
| 6. | Write the expressions for the active power. | | CO3 | R | 1 |
| 7. | List the two types of dynamic compressors. | | CO4 | U | 1 |
| 8. | Write the efficiency range of the centrifugal fan. | | CO4 | R | 1 |
| 9. | Write the energy recovery rate from Industrial solid waste. | | CO5 | U | 1 |
| 10. | Describe the range of efficiency improvements due to a computerized energy management system. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write short notes on World energy resources. | | CO1 | U | 3 |
| 12. | Discuss the importance of hydraulic energy. | | CO2 | R | 3 |
| 13. | Explain briefly electric distribution losses. | | CO3 | A | 3 |
| 14. | Write short notes on the volute casing. | | CO4 | An | 3 |
| 15. | Describe the different ways of waste management. | | CO5 | U | 3 |
| 16. | Write short notes on computers in energy savings. | | 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 the different types of renewable and non-renewable energy sources and also mention the merits and demerits. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the energy storage systems in detail. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the plant combined cycle cogeneration steam system. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the various types of Air compressors with neat sketches. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Define waste management, discuss the detailed process of waste management. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the importance of hydraulic energy; discuss the production process of hydraulic energy with suitable sketches. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the various types of Industrial fans with neat sketches. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain in detail energy and waste management by computerized systems with suitable sketches. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Discuss the need for industrial energy balance. |
| **CO2** | Describe the functioning of utility plants and renewable energy sources . |
| **CO3** | Compare the various distribution systems. |
| **CO4** | Explain the functioning of equipment used in energy management. |
| **CO5** | Summarize the concept of energy recovery from waste and the need of automation. |
| **CO6** | Discuss about the use of computers in Energy Management. |

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

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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2015** | **Duration** | **3hrs** |
| **Course Name** | **NEURAL NETWORKS AND FUZZY 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 activation function. | | CO1 | U | 1 |
| 2. | Cite a specific example where feedback networks have been put to use in practical applications. | | CO1 | A | 1 |
| 3. | List the types of typical neural network controllers used to identify and control a neural network dynamic system. | | CO2 | A | 1 |
| 4. | Write an application of Hebbian learning rule in neural networks. | | CO2 | A | 1 |
| 5. | Define deep learning. | | CO3 | R | 1 |
| 6. | Mention the types of widely used pooling in CNN layer. | | CO3 | A | 1 |
| 7. | Indicate the properties that are to be satisfied in tolerance relation. | | CO4 | An | 1 |
| 8. | Cite the operations of crisp relations. | | CO4 | U | 1 |
| 9. | Define de-fuzzification. | | CO5 | R | 1 |
| 10. | Mention the applications of Fuzzy Logic control system. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Compare ANN and BNN by listing any three differences between them. | | CO1 | An | 3 |
| 12. | Describe the architecture of a Discrete Hopfield Network with a neat diagram. | | CO2 | U | 3 |
| 13. | Explain any one application of deep architecture in computer vision. | | CO3 | A | 3 |
| 14. | Indicate the properties that are to be satisfied in tolerance relation. | | CO4 | U | 3 |
| 15. | Consider 2 fuzzy sets A and B, both defined on the universe of discourse X, given as follows :   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | X1 | X2 | X3 | X4 | X5 | | A | 0.2 | 0.3 | 0.4 | 0.7 | 0.1 | | B | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 |   Express (AUB)0.6 using Zadin’s notation. | | CO5 | E | 3 |
| 16. | Sketch the basic block diagram of a fuzzy logic control system. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the architecture of the Mc-Culloch Pitt’s neuron model with an example. | CO1 | U | 6 |
|  | b. | Explain the main components of the Basic Artificial Neuron with a neat diagram. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Using Hebb Rule, find weights required to perform the following classifications of given input pattern ‘+’ symbols which represent the value 1 and empty squares which indicate -1. Consider **‘I’** belongs to the members of class (target value 1) and **‘O’** does not belong to the members of class (target value = -1).    **‘I’ ‘O’** | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the architecture of the Convolution Neural Network with a neat diagram. | CO3 | An | 6 |
|  | b. | Explain any two CNN architectures evolved and developed, leading to amazing advances in the growing deep-learning field. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Consider two fuzzy sets,  Find the following:   1. b) c) d) e)   f) g)  k) l) | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Find the defuzzified value of the trapezoidal functions given in the figure below using center of sums defuzzification method. | CO5 | An | 9 |
|  | b. | Determine crisp λ-cut relation when λ = 0.1, 0**+**, 0.9 for the relation,    Rλ = {1 **|** μR(x,y) ≥ λ; 0 **|** μR(x,y) < λ} | CO5 | An | 3 |
|  |  |  |  |  |  |
| 22. | a. | Consider the following set of input training vectors of NAND gate. x1=[0 0 1 1], x2=[0 1 0 1], w0=-0.3(bias), Initial Weight vectors, w1=w2=0.5, learning rate, n=0.5 and xd=1. Calculate the final weights using delta learning rule. | CO2 | E | 8 |
|  | b. | Explain the steps involved in training an hetero-associative neural network using the Hebb or Delta Learning Rule. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Find the defuzzified value (X\*) for the below fuzzy set by centroid of area (COA) defuzzification method. | CO5 | An | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Design and develop a neural network based image compression system for self-driving cars. | CO6 | An | 6 |
|  | b | Design and develop a CMAC (Cerebellar Model Articulation Controller) for identification and real-time control of nonlinear dynamical systems. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Classify the types of neural networks. |
| CO2 | Discuss about the applications of neural networks. |
| CO3 | Describe the concepts of deep learning and convolutional neural networks. |
| CO4 | Compare fundamentals of classical logic and fuzzy logic concepts. |
| CO5 | Characterize the fuzzy membership functions. |
| CO6 | Summarize the applications of fuzzy logic controllers. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 7 | 7 | 3 | - | - | 17 |
| CO2 | - | 3 | 6 | 12 | 8 | - | 29 |
| CO3 | 1 | - | 10 | 6 | - | - | 17 |
| CO4 | - | 4 | - | 1 | 12 | - | 17 |
| CO5 | 1 | - | - | 24 | 3 | - | 28 |
| CO6 | - | - | 4 | 12 | - | - | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **19RO2016** | **Duration** | **3hrs** |
| **Course Name** | **MICROCONTROLLERS FOR ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Identify the clock frequency of 8051. | | | CO1 | R | 1 |
| 2. | List any two features of 8051. | | | CO1 | R | 1 |
| 3. | Identify the 8051 instruction used to exchange lower nibble and higher nibble bits of A register. | | | CO2 | U | 1 |
| 4. | Identify the addressing modes for the following 8051 instructions.  MOV A, #10 | | | CO2 | U | 1 |
| 5. | Name the pins used in serial peripheral Interface. | | | CO3 | R | 1 |
| 6. | Define Inter-Integrated Circuit (I2C) protocol. | | | CO3 | R | 1 |
| 7. | Illustrate an example for data transfer instruction used in ARM 9 Processor. | | | CO4 | A | 1 |
| 8. | List the operating modes of ARM 9 Processor. | | | CO4 | R | 1 |
| 9. | Identify the memory capacity of ARM Cortex M4. | | | CO5 | U | 1 |
| 10. | Name any two examples for analog sensor. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Compare Microprocessor and Microcontroller. | | | CO1 | An | 3 |
| 12. | Write an assembly language program in 8051 to multiply two 8 bit numbers. | | | CO2 | A | 3 |
| 13. | Distinguish between Asynchronous and Synchronous communication. | | | CO3 | An | 3 |
| 14. | Determine the status of NZCV flags when the following four-bit numbers are added 1001 + 1011. | | | CO4 | An | 3 |
| 15. | Outline the functions of debug mode in ARM Cortex M4. | | | CO5 | U | 3 |
| 16. | Interpret the steps followed in LCD for displaying a character or data. | | | 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 block diagram, summarize the functional blocks of 8051 microcontroller. | CO1 | U | 6 |
|  | | b. | Explain the port pin configuration of 8051. | CO1 | U | 6 |
|  | |  |  |  |  |  |
| 18. | | a. | Develop an assembly language program to find the largest number in an array of 10 numbers. | CO2 | A | 6 |
|  | | b. | Illustrate with example, different addressing modes in 8051. | CO2 | U | 6 |
|  | |  |  |  |  |  |
| 19. | | a. | Discuss timer/counter operations in 8051 with different modes. | CO3 | U | 6 |
|  | | b. | Design a circuit which interfaces 0800 ADC module with 8051. | CO3 | An | 6 |
|  | |  |  |  |  |  |
| 20. | | a. | Illustrate with example, different instruction set of ARM 9 processor. | CO4 | A | 6 |
|  | | b. | Summarize the features of ARM 9 Processor with necessary diagram. | CO4 | U | 6 |
|  | |  |  |  |  |  |
| 21. | | a. | Outline the functional blocks of ARM Cortex M4. | CO5 | U | 6 |
|  | | b. | Illustrate with example, bit band and bit alias operation in ARM Cortex M4. | CO5 | A | 6 |
|  | |  |  |  |  |  |
| 22. | | a. | Summarize 3 stage pipelining in ARM 9 Processor. | CO4 | U | 6 |
|  | | b. | Classify different arithmetic and logical instructions in 8051. | CO2 | An | 6 |
|  | |  |  |  |  |  |
| 23. | | a. | Design an interfacing system which connects 8KB of RAM and 16KB of EPROM in 8051. | CO1 | An | 8 |
|  | | b. | Distinguish between Von Neumann and Harvard architecture. | CO1 | A | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Create an interfacing circuit which connects a LED in Port 1.0 and write an embedded C program to switch ON/OFF LED with 100 millisecond delay. | CO6 | C | 6 |
|  | | b. | Develop an 8051 interfacing circuit which rotates stepper motor in clockwise direction. | CO6 | An | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the architecture of 8051 controllers |
| CO2 | Classify different types of instruction set and addressing modes 3 |
| CO3 | Express their knowledge in designing a system using 8051 |
| CO4 | Discuss the general features of RISC architecture |
| CO5 | Summarize the specific features of cortex controller |
| CO6 | Develop interfacing program with controller |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | 6 | 9 |  |  | 29 |
| CO2 | - | 8 | 9 | 6 |  |  | 23 |
| CO3 | 2 | 6 | - | 9 |  |  | 17 |
| CO4 | 1 | 12 | 7 | 3 |  |  | 23 |
| CO5 | - | 10 | 6 | - |  |  | 16 |
| CO6 | - | 4 |  | 6 | 6 |  | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **20RO1003** | **Duration** | **3hrs** |
| **Course Name** | **FUNDAMENTALS OF PYTHON PROGRAMMING FOR ROBOTICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List two built-in modules in python. | | CO1 | R | 1 |
| 2. | Identify the method that removes any whitespace from the beginning of the end. | | CO1 | A | 1 |
| 3. | Name any two operators in python. | | CO2 | R | 1 |
| 4. | Identify the output for the following python code.  x = 3  for i in range(x):  x += 1  print (x) | | CO2 | A | 1 |
| 5. | Name the function used to write all the characters in python. | | CO3 | R | 1 |
| 6. | Which command is used for getting Current Working Directory (CWD)? | | CO3 | R | 1 |
| 7. | Illustrate an example for function call with two arguments. | | CO4 | U | 1 |
| 8. | What is aliasing in python? | | CO4 | R | 1 |
| 9. | How do you instantiate a class in python? | | CO5 | R | 1 |
| 10. | Which function is used to delete properties on objects? | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the features of python. | | CO1 | An | 3 |
| 12. | Develop a python code to find the sum of the all numbers between 1 and 10. | | CO2 | C | 3 |
| 13. | Classify different modes in python files. | | CO3 | U | 3 |
| 14. | Differentiate: tuples and lists in Python. | | CO4 | An | 3 |
| 15. | Create a class named **Student**, which will inherit the properties and methods from the **Person** class: | | CO5 | C | 3 |
| 16. | Outline the steps in programming ESP32 with Micropython. | | 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. | Develop a python code to find factorial of a given number. | CO1 | C | 6 |
|  | b. | Summarize different data types in python. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Build a python code to convert Celsius to Fahrenheit. | CO2 | A | 6 |
|  | b. | Create python script to calculate the surface area and volume of a cube with the length of an edge as input. | CO2 | C | 6 |
|  |  |  |  |  |  |
| 19. |  | Discuss how to search for a string in text files with algorithm and python code. | CO3 | C | 12 |
|  |  |  |  |  |  |
| 20. | a. | Distinguish between: Del, Remove and Pop operators in Python Lists. | CO4 | An | 6 |
|  | b. | Summarize the features of a dictionary. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | **Discuss Polymorphism with Inheritance with example.** | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. |  | Develop an algorithm and python code to generate 10 random numbers and insert into a list. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Create a Python program to replace the last value of tuples in a list.  Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]  Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)] | CO4 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the algorithm for object recognition with Micropython | CO6 | U | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Outline the structure and components of a Python program. |
| CO2 | Explain loops and decision statements in Python. |
| CO3 | Illustrate class inheritance in Python for reusability |
| CO4 | Choose lists, tuples, and dictionaries in Python programs. |
| CO5 | Assess object‐oriented programs with Python classes. |
| CO6 | Develop simple code for robotics applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 6 | 1 | 3 |  | 6 | 17 |
| CO2 | 1 |  | 7 |  |  | 9 | 17 |
| CO3 | 2 | 3 | 12 |  |  | 12 | 29 |
| CO4 | 1 | 7 |  | 9 |  | 12 | 29 |
| CO5 | 2 |  |  |  |  | 15 | 17 |
| CO6 |  | 15 |  |  |  |  | 15 |
|  | | | | | | | **124** |



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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO1004** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO ROBOTICS AND AUTOMATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the 4 D’s that help in the implementation of robots in a system. | | CO1 | R | 1 |
| 2. | Specify the factors that determine the work volume of a robot. | | CO1 | U | 1 |
| 3. | Expand LIDAR and indicate its application in robots. | | CO2 | R | 1 |
| 4. | Mention the advantages of Vacuum grippers in robotic applications. | | CO2 | U | 1 |
| 5. | Represent the rotational transformation of a robot axis about X axis in the form of a matrix. | | CO3 | U | 1 |
| 6. | List the capabilities of lead through programming technique. | | CO3 | R | 1 |
| 7. | Indicate the characteristics that differentiate soft robots from conventional robots. | | CO4 | U | 1 |
| 8. | Illustrate a few industrial applications of AGVs. | | CO4 | U | 1 |
| 9. | Highlight the key enabling technologies of Industry 4.0. | | CO5 | U | 1 |
| 10. | Outline the significant features of smart cities. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A cylindrical robot has a revolute joint with a total range of 200 degrees. It is required to have a maximum control resolution of 0.2 degree. Determine the required bit storage capacity in order to achieve this resolution. | | CO1 | A | 3 |
| 12. | Sketch the functional blocks of a machine vision system and indicate the significance of each block. | | CO2 | U | 3 |
| 13. | Represent the general form of the homogeneous transformation matrix in terms of its constituent elements and mention the function of each element. | | CO3 | A | 3 |
| 14. | Highlight the technology of Robot Process Automation (RPA). | | CO4 | U | 3 |
| 15. | Expand SCADA and mention its significance in an automation system. | | CO5 | U | 3 |
| 16. | Illustrate the functions and benefits of a building automation system. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | How are robots classified based on the path control techniques employed? Illustrate with relevant examples and descriptions. | CO1 | U | 6 |
|  | b. | With appropriate examples, describe the parameters that characterize the performance of a robot. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Differentiate Internal and External Sensors in robots with examples. | CO2 | An | 6 |
|  | b. | Classify the types of position sensors used in robotic applications and describe about encoders with necessary diagrams. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | A frame F = (2 -3 4) was subjected to the following transformations in order.  (i) rotation about the y-axis by 90 degree  (ii) translation of 4 units along the x-axis.  (iii) rotation about the z axis by 90 degree  Find the total transformation matrix and the resultant position of the frame after the transformations. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Specify the types of mobile robots and illustrate the see-think-act cycle of an autonomous mobile robot with necessary diagrams and explanations. | CO4 | U | 6 |
|  | b. | Highlight the concept of Robotic Process Automation (RPA) and mention its use in IT automation. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Sketch the functional block of an automatic closed loop control system and mention the function of each component. | CO5 | U | 6 |
|  | b. | Comment on the role of PLC, DCS and SCADA systems in automation. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Derive the mathematical relation between joint coordinates and world coordinates with necessary diagrams and equations. | CO3 | U | 6 |
|  | b. | Outline the types of robot programming and highlight the significant features of each type. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Compare the three types of automation with relevant examples and diagrams. | CO4 | An | 6 |
|  | b. | Indicate the key enabling technologies of Industry 4.0 and describe the significance of each one. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Specify the various features that can be incorporated in a home automation system and describe the technology involved. | CO6 | A | 6 |
|  | b. | Comment on the impact of robots in making life easier and safer for humankind in the near future with appropriate examples. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the evolution of robots and their classification |
| **CO2** | Analyze the applications of sensors and actuators in robotics. |
| **CO3** | Describe the kinematics and dynamic behavior of robots and its programming. |
| **CO4** | Appraise the emerging technologies in the field of robotics |
| **CO5** | Compare different concepts of automation |
| **CO6** | Apply knowledge of automation in various fields |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | 3 |  |  |  | 17 |
| **CO2** | 1 | 10 |  | 6 |  |  | 17 |
| **CO3** | 1 | 13 | 3 | 12 |  |  | 29 |
| **CO4** |  | 17 | 6 | 6 |  |  | 29 |
| **CO5** |  | 10 |  | 6 |  |  | 16 |
| **CO6** |  | 1 | 12 | 3 |  |  | 16 |
|  | | | | | | | **124** |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO2001** | **Duration** | **3hrs** |
| **Course Name** | **DIGITAL ELECTRONICS AND MICROPROCESSORS** | **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 the universal logic gates. | | CO1 | R | 1 |
| 2. | Convert the gray code (101100) to binary code. | | CO1 | U | 1 |
| 3. | List the advantages of Boolean theorems. | | CO2 | R | 1 |
| 4. | Mention the number of bits in ASCII code. | | CO2 | R | 1 |
| 5. | Infer the output from a D flip-flop if the clock signal is low and D=0. | | CO3 | U | 1 |
| 6. | Define 1 bit memory cell. | | CO3 | R | 1 |
| 7. | Outline the specifications of ADC. | | CO4 | U | 1 |
| 8. | Name the slowest type of Analog to Digital Converter. | | CO4 | R | 1 |
| 9. | Infer the form of digital memory that can be designed with a fixed collection of OR gates and programmable collection of AND gates. | | CO5 | U | 1 |
| 10. | Illustrate an example for input device. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Perform subtraction using 1’s complement (0.1001 - 0.0110) | | CO1 | U | 3 |
| 12. | Represent the logic diagram and working of an AND gate. | | CO2 | U | 3 |
| 13. | Differentiate between combinational circuit and sequential circuit. | | CO3 | U | 3 |
| 14. | Outline the importance of Sample and Hold circuit in ADC. | | CO4 | U | 3 |
| 15. | Distinguish between RAM and ROM. | | CO5 | U | 3 |
| 16. | Paraphrase the functionality of bus structure in 8085. | | 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. |  | Convert decimal (1248.56)10 into equivalent (a) binary (b) octal  (c) hexadecimal. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Sketch the symbols, truth tables and output expressions of all the basic logic gates. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Obtain the canonical SOP form of the given function Y=A+B'C. | CO2 | A | 6 |
|  | b. | Minimize F=A'BC+A'BC'+AB'C'+AB'C using Karnaugh map. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Develop truth table and excitation table for S-R Flip-flop. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the operation of successive approximation ADC with necessary diagram. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Design a combinational circuit using a suitable PAL having four inputs, four outputs and three wide AND-OR structure for the following Boolean expression.  X(A,B,C) = Σm(2,3,5,7)  Y(A,B,C)= Σm(0,1,5)  Z(A,B,C)= Σm(0,2,3,5) | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Compare Static RAM with Dynamic RAM. | CO5 | U | 6 |
|  | b. | Explain CPLD and FPGA. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the architecture of 8085 microprocessor. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the concepts of logic gates and tri state logic |
| CO2 | Design Combinational Circuits using Boolean Logic |
| CO3 | Implement Sequential Circuits using logic gates. |
| CO4 | Outline the process of Analog to Digital conversion and Digital to Analog conversion. |
| CO5 | Apply PLDs to implement the given logical problem. |
| CO6 | Relate the concepts of Digital Systems to Microprocessor Architecture |

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



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

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| **Course Code** | **20RO2002** | **Duration** | **3hrs** |
| **Course Name** | **MECHANICS OF SOLIDS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Bulk modulus. | | CO1 | U | 1 |
| 2. | State Hooke’s Law. | | CO1 | R | 1 |
| 3. | Define the term resilience. | | CO2 | R | 1 |
| 4. | Describe the sign convention for bending moment in beam. | | CO4 | R | 1 |
| 5. | Describe overhanging beam. | | CO4 | U | 1 |
| 6. | Interpret the term neutral axis. | | CO4 | R | 1 |
| 7. | Define the term section modulus. | | CO5 | U | 1 |
| 8. | Write torsional equation for circular shaft. | | CO5 | R | 1 |
| 9. | State the term polar modulus. | | CO5 | U | 1 |
| 10. | Illustrate the term ‘Principal stress. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A load of 15 kN is to be raised with the help of a steel wire. Compute the minimum diameter of the steel wire, if the stress is not to exceed 250 N/mm2. | | CO1 | An | 3 |
| 12. | Explain Strain energy with an example. | | CO2 | U | 3 |
| 13. | Sketch the shear force diagram of an overhanging beam of length ‘l’, carrying a point load P at the free end. | | CO4 | An | 3 |
| 14. | Derive the expression for section modulus of a hollow circular section. | | CO5 | U | 3 |
| 15. | List the assumptions made in the theory of torsion. | | CO5 | R | 3 |
| 16. | Illustrate the sign conventions of principle stress and strain for analytical method. | | 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 steel bar of 30 mm diameter is subjected to a pull of 60KN. The measured extension on gauge length of 200mm is 0.1mm and change in diameter is 0.004mm. Calculate the Young’s modulus, Poisson’s ratio, Shear modulus and Bulk Modulus. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the relationship between Modulus of Elasticity and Modulus of rigidity. | CO3 | U | 6 |
|  | b. | Explain the salient features of stress-strain diagram for ductile material with neat sketch. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | An axial pull of 35 kN is acting on a bar consisting of three lengths as shown in Fig (a). If the Young’s modulus is 2.1 x 105 N/mm2, calculate: (i) stresses in each section and (ii) total extension of the bar.    Fig (a) | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | A compound tube consists of a steel tube 140mm internal diameter and 160mm external diameter and an out brass tube 160mm internal diameter and 180mm external diameter. The two tubes are of the same length. The compound tube carries an axial load of 900 kN. Find the stresses and the load carried by each tube and the amount if shortens. Length of each tube is 140mm. Take E for Steel as 2 x 105 N/mm2 and for brass as 1 x 105 N/mm2. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | An overhanging beam ABC carries a uniformly distributed load of 4.5 kN/m over its entire span, as shown in figure. Illustrate and sketch the shear force and bending moment diagrams and compute the point of contraflexure. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | A Beam of I-section shown in Fig. is simply supported over a span of 10 m. It carries a uniformly distributed load of 4 kN/m over the entire span. Evaluate the maximum bending stresses. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | A hollow shaft of external and internal diameters of 100 mm and 40 mm is transmitting power at 120 r.p.m. find the power the shaft can transmit, if the shearing stress is not to exceed 50 MPa. | CO5 | A | 4 |
|  | b. | A solid shaft of 120 mm diameter is required to transmit 200kW at 100 r.p.m. If the angle of twist not to exceed 2o, find the length of the shaft. Take modulus of rigidity for the shaft material as 90 GPa. | CO5 | A | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The stresses at a point of a machine component are 100 MPa and 50 MPa both tensile. Find the intensities of normal stress, shear stress and resultant stress on a plane incline at an angle of 55o with the axis of major tensile stress. Also find the magnitude of the maximum shear stress in the machine component. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the concepts of stress-strain relationships for homogenous, isotropic materials. |
| **CO2** | Calculate stresses and strains in members subjected to axial structural loads and thermal loads. |
| **CO3** | Determine the volumetric strain of the components and also derive the relationship between the elastic constants. |
| **CO4** | Calculate the shear force and bending moment of beams. |
| **CO5** | Compute the stresses and strains in members subject to flexural and torsional loadings. |
| **CO6** | Illustrate principal stresses, maximum shearing stress, and the stresses acting on a structural member. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 6 | 3 | - | - | 11 |
| **CO2** | 1 | 3 | 12 | 12 | - | - | 28 |
| **CO3** |  | 6 | 12 |  | - | - | 17 |
| **CO4** | 1 | 1 |  | 15 | - | - | 29 |
| **CO5** | 5 | 5 | 12 | 12 | - | - | 16 |
| **CO6** | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO2003** | **Duration** | **3hrs** |
| **Course Name** | **SENSORS AND PROTOCOLS FOR INSTRUMENTATION** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define linearity. | | CO1 | U | 1 |
| 2. | Give the SI unit of velocity. | | CO1 | R | 1 |
| 3. | Give an example of mechanical temperature sensor. | | CO2 | R | 1 |
| 4. | State the expression for capacitance. | | CO2 | U | 1 |
| 5. | Identify the circuit used along with resistive sensors. | | CO3 | A | 1 |
| 6. | List a few applications of LVDT. | | CO3 | U | 1 |
| 7. | Identify the sensor that can be used for speed measurement. | | CO4 | A | 1 |
| 8. | List the sensors used in mobile phones. | | CO4 | R | 1 |
| 9. | Expand SPI. | | CO5 | U | 1 |
| 10. | Give the operational frequency of ZIGBEE. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define Calibration. | | CO1 | U | 3 |
| 12. | State the principle of Piezoelectric sensor. | | CO2 | U | 3 |
| 13. | Describe the operation of capacitance sensor while measuring displacement. | | CO3 | R | 3 |
| 14. | Identify the simple method used to measure level in a tank draw and illustrate the working. | | CO4 | A | 3 |
| 15. | List out the difference of RS232 and RS485. | | CO5 | U | 3 |
| 16. | Summarize the merits and demerits of WiFi. | | 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. | Tabulate the various classifications of sensor. | CO1 | R | 6 |
|  | b. | List the types of errors occur in sensor measurements and explain the same. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Select a resistance-based sensor module for the measurement of pressure and explain the working in detail. | CO2 | A | 6 |
|  | b. | Summarize the structure and working of a piezoelectric sensor. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | With neat diagrams explain the construction and working of Ultrasonic Sensor. | CO3 | A | 6 |
|  | b. | Identify an application of potentiometer explain its working in detail with respect to potentiometer as a sensor. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain the construction and working of Orifice flow meters and derive the expression for discharge. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Identify and explain the data transfer technique used in embedded systems to integrate sensors. | CO5 | A | 12 |
|  |  |  | CO3 | A | 6 |
| 22. | a. | A linear variable differential transformer has a stroke length of ±150mm and produces a resolution of 50mV/mm when moved. Determine  a) The LVDT’s maximum output voltage.  b) The output voltage when the core is moved 100mm from its null position.  c) The core position from center when the output voltage is 3.75 volts.  d) The change in output voltage when the core is moved from +70mm to  -70mm displacement. |  |  |  |
|  | b. | Explain on the construction and working of torque sensor. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | With neat diagram illustrate the working of digital encoders. | CO3 | A | 6 |
|  | b. | Explain the various circuit options for the RTD and its working in detail. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the Zigbee wireless protocols in detail and give its merits and demerits. | CO6 | U | 12 |

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify and understand the automation concepts for Industries. |
| **CO2** | Apply PLC architecture knowledge to select PLC for specific problems. |
| **CO3** | Use PLC Ladder diagram for simple applications |
| **CO4** | Design real time application using PLC. |
| **CO5** | Create prototype for the real time application Using PLC, with HMI |
| **CO6** | Recognize the faults and identify the protocol to be used for the applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 10 |  |  |  |  | 17 |
| **CO2** | 1 | 4 | 18 |  |  |  | 23 |
| **CO3** | 3 | 1 | 25 |  |  |  | 29 |
| **CO4** | 1 | 6 | 16 |  |  |  | 23 |
| **CO5** |  | 4 | 12 |  |  |  | 16 |
| **CO6** | 4 | 12 |  |  |  |  | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **20RO2007** | **Duration** | **3hrs** |
| **Course Name** | **SMART SENSORS FOR IoT APPLICATIONS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the sensors used in cars. | | CO1 | A | 1 |
| 2. | A Thermistor is a temperature sensor which gives change in \_\_\_\_\_\_\_\_\_\_ with respect to the input temperature. | | CO1 | U | 1 |
| 3. | Potentiometers are used to find \_\_\_\_\_\_\_\_\_\_\_\_ displacement. | | CO2 | U | 1 |
| 4. | Find the value of resistance for the low pass filter with a cutoff frequency of 200Hz. Assume C= 0.1nF. | | CO2 | A | 1 |
| 5. | Give the pin number of non-inverting terminal in IC 741. | | CO3 | A | 1 |
| 6. | Unity gain amplifier is also known as \_\_\_\_\_\_\_\_\_ amplifier. | | CO3 | U | 1 |
| 7. | Mention the audible frequency. | | CO4 | A | 1 |
| 8. | The maximum distance a Wi-Fi device can transmit is \_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | \_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_ is the RF link used in smart sensors for data transmission. | | CO5 | R | 1 |
| 10. | Integrating electronics and the sensor makes it an \_\_\_\_\_\_\_\_\_\_\_\_\_\_ sensor. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the sensor characteristics. | | CO1 | R | 3 |
| 12. | State loading effect. | | CO2 | U | 3 |
| 13. | Draw V/I and I/V circuits. | | CO3 | R | 3 |
| 14. | Tabulate the differences between Bluetooth and Wi-Fi. | | CO4 | A | 3 |
| 15. | Define smart sensor. | | CO5 | U | 3 |
| 16. | Give the attributes of sensor nodes. | | 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 the help of neat diagrams explain the construction and working of the capacitance sensor with their application. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the construction and working of the potentiometer. | CO2 | U | 6 |
|  | b. | A resistance-based accelerometer sensor is moved by 60% from its initial position, whose full-scale reading is 48 Kohm. The interface circuit for the sensor behaves as a resistive load of 10 Kohm. Find the current flowing through the interfacing circuit. (Assume a 12 Volt Power supply). | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Give the ideal characteristics of Op-amp and explain the basic circuits of Op-amp. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explore the relationship between Wi-Fi architecture and the Internet of Things. Discuss how Wi-Fi networks support the connectivity and communication needs of IoT devices. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the design aspect of smart sensors. | CO5 | U | 8 |
|  | b. | Give the advantages of smart sensors. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | A Platinum thermometer has a resistance of 100Ω at 25 ºC. The temperature coefficient of resistance at 25ºC for platinum is αpt = 0.00392/ ºC.  a) Find the resistance of the RTD at 80 ºC  b) If the RTD has the resistance of 140Ω find it temperature. | CO1 | A | 6 |
|  | b. | Explain the construction and working of NDIR gas sensor. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Design an instrumentation amplifier for reading the temperature from an RTD. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss in detail the role of Edge and Cloud computing sustained development of technology with respect to the instrumentation field. | CO6 | E | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the various sensors and their application. |
| CO2 | Identify an appropriate signal condition circuit for the sensor. |
| CO3 | Implement an efficient amplifier circuit for the sensor. |
| CO4 | Explain the use of wireless network. |
| CO5 | Apply the skills to develop smart sensors. |
| CO6 | Analyze the use of Smart Sensors and IOT |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 3 | 7 | 19 |  |  |  | 29 |
| CO2 |  | 10 | 7 |  |  |  | 17 |
| CO3 | 3 | 13 | 13 |  |  |  | 29 |
| CO4 | 1 |  | 4 | 12 |  |  | 17 |
| CO5 | 6 | 11 |  |  |  |  | 17 |
| CO6 |  | 3 |  |  | 12 |  | 15 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3003** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTER AIDED MODELLING AND DESIGN** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the benefits of CAD to Engineering design as compared to conventional methods. | CO1 | U | 8 |
|  | b. | Explain the various steps for the design process. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Construct a line using DDA algorithm. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | A rectangle is defined in a two-dimension system by its vertices **(A = 2, 2) (B = 6, 2)** and **(C = 6, 6)** and **(D = 2, 6)**. Calculate the new positions after the following transformations.   1. Translate the rectangle in space by 2 units in the **X** direction and 4 **units** in the **Y** direction. 2. Scale the original rectangle by a factor of **2** in the **X** direction and **3** in the **Y** direction. 3. Rotate the original rectangle by **45o** about the origin. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Construct a CSG models for each of the solids shown below and write Boolean operations to be performed. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 5. | a. | Analyse how product life management (PLM) aid product development | CO4 | An | 10 |
|  | b. | Predict the reasons for product development. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 6. | a. | Describe the general steps of the finite element method. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the importance of powder structure in Selective Laser Sintering. | CO6 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Design a thin-walled spherical vessel for maximizing gas storing capacity under pressure pi = 4 MPa and with the following considerations.  t < D, t = wall thickness; D = Mean diameter of the vessel; Factor of Safety = 3; Mass of the Vessel ≤ 125 kg. | CO6 | A | 20 |

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

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  |  | 16 |  |  |  | 16 |
| CO3 |  |  | 32 |  |  |  | 32 |
| CO4 |  |  | 6 | 10 |  |  | 16 |
| CO5 |  | 16 |  |  |  |  | 16 |
| CO6 |  |  | 16 | 16 |  |  | 32 |
|  | | | | | | | **132** |



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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO3004** | **Duration** | **3hrs** |
| **Course Name** | **DRIVES AND CONTROL SYSTEMS FOR AUTOMATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the working of stepper motor with suitable diagrams. Also explain the types of stepper motor. | CO1 | U | 12 |
|  | b. | A 3-phase induction motor is wound for 6 poles and is supplied from 50 Hz source. Calculate  (1) synchronous speed  (2) percentage slip of the motor when speed is 960 RPM | CO1 | An | 4 |
|  |  |  |  |  |  |
| 2. | a. | Describe the working of servo motor with suitable diagrams. Also explain the types of servo motor. | CO2 | A | 12 |
|  | b. | List out the advantages of electric drives over other prime movers. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 3. | a. | Describe the principle of operation of rack and pinion drives. Also write its advantages and disadvantages. | CO4 | U | 8 |
|  | b. | Explain the principle of Converting rotary to linear system with example. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 4. |  | Draw the functional block diagram of Programmable logic controller. Explain in detail. Also describe different data types used in PLC programming with example. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Develop PLC Programming ladder logicon Industrial Automation according to the logic given below.   1. A Saw, Fan and oil pump all go ON when a start button is pressed. 2. If the saw has operated less than 20s, the oil pump should go off when the saw is turned off and the fan is to run for an additional 5s after the shutdown of the saw. 3. If the saw has operated for more than 20s, the fan should remain on until reset by a separate fan reset button and the oil pump should remain on for an additional 10 s after the saw is turned off.   Write a PLC program that will implement this process. | CO5 | A | 8 |
|  | b. | Explain various steps involved in interfacing PLC with HMI. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. |  | Describe different Timer and Counter instructions used in PLC programming with suitable example. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Describe different BUS configurations used for industrial automation in detail. | CO6 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Describe the procedure to interface PLC with SCADA systems with suitable example. | CO6 | A | 10 |
|  | b. | Draw and explain the functional diagram of Distributed Control System. | CO6 | A | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the working principles of various types of motors, differences, characteristics and selection criteria. |
| CO2 | Apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications |
| CO3 | Explain control methods of special drives |
| CO4 | Elucidate various linear and rotary motion principles and methods and use the same to application areas |
| CO5 | Design programming using PLC and use of various PLCs to Automation problems in industries. |
| CO6 | Discuss supervisory control and data acquisition method and use the same in complex automation areas. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 12 | 4 |  |  |  | 16 |
| CO2 |  |  | 12 |  |  |  | 12 |
| CO3 |  | 4 |  |  |  |  | 4 |
| CO4 |  | 16 |  |  |  |  | 16 |
| CO5 |  | 16 | 32 |  |  |  | 48 |
| CO6 |  | 16 | 20 |  |  |  | 36 |
|  | | | | | | | **132** |



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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3014** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL INTERNET OF THINGS AND ITS APPLICATIONS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the different approaches used in enhancing the utilization of IIoT (Industrial Internet of Things) in plant maintenance practices with a neat sketch. | CO1 | A | 6 |
|  | b. | |  | | --- | | Explain the Hype Cycle concept with a neat sketch and illustrate the role of Industrial Internet of Things (IIoT) in manufacturing processes. | | CO1 | A | 10 |
|  |  |  |  |  |  |
| 2. | a. | Analyze the different architectures of the Industrial Internet of Things (IIoT) using a neat block diagram. Indicate their advantages and disadvantages to demonstrate their respective functionalities and implications for IIoT deployment. | CO2 | An | 10 |
|  | b. | Explain the key components and layers within the IIoT reference architecture with a neat block diagram, highlighting their roles and interactions. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the various types of actuators in Industrial Internet of Things (IIoT) that facilitates the translation of digital commands into physical actions, revolutionizing industrial automation and efficiency. With a neat block diagram, explain how the controller directs the actuator based on the sensor data in performing the tasks. Explain the role of actuators in integrating physical machinery with networked sensors and software. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Analyze the industrial-grade security features and compliance of different IIoT Commercial Off-The-Shelf (COTS) Cloud Platforms with industry standards. | CO4 | An | 6 |
|  | b. | |  | | --- | | Describe the various types of protocols that facilitate efficient data exchange, device management and interoperability within industrial ecosystems, with an example. | | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the impact of the vulnerability of IoT devices in hijacking critical systems due to inadequate built-in security controls, attributed to their constrained environment and limited computational capacity. | CO5 | An | 10 |
|  | b. | Sketch the block diagram of the layered attacker model and explain its application to IoT/M2M security and the potential impact of attacks that can occur within each layer. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 6. | a. | Write the key differences between hardwiring sensors with different protocols like MODBUS and HART. | CO4 | A | 10 |
|  | b. | Define the term ‘Network security’. Differentiate between cyber security and network security. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 7. | a. | Explain the different IoT analytics tools available for effective data processing, analysis and visualization in the context of the**Internet of Things.** | CO6 | An | 9 |
|  | b. | Compare and contrast current and M2M protocols. | CO4 | A | 7 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Analyze the influence of IoT technology in smart metering applications. Give real-world examples to elucidate the effectiveness of IoT in powering efficiency within smart metering contexts. | CO6 | An | 14 |
|  | b. | Explain the importance of Data Analytics to the significance of data analytics in IoT. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the overview of IoT. |
| CO2 | Discuss architecture of IIoT |
| CO3 | Discuss the sensor and its interfaces. |
| CO4 | Explain protocol and cloud concepts. |
| CO5 | Explain web security and its need. |
| CO6 | Create simple IIoT applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 16 | - | - | - | 16 |
| CO2 | - | - | 6 | 10 | - | - | 16 |
| CO3 | - | - | 16 | - | - | - | 16 |
| CO4 | - | - | 27 | 6 | - | - | 33 |
| CO5 | - | - | 5 | 10 | - | - | 22 |
| CO6 | - | - | - | 29 | - | - | 29 |
|  | | | | | | | **132** |

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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3014** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL INTERNET OF THINGS AND ITS 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. | Explain IoT components and Implementation. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Elaborate the functional blocks of IoT service oriented architecture. | CO2 | U | 10 |
|  | b. | Analyze the desirable characteristics of sensors used in IoT applications. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Classify the various types of sensors with their applications in IoT. | CO3 | A | 10 |
|  | b. | Distinguish between failed node and selfish node in MQTT protocol. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain Zigbee Protocol and its significant characteristics. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain network security techniques. | CO5 | A | 10 |
|  | b. | Explain the conventional web technology and relationship with IIOT. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Highlight various layers in HART Protocol. | CO3 | A | 10 |
|  | b. | Explain the types of actuators used in IoT applications. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Elaborate the functional blocks of CoAP architecture. | CO4 | A | 10 |
|  | b. | Summarize in detail about cots cloud platforms. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the need of different types of Protocols. | CO4 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the concept of IoT to implement a smart city. | CO6 | A | 10 |
|  | b. | Highlight the role of IoT in Automotive Industry | CO6 | U | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the overview of IoT |
| CO2 | Discuss architecture of IIoT |
| CO3 | Discuss the sensor and its interfaces |
| CO4 | Explain protocol and cloud concepts. |
| CO5 | Explain web security and its need |
| CO6 | Create simple IIoT applications |

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

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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3015** | **Duration** | **3hrs** |
| **Course Name** | **OPTIMIZATION TECHNIQUES** | **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 concept of artificial neuron. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain single layer perceptron. | CO1 | U | 10 |
|  | b. | Explain the architecture of Hopfield network. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss about the various types of soft computing techniques. | CO5 | U | 10 |
|  | b. | Apply the concept of neural network toolbox for embedded applications. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Elaborate on radial basis function networks. | CO3 | U | 10 |
|  | b. | Discuss about stability constraints. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the fundamentals of fuzzy set theory. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the concept of linear programming. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain the various optimization problems. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the fitness functions of genetic algorithm. | CO5 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the steepest ascent hill climbing algorithm. | CO4 | A | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Apply neural network tool box for embedded applications. |
| CO2 | Analyze the concept of fuzzy logic and neuro fuzzy systems. |
| CO3 | Examine various optimization techniques |
| CO4 | Choose appropriate optimization techniques for engineering applications. |
| CO5 | Apply genetic algorithm concepts and tool box for embedded applications |

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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3017** | **Duration** | **3hrs** |
| **Course Name** | **IMAGE PROCESSING AND MACHINE VISION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the components of digital image processing with a suitable block diagram. | CO1 | U | 10 |
|  | b. | Explain, with a neat sketch the fundamental steps involved in a digital image processing system. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define a pixel and illustrate the relationship between the neighborhood pixels with suitable examples. | CO2 | U | 15 |
|  | b. | Distinguish the subjective brightness adaptation and discrimination within the visual system. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the smoothing and sharpening filters to enhance the image in the frequency domain. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the concepts of lossy predictive coding to map the encoded prediction error. | CO4 | An | 10 |
|  | b. | Summarize the image compression and coding models with a suitable block diagram. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the machine vision technology used in industrial robot applications. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Apply histogram equalization for the gray levels of an 8 X 8 image and plot the histogram of the original and the processed image.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Gray levels | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | No. of pixels | 9 | 8 | 11 | 4 | 10 | 15 | 4 | 3 | | CO3 | A | 15 |
|  | b. | Tabulate the arithmetic and logic array operations carried out between the pixel pairs of digital images. | CO3 | R | 5 |
|  |  |  |  |  |  |
| 7. | a. | Describe the functions of a human eye with a suitable diagram and label its anatomical parts. | CO2 | U | 15 |
|  | b. | Compare the fundamental characteristics that demonstrate the similarities between a camera and the human eye. | CO2 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the illumination techniques used in industrial machine vision systems. | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Sketch the architecture of the industrial machine vision system and explain the camera calibration procedure for the acquisition of images with a suitable example. | CO6 | A | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the concepts of image processing basics. |
| CO2 | Explain the fundamentals of digital image processing. |
| CO3 | Discuss image enhancement techniques. |
| CO4 | Explain the importance of image compression. |
| CO5 | Explain the concepts of machine vision. |
| CO6 | Describe the importance of industrial machine vision. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | 40 | - | - | - | - | 40 |
| CO3 | 5 |  | 15 |  | 20 | - | 40 |
| CO4 | - | 10 | - | 10 | - | - | 20 |
| CO5 | - | - | - | 20 | - | - | 20 |
| CO6 | - | - | 40 | - | - | - | 40 |
|  | | | | | | | **180** |



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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO3018** | **Duration** | **3hrs** |
| **Course Name** | **ARTIFICIAL INTELLIGENCE IN ROBOTICS AND AUTOMATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Illustrate the depth first and breadth first strategy with suitable state space representations. | CO1 | An | 8 |
|  | b. | Discuss the utility and learning-based agent in detail. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Assume that the initial state is A and the goal state is G for the state space representation given below. Determine the shortest path from the initial state to the goal state using the A\* search algorithm. The straight-line distance heuristic estimates for the nodes are as follows: h(1)= 40, h(2)=32, h(3)=25, h(4)=35, h(5)=19, h(6)=17, h(7)= 10. Report the solution cost.  Description: C:\Users\Admin\Desktop\al.png | CO2 | A | 10 |
|  | b. | Solve the following crypt-arithmetic problem with the constraint satisfactions.  SEND  + MORE  MONEY | CO2 | A | 6 |
|  |  |  |  |  |  |
| 3. | a. | Apply Baye’s Rule to compute the probability of a student passing a mathematics exam given that the probability of studying for the exam and passing it are 0.80 and 0.90 respectively, while the overall probability of passing the exam is 0.85. | CO3 | A | 6 |
|  | b. | Express the given information utilizing the methods of knowledge representation and update the knowledge base to indicate that Jack is a criminal using an inference engine.  Information: “The law says that it is a crime for an American to sell weapons to hostile nations. Country Q, an enemy of America, has some missiles, and all of its missiles were sold to it by Jack, who is an American.” | CO3 | C | 10 |
|  |  |  |  |  |  |
| 4. | a. | Discuss the major components of Natural Language Processing and their roles in processing human language. | CO4 | U | 10 |
|  | b. | Classify the types of learning methods adopted in AI and brief them. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 5. |  | Explain the impact of ethical principles on the design process of AI systems. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | Illustrate the Hill climbing algorithm with suitable examples and enumerate the challenges in the algorithm. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 7. | a. | Consider the water jug problem: You are given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring marker on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water from the 4-gallon jug?  Explicit Assumptions: A jug can be filled from the pump, water can be poured out of a jug onto the ground, water can be poured from one jug to another and there are no other measuring devices available. Apply suitable production rules to solve this problem. Discuss any constraints or limitations imposed by the production rules in achieving the target volume of water. | CO1 | E | 10 |
|  | b. | Explain the concept of swarm intelligence in Ant Colony Optimization for routing. | CO4 | An | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Express the role of AI in assembly, packaging and customer services in manufacturing industries, emphasizing enhancing efficiency and quality control. Provide examples of AI-powered assembly systems and explain their impact on production outcomes. | CO6 | C | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the basics of AI. |
| CO2 | Understand the various intelligent search methods. |
| CO3 | Explain the concepts of knowledge and reasoning. |
| CO4 | Understand the in-depth concepts of learning methods. |
| CO5 | Explore the ethics of AI. |
| CO6 | Understand the application of AI for robotics. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 8 | - | 8 | 10 | - | 26 |
| CO2 | - | 16 | 16 | - | - | - | 32 |
| CO3 | - | - | 6 | - | - | 10 | 16 |
| CO4 | - | 10 | - | 12 | - | - | 22 |
| CO5 | - | - | 16 | - | - | - | 16 |
| CO6 | - | - | - | - | - | 20 | 20 |
|  | | | | | | | **132** |

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

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| --- | --- | --- | --- |
| **Course Code** | **20RO3018** | **Duration** | **3hrs** |
| **Course Name** | **ARTIFICIAL INTELLIGENCE IN ROBOTICS AND AUTOMATION** | **Max. Marks** | **100** |

**(For Ph.D only)**

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the concepts of Intelligent agents and describe the various types of intelligent agents with suitable examples. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Apply the A\* search and BEST FIRST search algorithms to find the shortest path from source A to reach goal node I in the given state space representation. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Sketch the architecture of a knowledge-based agent and explain the inference system to generate new facts to update the knowledge base. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Categorize the learning methods adopted in AI and brief them. | CO4 | An | 10 |
|  | b. | Illustrate the concepts of reinforcement learning with suitable examples. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Discuss the ethical considerations and challenges associated with decision-making processes in AI. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the depth first and breadth first strategy with suitable state space representations. | CO1 | U | 10 |
|  | b. | Solve the following crypt-arithmetic problem with the constraint satisfactions. EAT  + THAT  APPLE | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the state space search progression and regression planning algorithm in detail. | CO3 | U | 10 |
|  | b. | Describe the major components of Natural Language Processing and their roles in processing human language. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Express how AI is utilized in assembly, packaging and customer services in manufacturing industries, emphasizing its role in enhancing efficiency and quality control. | CO6 | C | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Evaluate the impact of AI on software testing and development processes, highlighting its role in automating test case generation, detecting defects, and improving code quality. | CO6 | E | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the basics of AI. |
| CO2 | Understand the various intelligent search methods. |
| CO3 | Explain the concepts of knowledge and reasoning. |
| CO4 | Understand the in-depth concepts of learning methods. |
| CO5 | Explore the ethics of AI. |
| CO6 | Understand the application of AI for robotics. |

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



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

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| **Course Code** | **20RO3019** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED MACHINE LEARNING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the concept of Principal Component Analysis. | CO1 | U | 20 |
|  |  | OR |  |  |  |
| 2. | a. | Brief the following: (i) Joint probability (ii) Conditional probability and (iii) Bayesian rule.  A patient takes a lab test and the result comes back positive. It is known that the test returns a correct positive result in only 98% of the cases and a correct negative result in only 97% of the cases. Furthermore, only 0.008 of the entire population has this disease. 1. What is the probability that this patient has cancer? 2. What is the probability that he does not have cancer? 3. What is the diagnosis? | CO1 | U | 10 |
|  | b. | Consider the two dimensional patterns (2.5, 2.4), (0.5, 0.7), (2.2, 2.9), (1.9, 2.2), (3.1, 3.0). Compute the principal component using PCA Algorithm. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. |  | Use the k-means clustering algorithm and Euclidean distance to cluster the following 8 data into 3 clusters: A1=(2,10), A2=(2,5), A3=(8,4), A4=(5,8), A5=(7,5), A6=(6,4), A7=(1,2), A8=(4,9). The distance matrix based on the Euclidean distance is given below:    Suppose that the initial seeds (centers of each cluster) are A1, A4 and A7. Run the k-means clustering algorithm for 1 epoch only. At the end of this epoch show: a) The new clusters (i.e. the examples belonging to each cluster). b) The centers of the new clusters  c) Draw a 10 by 10 space with all the 8 points and show the clusters after the first epoch and the new centroids. d) How many more iterations are needed to converge? Draw the result for each epoch. | CO3 | An | 20 |
|  |  | OR |  |  |  |
| 4. |  | Analyze the relationship between attributes using Covariance and Correlation. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the concept on density based clustering and write the steps involved in DBSCAN algorithm. | CO3 | U | 20 |
|  |  | OR |  |  |  |
| 6. |  | Construct the dendrogram using Single Linkage method for Hierarchical Agglomerative Clustering.   |  |  |  | | --- | --- | --- | |  | X | Y | | P1 | 0.40 | 0.53 | | P2 | 0.22 | 0.38 | | P3 | 0.35 | 0.32 | | P4 | 0.26 | 0.19 | | P5 | 0.08 | 0.41 | | P6 | 0.45 | 0.30 | | CO3 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the k-nearest neighbor algorithm. | CO4 | U | 20 |
|  |  | OR |  |  |  |
| 8. |  | Analyze the algorithm of Support vector Machine. | CO5 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. |  | Discuss the benefits of applying the Apriori principle in the context of the Apriori algorithm for the association rule mining. | CO6 | A | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe overview of ML techniques |
| CO2 | Classify and contrast pros and cons of various machine learning techniques |
| CO3 | Illustrate various methods for clustering |
| CO4 | Infer various machine learning approaches and paradigms |
| CO5 | Explain the importance of support vector machine |
| CO6 | Discuss the concept of association rule mining |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 30 | 10 |  |  |  | 40 |
| CO2 |  |  |  | 40 |  |  | 40 |
| CO3 |  |  |  | 40 |  |  | 40 |
| CO4 |  | 20 |  |  |  |  | 20 |
| CO5 |  | 20 |  |  |  |  | 20 |
| CO6 |  |  | 20 |  |  |  | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20RO3021** | **Duration** | **3hrs** |
| **Course Name** | **DEEP LEARNING FOR COMPUTER VISION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the architecture and functioning of feed-forward neural networks. | CO1 | U | 10 |
|  | b. | Investigate the back propagation algorithm and its significance in training deep neural networks. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare and contrast convolutional neural network (CNN) and recurrent neural network (RNN) architectures. | CO2 | An | 10 |
|  | b. | Examine the Encoder-Decoder architecture and its applications in sequence-to-sequence tasks such as machine translation and speech recognition. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the concept of Variational Auto Encoders (VAEs) and their role in probabilistic modeling and latent space learning. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Investigate the principles of adversarial generative networks (GANs) and their applications in generating realistic data samples | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Compare and contrast the Continuous Skip-Gram Model and the Continuous Bag-of-Words Model in word vector representations. | CO5 | A | 10 |
|  | b. | Describe the GloVe model for word vector representations. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) architectures in recurrent neural networks. | CO3 | U | 10 |
|  | b. | Explain the role of convolutional layers in CNN architectures. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the gradient descent optimization algorithm and its application in training neural networks. | CO1 | U | 10 |
|  | b. | Discuss the concept of regularization in neural network training and its role in preventing over-fitting. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize the challenges and solutions involved in implementing smart reply systems using deep learning methods in NLP. | CO6 | U | 10 |
|  | b. | Elaborate on the sentence classification using Convolutional Neural Networks. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the architecture of LSTM-based models for generating coherent and contextually relevant responses in conversational agents. | CO6 | U | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the introduction to neural network |
| CO2 | Explain the concepts of convolutional neural networks |
| CO3 | Discuss deep learning unsupervised learning |
| CO4 | Summarize the application of deep learning to computer vision |
| CO5 | Describe the application of deep learning to NLP |
| CO6 | Discuss the concept of recursive neural network. |

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



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

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| --- | --- | --- | --- |
| **Course Code** | **21RO2001** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Discuss the types of forces acting on particles. | | CO1 | U | 1 |
| 2. | Explain Varignon’s theorem. | | CO1 | U | 1 |
| 3. | Illustrate the meaning of centroid of a plane. | | CO2 | A | 1 |
| 4. | Sketch and explain Parallel axis theorem. | | CO2 | A | 1 |
| 5. | Identify the different types of motion. | | CO3 | U | 1 |
| 6. | What are the three main types of motion? | | CO3 | R | 1 |
| 7. | What do you mean by work-energy principle? | | CO4 | R | 1 |
| 8. | Define the principle of Impulse momentum. | | CO4 | R | 1 |
| 9. | State Grashoff’s law. | | CO5 | R | 1 |
| 10. | What is a kinematic pair chain? | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss about moment of a force. | | CO1 | U | 3 |
| 12. | Establish polar moment of area. | | CO2 | A | 3 |
| 13. | Illustrate the concept of relative motion of a body. | | CO3 | U | 3 |
| 14. | Interpret linear momentum with an illustration. | | CO4 | A | 3 |
| 15. | What is the difference between Kutzbach criterion and Grubler criterion? | | CO5 | U | 3 |
| 16. | Discuss the basic steps involved in Machine design process. | | 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 types of supports and their reactions. | CO1 | An | 6 |
|  | b. | Appraise free body diagram with neat sketches. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Interpret the concept of equivalent system of forces with neat sketches. | CO1 | U | 6 |
|  | b. | Illustrate the resolution of forces with suitable examples. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Derive an expression of moment of inertia of a rectangular section, about an axis passing through the C.G. of the section and perpendicular to the base. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | On turning a corner, a motorist rushing at 10 m/s, finds a child on the road 40 m ahead. He instantly stops the engine and applies brakes, so as to stop the car within 15 m of the child. Calculate: The time required for stopping the car. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the mechanism behind the braking of an automobile using the work energy principle. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | What is a kinematic chain? Describe the construction of four bar chain. What are the applications of four bar chains? | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Formulate and derive an expression for the perpendicular axis theorem. | CO2 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With the help of a block diagram, discuss the steps involved in the process of machine design. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the basic concepts of equilibrium of forces |
| **CO2** | Interpret the properties of engineered surfaces and volumes |
| **CO3** | Recognize the motion characteristics of particles using laws of motion |
| **CO4** | Describe the motion characteristics of rigid bodies |
| **CO5** | Identify the kinematic principles of simple mechanisms |
| **CO6** | Explain the elementary design process of the simple machine components |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 11 | 6 | 6 | 6 | - | 29 |
| **CO2** | - | - | 5 | - | 12 | 12 | 29 |
| **CO3** | 1 | 4 | 12 | - | - | - | 17 |
| **CO4** | 2 | 12 | 3 | - | - | - | 17 |
| **CO5** | 1 | 3 | - | 12 | - | - | 16 |
| **CO6** | 1 | 3 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **21RO2002** | **Duration** | **3hrs** |
| **Course Name** | **AUTOMATIC CONTROL SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Sketch the rule for eliminating the negative feedback loop. | | CO1 | R | 1 |
| 2. | Define non-touching loop. | | CO1 | R | 1 |
| 3. | State damping ratio. | | CO2 | R | 1 |
| 4. | Determine the type and order of the following system transfer function  . | | CO2 | U | 1 |
| 5. | Define state vector. | | CO3 | R | 1 |
| 6. | List the advantages of state variable approach. | | CO3 | U | 1 |
| 7. | Define bandwidth. | | CO4 | R | 1 |
| 8. | The first column of the Routh array is 5, 1, 2, 4, -3. Determine the number of roots in right half of s-plane. | | CO5 | R | 1 |
| 9. | Define gain crossover frequency. | | CO5 | U | 1 |
| 10. | List the Characteristics of P-controller. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Mention the force balance equation of ideal mass element. | | CO1 | U | 3 |
| 12. | A second order system has a damping ratio of 0.6 and natural frequency of oscillation is 10 rad/sec. Determine the damped frequency of oscillation. | | CO2 | U | 3 |
| 13. | Give the condition for routh stability. | | CO3 | R | 3 |
| 14. | Sketch Polar plot for the transfer function | | CO4 | U | 3 |
| 15. | Give the general form of state variable representation. | | CO5 | U | 3 |
| 16. | State the advantages of frequency response 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. |  | Determine the transfer function for the system shown below. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the overall transfer function of the system for the signal flow graph shown below. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Derive the response of first order system when the input is unit step. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | The characteristic polynomial of a system is s 6+ 2s5+ 8s4+ 12s3+ 20s2+ 16s + 16 = 0.   1. Determine the location of roots on the s-plane. 2. Comment on the stability of the system. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Sketch bode plot for the following transfer function and obtain the gain cross over frequencies. . | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Consider the matrix A. Compute the state estimation matrix, . . | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Consider a unity feedback system with open transfer function, G(s)=5/s(s+0.05)(s+1). Design a PD controller so that the phase margin of the system is 30o at a freqency of 1.2 rad/sec. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The open loop transfer function of a unity feedback control system is given by. Sketch the polar plot and determine the phase margin and gain margin. | CO4 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Develop mathematical models of control components and physical systems |
| CO2 | Analyze the time domain responses of LTI systems and determine transient/steady state time response related performance goals. |
| CO3 | Derive equivalent differential equation, transfer function and state space model for a given system. |
| CO4 | Examine the frequency domain specifications of the LTI systems |
| CO5 | Evaluate stability of the linear systems with respect to time domain |
| CO6 | Investigate the stability of systems based on frequency domain by using different techniques. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 24 |  |  |  | 29 |
| CO2 | 1 | 4 | 12 |  |  |  | 17 |
| CO3 | 4 | 1 | 12 |  |  |  | 17 |
| CO4 | 1 | 3 | 24 |  |  |  | 28 |
| CO5 | 1 | 4 | 12 |  |  |  | 17 |
| CO6 | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **21RO2003** | **Duration** | **3hrs** |
| **Course Name** | **SENSOR SIGNAL CONDITIONING CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Design an amplifier with a gain of –10 and input resistance of 10k. | | CO1 | A | 1 |
| 2. | Compare the performance of inverting and non- inverting operational amplifier configurations. | | CO1 | A | 1 |
| 3. | List the features of an instrumentation amplifier. | | CO2 | R | 1 |
| 4. | Enumerate the advantages of active filter over passive filter. | | CO2 | R | 1 |
| 5. | Draw the diagram for a Positive clipper circuits. | | CO3 | R | 1 |
| 6. | Sketch the positive comparator circuit with a positive Reference voltage. | | CO3 | R | 1 |
| 7. | Choose the frequency for a 555 timer monostable multivibrator with R=10Kohm and C-0.01 µF. | | CO4 | R | 1 |
| 8. | Voltage Controlled Oscillator is called as voltage to frequency converter. Why? | | CO4 | R | 1 |
| 9. | What is the largest value of output voltage from an 8 bit DAC that produces 1.0V for a digital input of 00110010? | | CO5 | R | 1 |
| 10. | Draw a sample and hold circuit diagram. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Calculate the maximum distorted amplitude that a sine wave input of 10 kHz, can produce at the output of an op-amp whose slew-rate is 0.5v/μsec. | | CO1 | A | 3 |
| 12. | Sketch the basic circuit using op amp to perform the mathematical operation of Integrator and explain. | | CO2 | A | 3 |
| 13. | Draw the circuit diagram for a square wave generator. | | CO3 | U | 3 |
| 14. | Sketch the block diagram for a phase locked loop. | | CO4 | R | 3 |
| 15. | List the types of analog to digital converters with their merits and demerits. | | CO5 | R | 3 |
| 16. | Explain the impedance matching in aground interfacing circuit. | | CO6 | U | 3 |
|  | | | | | |
| 17. |  | Discuss the DC characteristics of an operational amplifier. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Draw an instrumentation amplifier whose gain is controlled by adjustable gain and explain its working concept. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | With the help of circuits and necessary equations, explain how logarithmic amplifier computations are performed using IC741 and derive an expression for the same. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | With a neat functional diagram, explain the working of IC 555 timer as an astable multivibrator and derive an expression for the frequency of oscillation with relevant waveforms. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the applications of Phase Locked Loop (PLL) for Amplitude Modulation (AM) detection, Frequency Shift Key(FSK) demodulation. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Draw the circuit diagram of a second order Butterworth active Low Pass Filter and derive its transfer function. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | With a neat block diagram explain the working of R-2R method using digital to analog converter (DAC) and state its merits and demerits. | CO5 | U | 6 |
|  | b. | With a neat block diagram explain the flash type analog to digital converter (ADC) and state its merits and demerits. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss in detail about the grounding and shielding effects in strain gauge and thermocouple sensors. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Define the characteristics of operational amplifiers |
| **CO2** | Describe the linear applications of op-amp |
| **CO3** | Design circuits for non-linear applications of op-amp |
| **CO4** | Apply the knowledge of special ICs like IC 555 to design circuits |
| **CO5** | Discuss about the types of ADCs and DACs |
| **CO6** | Analyze the parameters to be considered for interfacing. |

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

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

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| --- | --- | --- | --- |
| **Course Code** | **21RO2004** | **Duration** | **3hrs** |
| **Course Name** | **ROBOT KINEMATICS AND DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Determine the Euclidean norm of the vector x = {2,1,4} | | CO1 | A | 1 |
| 2. | List the 4 Ds of Robotics that enables one to justify the need for implementing robotic systems. | | CO1 | R | 1 |
| 3. | State the significance of an orthogonal matrix. | | CO2 | U | 1 |
| 4. | Determine the dot product of the vectors a={1, 1, 2} and b={2, 0, 4} | | CO2 | A | 1 |
| 5. | Mention the kinematic parameters used in robot kinematics. | | CO3 | R | 1 |
| 6. | Specify the 4 DH rule used to assign coordinate frames of a robot | | CO3 | U | 1 |
| 7. | Define the term manipulator degeneracy. | | CO4 | R | 1 |
| 8. | Suggest few methods to resolve the joint space singularity condition of a robot joint. | | CO4 | U | 1 |
| 9. | Write the generalized torque equation based on Lagrangian mechanics. | | CO5 | U | 1 |
| 10. | Differentiate path and trajectory of a robot. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Represent the position vectors x={2,  3,  5 } and y={1,  0,  3} in terms of the unit vectors i,  j and k and thereby find the dot product between x and y. | | CO1 | A | 3 |
| 12. | Write the general form of the homogeneous transformation matrix and indicate the significance of each element in the matrix. | | CO2 | U | 3 |
| 13. | State the sequence of operations involved in DH algorithm and express the same as an equation. | | CO3 | U | 3 |
| 14. | Compare Interior and Boundary Singularity condition of a robot joint. | | CO4 | An | 3 |
| 15. | Derive the force-acceleration relationship of a simple cart spring system using Newtonian Mechanics. | | CO5 | U | 3 |
| 16. | Specify the characteristics of Cartesian space trajectory planning. | | 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 moving frame B is subjected to a rotation of angle θ about the X axis of the reference frame A. Derive the rotation matrix that represents the above transformation. | CO1 | U | 6 |
|  | b. | Derive the mathematical relation associated with the mapping that involves (i) combination of translation and rotation transformation (ii) compound transformation involving three frames. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Derive the forward kinematic equations of a 2 link RR Manipulator and thereby compute the Cartesian coordinates for the end of the arm, given that the length of joints L1 = 10 in, L2 = 12 in, angles θ1 = 900 and θ2 = 300. | CO2 | A | 6 |
|  | b. | A point P in space is defined as P (2, 3, 5)T relative to frame B which is attached to the origin of the reference frame A and is parallel to it. Apply the following transformations to frame B and find P with respect to A frame.   1. Rotate 900 about x-axis, 2. Then Rotate 900 about local a-axis 3. Then Translate 3 units about y-, 6 units about z-, and 5 units about x-axes. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | The coordinate frames of a manipulator are assigned as shown in Fig.1 Determine the DH parameters.  https://lh5.googleusercontent.com/p1AQWtLADdKsY32HBv8NzwsgMaZK7-U1KtlAz1op90dfB8LGYi1as9GLlfBp_Jde7qh27UBCXsxzm9D8Ul4_b19Vw6g4NFHB-SnnQ9M4myNjm4zkrflBnBW5aGNLSIBcqzUiwaumslX5rczaxZJ9_w  Fig. 1 | CO3 | A | 6 |
|  | b. | It is desired to place the origin of the hand frame of a cylindrical robot at [3,4,7]T . Calculate the joint variables of the robot. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Outline the significance of Jacobian matrix for differential kinematic analysis and hence derive the Jacobian of 3R planar manipulator. | CO4 | An | 6 |
|  | b. | Comment on the concept of resolved motion rate control and describe the sequence of steps involved in its implementation. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Determine the Lagrange function of a 2 DoF manipulator with concentrated masses and hence derive the equations of motion. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Specify the significance of normal, orientation and approach vectors of a moving frame and express the vectors in matrix form. | CO2 | U | 6 |
|  | b. | The frame shown in Fig.2 is located at 3,5,7 units, with its n-axis parallel to x, its o-axis at 450 relative to the y-axis, and a-axis at 450 relative to the z-axis. Represent the position and orientation of the frame in the form of a matrix.    Fig.2 | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Determine the DH parameters of the 2 DoF robot whose kinematic diagram is shown in Fig.3 and hence derive the arm equation of the robot.  1-connected-to-first-jointJPG  Fig.3 | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Highlight the basic concepts of joint space trajectory planning with relevant diagrams. | CO6 | An | 6 |
|  | b. | The second joint of a 6-axis robot is to go from an initial angle of 20to an intermediate angle of 80in 5 seconds and continue to its destination of 25in another 5 seconds. Calculate the coefficients for third-order polynomials in joint-space. Assume the joint stops at intermediate points. | CO6 | A | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the mathematical concepts of kinematics |
| CO2 | Utilize kinematics analysis of robotic manipulators |
| CO3 | Perform Workspace analysis of a Robotic System |
| CO4 | Describe the Differential Motion and Statics of robotic manipulators |
| CO5 | Analyze dynamics and force of robotic manipulators |
| CO6 | Plan off-line Robot trajectories to meet desired End-Effector tasks |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 12 | 4 | - | - | - | 17 |
| CO2 | - | 10 | 19 | - | - | - | 29 |
| CO3 | 1 | 4 | 18 | 6 | - | - | 29 |
| CO4 | 1 | 1 | - | 15 | - | - | 17 |
| CO5 | - | 4 | 12 | - | - | - | 16 |
| CO6 | - | 3 | 6 | 7 | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **21RO2012** | **Duration** | **3hrs** |
| **Course Name** | **ROBOTICS AND ITS APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Robotic Workspace. | | CO1 | R | 1 |
| 2. | Write the advantages of Robots. | | CO1 | R | 1 |
| 3. | Define Actuator. | | CO2 | R | 1 |
| 4. | Express any two types of force sensors. | | CO2 | R | 1 |
| 5. | Write the advantage of a Serial Manipulator. | | CO3 | U | 1 |
| 6. | Mention the mapping methods in Mobile Robot. | | CO3 | R | 1 |
| 7. | Indicate the matrices used in the dynamics of mobile robots to represent the robot's motion and dynamics. | | CO4 | U | 1 |
| 8. | Write the applications of Mobile Robot. | | CO4 | R | 1 |
| 9. | Define Collaborative Robots. | | CO5 | U | 1 |
| 10. | Mention the medical applications of robots. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Mention what robots can do to ease the life of humans. | | CO1 | R | 3 |
| 12. | Write the characteristics of sensors that affect their measurement capabilities and sustainability for each application. | | CO2 | R | 3 |
| 13. | State the three laws of Robotics formulated by Isaac Asimov. | | CO3 | U | 3 |
| 14. | Write the formulas commonly used in the dynamics of Mobile Robots. | | CO4 | U | 3 |
| 15. | Demonstrate how the level of intelligence is exhibited by a robotic system | | CO5 | R | 3 |
| 16. | Write the Palletizing application of robots in material handling and logistics. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate Robot Anatomy and the different types of joints with a neat sketch. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain in brief about the LVDT position sensor with a neat sketch. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Consider the forward transformation of the three-joint manipulator. Given that the length of joint 1, L1 = 10 in., the length of joint 2, L2 = 8 in., the length of joint 3, L3 = 8 in., the angle Ɵ1 = 30°, the angle Ɵ2 = 45° and the angle Ɵ3 = 30°. Compute the coordinate position (x and y coordinates) for the end-of-the-arm P. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. | a. | Analyze how wheeled mobile robots can be classified into several different categories for manufacturing and logistics applications. List their advantages and disadvantages in flat and complex environments. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe in brief the application of robotic assembly system for pick and place operations with a neat block diagram. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Sketch the steps followed in a robot-assisted surgery with a neat block diagram. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the various factors that affect the stability of a mobile robot. | CO5 | U | 12 |
|  | | | | | |
| 24. | a. | Explain the different Assistive applications of robots in the field of medicine. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the concept of robots and robotics. |
| **CO2** | Identify and select sensors and actuators robotic applications. |
| **CO3** | Analyse the working principle of the serial chain manipulators. |
| **CO4** | Analyse the working principle and characteristics of mobile robots. |
| **CO5** | Identify the robotic technology used in the different domains. |
| **CO6** | Discuss different applications of the robots in several domains. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 17 | - | - | - | - | - | 17 |
| **CO2** | 5 | 12 | - | - | - | - | 17 |
| **CO3** | 13 | 4 | - | - | - | - | 17 |
| **CO4** | 1 | 16 | 12 | - | - | - | 29 |
| **CO5** | 15 | 13 | - | - | - | - | 28 |
| **CO6** | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **21RO3005** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ROBOT OPERATING SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the characteristics of ROS. | CO1 | U | 10 |
|  | b. | With block diagram, discuss how the message communication takes place between Nodes. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the importance of visualization in robotics and how RViz facilitates this process. | CO2 | U | 10 |
|  | b. | Compare and contrast the features of RViz and RQT for GUI development in ROS. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Summarize the best practices for debugging URDF-related issues in ROS applications. | CO3 | U | 10 |
|  | b. | Distinguish between feature-based SLAM and grid-based SLAM approaches. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | With flow diagram, describe the Communication scheme with move\_group node. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Interpret the deployment of 2D and 3D object detection models on edge devices used in ROS-based robotic platforms. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate the advantages and limitations of using roscpp over rospy for implementing intensive tasks in ROS applications. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the role of MoveIt within the ROS ecosystem and its significance in enabling robot motion planning, manipulation, and control. | CO4 | An | 10 |
|  | b. | Critically evaluate the role of URDF (Unified Robot Description Format) and xacro (XML Macros) for developing robot models. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Analyze the trade-offs between implementing point cloud processing algorithms as standalone ROS nodes versus nodelets. | CO5 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Develop the process of integrating custom hardware with ROS 2 using sensor and actuator drivers, including hardware abstraction and communication protocols. | CO6 | An | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the need for ROS and its significance |
| CO2 | Summarize the Linux commands used in robotics |
| CO3 | Discuss about the concepts behind navigation through file system. |
| CO4 | Explain the concepts of Node debugging |
| CO5 | Analyse the issues in hardware interfacing |
| CO6 | Able to program mobile robot and Industrial Robot |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 20 |  |  |  |  | 20 |
| CO2 |  | 10 |  | 30 |  |  | 40 |
| CO3 |  | 10 | 10 | 10 |  |  | 30 |
| CO4 |  |  | 20 | 10 |  |  | 30 |
| CO5 |  | 20 |  | 20 |  |  | 40 |
| CO6 |  |  |  | 20 |  |  | 20 |
|  | | | | | | | **180** |



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

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| **Course Code** | **22RO1001** | **Duration** | **3hrs** |
| **Course Name** | **MATERIAL SCIENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Unit cell in crystal structures. | | CO1 | U | 1 |
| 2. | Distinguish between Body center cubic and Hexagonal center cubic in crystal structure. | | CO1 | R | 1 |
| 3. | Identify at what temperature Iron changes its structure from BCC to FCC. | | CO2 | R | 1 |
| 4. | State the principle of Valence band for a semiconductor material. | | CO2 | R | 1 |
| 5. | Define the principle of electron ballistics. | | CO3 | U | 1 |
| 6. | Identify the material used as cathode (tool) in the Electron beam Machining Process. | | CO3 | R | 1 |
| 7. | Identify the mechanism involved in atomic dislocation of materials. | | CO4 | U | 1 |
| 8. | Explain the solid solution strengthening principle. | | CO4 | R | 1 |
| 9. | Indicate an example for soft magnetic material. | | CO5 | U | 1 |
| 10. | State any two applications of nano composite material. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the principle solubility limits in materials with an example. | | CO1 | An | 3 |
| 12. | Summarize the importance of phase diagram in engineering materials. | | CO2 | U | 3 |
| 13. | Enumerate the functions of Dielectric Fluid used in electric discharge machining process. | | CO3 | An | 3 |
| 14. | Distinguish the properties of elastic and plastic deformation. | | CO4 | U | 3 |
| 15. | Explain the S-N curve fatigue for mild steel with neat sketch. | | CO4 | A | 3 |
| 16. | Differentiate retentivity and coercivity in hysteresis curve. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the arrangement of atoms in a body Centered cubic and Face centered cubic structure. Determine its coordination number and atomic packing factor. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate various Interatomic bonding in crystal structure with neat sketch. | CO1 | U | 8 |
|  | b. | Illustrate the principle of diffusion with simple sketch | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. |  | Explain in detail the different phases in Iron carbon diagram with microstructural changes on cooling. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the salient features in classical free electron theory. | CO3 | A | 4 |
|  | b. | Indicate the importance of stress-strain curve for ductile material and its salient features with a simple sketch. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 21. |  | Describe the working principle of Plasma arc Machining process in detail with major components and draw its schematic diagram. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain with neat sketch the different stages of creep. Which stage of creep is considered during designing a product? | CO4 | A | 8 |
|  | b. | Indicate various properties of hard and soft ferromagnetic materials with example. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Describe polar and non-polar molecule in dielectrics with examples. | CO5 | R | 6 |
|  | b. | Illustrate the types of superconductors and its properties in detail. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain thermotropic liquid crystal in detail and its applications. | CO6 | A | 6 |
|  | b. | Illustrate biomimetic materials properties and applications in detail. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the various phase diagrams and their applications |
| **CO2** | Explain the applications of Ferrous alloys |
| **CO3** | Discuss about the electrical properties of materials |
| **CO4** | Summarize the mechanical properties of materials and their measurement |
| **CO5** | Differentiate magnetic, dielectric and superconducting properties of materials |
| **CO6** | Outline the application of modern engineering materials |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 9 | 12 | 3 | - | - | 25 |
| **CO2** | 2 | 7 | 12 | - | - | - | 21 |
| **CO3** | 13 | 1 | 3 | - | - | - | 17 |
| **CO4** | 1 | 9 | 7 | 3 | - | - | 20 |
| **CO5** | 6 | 5 | 8 | 6 | - | - | 25 |
| **CO6** | 1 | 3 | 6 | 6 | - | - | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **22RO1002** | **Duration** | **3hrs** |
| **Course Name** | **FUNDAMENTALS OF PYTHON PROGRAMMING FOR ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What is the purpose of an escape sequence in Python? | | CO 1 | U | 1 |
| 2. | Determine the output of the following program:  a = 12 b = str(13) c = str(12)+b d = int(c)-1200.5  print(int(d)) | | CO 1 | R | 1 |
| 3. | What is the output of the following Python code snippet?  for i in range(1, 6):  print(i \* 2) | | CO 2 | A | 1 |
| 4. | What is the difference between a one-way selection statement and a multi-way if statement in Python? | | CO 2 | R | 1 |
| 5. | Determine the output for the following code:  a = "aabasacsssgf"  for i in range(len(a)):  if i>4 and i<9:  print(a[i], end = "") | | CO 3 | A | 1 |
| 6. | Write the statement to open a textfile in read mode in python? | | CO 3 | U | 1 |
| 7. | How do you define a dictionary in Python, and how do we access a value using its key? | | CO 4 | U | 1 |
| 8. | What is the purpose of the "return" statement in a Python function? | | CO 4 | U | 1 |
| 9. | What is polymorphism in python? | | CO 5 | R | 1 |
| 10. | What is ImageAI? | | CO 6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | What is the difference between eval(), float(), and int() in the given variable assignment statements?  1) Num = int(input())  2) Num = float(input())  3) Num = eval(input()) | | CO 1 | An | 3 |
| 12. | Determine the output of the following code:  for i in range(6):  print(i)  i = i\*3 | | CO 2 | A | 3 |
| 13. | Write about any 3 different modes to read, write and append the content of a Text File using python. | | CO 3 | U | 3 |
| 14. | Write about any 3 basic list functions in python. | | CO 4 | U | 3 |
| 15. | How does top-down design help in problem-solving, and what is its role in designing functions in Python? | | CO 5 | A | 3 |
| 16. | Explain with illustration how to teach a robot a path of positions by selecting edges and curve? | | CO 6 | 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. | Evaluate the following expressions (write “error”, if the command will result into an error with a suitable explanation):   1. print(int(float(str(12.45)) +6)) 2. print(type(“15”)) 3. print(“abc” + str(12)) 4. print(3\*“aba”+“ba”) 5. print(float(“7” + str(float(6)))) 6. print(float(int(7.087))) | CO 1 | E | 6 |
|  | b. | Answer the following questions within 20 words:   1. What is the purpose of the main module in Python? 2. How do you run a Python script from the command line? 3. What is a variable in Python? 4. What is the difference between int() and float() in Python? 5. What is an escape sequence in Python?   What is a numeric data type in Python? int(), float(), str(), complex(), bool() which of these belong to numeric datatype? | CO 1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Write a python code for a guessing game, where a USER thinks of a number from 1 - 100, and the program will find the number by throwing random numbers to the user, and taking the feedback if that number guessed by the computer is higher or lower than the original number thought by the USER.  Eg: If the user thought of a number “76”  Program will generate a random number from 1 to 100.  Let’s assume the guessed number is 56. As it’s lower than 76, the user will enter “LOW”.  After taking the following feedback, the program will now give a random number from 56 to 100.  Assume that now, the number guessed by the program is 90. As it’s higher than 76, the user will enter “HIGH”.  After taking the following feedback, the program will now give a random number from 56 to 90. The iterations will continue till user enters “Correct”.  (Hint:  import random  guess = random.randint(low, high)  this command will put any random number between “low” and “high” in “guess” variable. If low = 25 and high = 70, guess can get any random number from 25 to 70, i.e. 25 or 26 or 27 or …. 68 or 69 or 70.S | CO 2 | An | 10 |
|  | b. | What is the difference between a for loop and a while loop in Python? Give an example of each. | CO 2 | An | 2 |
|  |  |  |  |  |  |
| 19. | a. | Write a Python program that reads in a text file named "input.txt" and performs the following tasks:   1. Access the contents of the file and store it in a string variable. 2. Convert all lowercase letters in the string to uppercase. 3. Replace all occurrences of the word "python" with the word "Java". 4. Write the modified text to a new text file named "output.txt". 5. Read the contents of "output.txt" and count the total number of vowels (A, E, I, O, U) in the text. | CO 3 | An | 10 |
|  | b. | What is the difference between “a” and “a+” modes in python? | CO 3 | An | 2 |
|  |  |  |  |  |  |
| 20. | a. | Write a Python program that does the following:   1. Takes a list of integers as input from the user 2. Calculates the sum, minimum value, and maximum value of the list 3. Removes any duplicates in the list and prints the updated list 4. Sorts the list in ascending order and prints the sorted list 5. Creates a new list that contains only the even numbers from the original list, and prints the new list. | CO 4 | A | 10 |
|  | b. | What is the key-value pair in Python dictionaries? | CO 4 | U | 2 |
|  |  |  |  |  |  |
| 21. | a. | Write a Python program that implements a class hierarchy for different types of vehicles. The base class should be named "Vehicle" and should have a method called "drive" that prints "Driving the vehicle."  The derived classes should include "Car", "Truck", and "Motorcycle". Each derived class should have its own "drive" method that prints "Driving the car/truck/motorcycle". The "Car" class should also have a method called "park" that prints "Parking the car." The "Truck" class should have a method called "haul" that prints "Hauling cargo." The "Motorcycle" class should have a method called "wheelie" that prints "Popping a wheelie." | CO 5 | E | 10 |
|  | b. | What is inheritance in python? | CO 5 | R | 2 |
|  |  |  |  |  |  |
| 22. | a. | Write the python code using MicroPython to control a Picker Robot to pick and place parts on the same conveyor using Python API. | CO 6 | A | 6 |
|  | b. | Use Nested While Loops and variables in MicroPython to pick and place parts in a robot program | CO 6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Write the python program using MicroPython to teach a robot to pick moving parts and then place them on other moving objects by declaring the necessary basic objects in python. | CO 6 | A | 9 |
|  | b. | Brief Signal Grasp and Release actions using MicroPython to pick and place components in steps. | CO 6 | A | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain how to manipulate the joints of a robot using its controller and DOF (Degree of Freedom) objects of nodes in MicroPython PyBoard. | CO 6 | An | 5 |
|  | b. | A small subset of the Python standard library is optimized to run on microcontrollers and in constrained environments.Brief the workflow process involved in MicroPython Pyboard. | CO 6 | An | 7 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Outline the structure and components of a Python program. |
| CO2 | Explain loops and decision statements in Python. |
| CO3 | Illustrate class inheritance in Python for reusability. |
| CO4 | Choose lists, tuples, and dictionaries in Python programs. |
| CO5 | Assess object oriented programs with Python classes and GUI. |
| CO6 | Develop simple code for robotics applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 6 | 3 | 6 | 0 | 17 |
| CO2 | 1 | 0 | 4 | 12 | 0 | 0 | 17 |
| CO3 | 0 | 4 | 1 | 12 | 0 | 0 | 17 |
| CO4 | 2 | 7 | 10 | 0 | 0 | 0 | 19 |
| CO5 | 2 | 0 | 13 | 0 | 10 | 0 | 25 |
| CO6 | 0 | 0 | 14 | 15 | 0 | 0 | 29 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **22RO2001** | **Duration** | **3hrs** |
| **Course Name** | **ELECTRICAL CIRCUIT ANALYSIS** | **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. | Name any two active elements in Electrical Circuits. | | CO1 | U | 1 |
| 2. | State Ohm’s law. | | CO1 | R | 1 |
| 3. | A resistor of 30 Ω has a voltage rating of 500 V. Evaluate its power rating. | | CO2 | AN | 1 |
| 4. | Mention the time constant of a series RL circuit. | | CO2 | A | 1 |
| 5. | Evaluate the maximum possible mutual inductance of two inductively coupled coils with self-inductances L1 = 25 mH and L2 = 100 mH. | | CO3 | A | 1 |
| 6. | Define average value of function v(t) with period T. | | CO4 | R | 1 |
| 7. | State final value theorem. | | CO5 | R | 1 |
| 8. | Determine the poles of the network function . | | CO5 | A | 1 |
| 9. | Calculate the frequency for the time period of 0.2 s. | | CO4 | A | 1 |
| 10. | Write the transmission parameter in matrix form for a two port network. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Evaluate the capacitance of a circuit in which an applied voltage of 20 V gives an energy store of 0.3 J. | | CO1 | AN | 3 |
| 12. | Write the mesh current equations in the circuit | | CO2 | A | 3 |
| 13. | Interpret the expression for calculating real, reactive and apparent power in a three phase system? | | CO3 | U | 3 |
| 14. | A wire carrying a direct current of 20A and a sinusoidal alternating current of peak value with 20A. Calculate the RMS value of the resultant current in the wire | | CO4 | A | 3 |
| 15. | Write the initial value theorem for 5e–4t. | | CO5 | A | 3 |
| 16. | For a given, Z11 = 3Ω, Z12 = 1Ω; Z21 = 2 Ω and Z22 = 1Ω, estimate the admittance matrix. | | 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. | Determine the current in the 10 Ωresistance in the given circuit | CO1 | A | 6 |
|  | b. | Determine the power dissipation in the 4 W resistor of the circuit shown in Fig. by using mesh analysis. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Estimate Thevenin’s equivalent circuit for the circuit. | CO2 | AN | 6 |
|  | b. | Develop the Norton’s equivalent circuit at terminal AB for the circuit | CO2 | AN | 6 |
|  |  |  |  |  |  |
| 19. | a. | A series RL circuit with R = 30 Ω and L = 15 H has a constant voltage V = 60 V applied at t = 0 as shown in Fig. Determine the current i, the voltage across resistor and the voltage across the inductor. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Using convolution theorem , evaluate the inverse Laplace transform for  H (s) = | CO5 | AN | 6 |
|  | b. | Determine the transfer function of RL circuit connected in series. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | A sine wave has a peak value of 25 V. Calculate the following values. (a) RMS (b) peak to peak (c) average | CO4 | A | 6 |
|  | b. | Write the form factor of the square wave  v = 20 for 0 < t < 0.01  = 0 for 0.01 < t < 0.03 | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the voltage across the 2 Ω resistor using superposition theorem | CO2 | AN | 12 |
|  |  |  |  |  |  |
| 23. | a. | For the circuit shown in Fig., evaluate the current equation when the switch is changed from position 1 to position 2 at t = 0. | CO3 | AN | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Determine the Y parameters for the network. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the various circuit elements, and their characteristics. |
| CO2 | Analyze the circuits using KVL, KCL, Mesh and Nodal analysis techniques and theorems. |
| CO3 | Solve first order and second order differential equations to obtain the transient responses |
| CO4 | Describe fundamental concepts used in single phase, three phase AC circuits and coupled circuits. |
| CO5 | Apply Laplace transform techniques to examine the behavior of resonant circuits and tuned coupled circuits |
| CO6 | Derive the parameters of two port networks |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 12 | 3 |  |  | 17 |
| CO2 |  |  | 4 | 25 |  |  | 29 |
| CO3 |  | 3 | 13 | 12 |  |  | 28 |
| CO4 | 1 |  | 16 |  |  |  | 17 |
| CO5 | 1 |  | 10 | 6 |  |  | 17 |
| CO6 |  |  | 13 | 3 |  |  | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **22RO2002** | **Duration** | **3hrs** |
| **Course Name** | **ELECTRICAL MACHINES AND DRIVES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Indicate the purpose of employing an auxiliary winding in a reluctance motor. | | CO1 | U | 1 |
| 2. | Explain the concept of skewing of three-phase induction motors. | | CO1 | U | 1 |
| 3. | Name the motor which rotates in discrete angular steps. | | CO2 | R | 1 |
| 4. | Indicate the method used to control the speed of a dc motor above rated speed. | | CO2 | U | 1 |
| 5. | State the principle behind why some electrical motors need a starter. | | CO3 | U | 1 |
| 6. | List the disadvantages of using mechanical brakes. | | CO3 | R | 1 |
| 7. | An electric drive is often referred to as an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | Classify the different types of electric drives based on the power supply. | | CO4 | An | 1 |
| 9. | Draw the symbol of an IGBT. | | CO5 | U | 1 |
| 10. | Identify the two types of Ward-Leonard control techniques. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | State Fleming’s right hand rule. | | CO1 | R | 3 |
| 12. | Indicate the three main methods employed to control the speed of dc motor. | | CO2 | U | 3 |
| 13. | Explain the dynamic/rheostatic braking of a DC Series Motor with a neat diagram. | | CO3 | A | 3 |
| 14. | Sketch the basic components of an electrical drive using a block diagram. | | CO4 | A | 3 |
| 15. | Explain how a VSI be converted into CSI with a neat diagram. | | CO5 | A | 3 |
| 16. | Cite the advantages of solid state control of electric drives. | | 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 a squirrel cage induction motor and a wound rotor induction motor. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Define a servo motor. Mention the working principle on which a servo motor works. Discuss in detail the construction and working principle of an AC servo motor with a neat diagram. | CO2 | U | 8 |
|  | b. | Explain the torque-speed characteristics of a servo motor with a neat diagram. List the applications of servo motor in the field of Robotics. | CO2 | An | 4 |
|  |  |  |  |  |  |
| 19. | a. | Write the potential applications of a three-phase induction motor in the field of robotics. | CO3 | A | 7 |
|  | b. | Servo motors are widely used due to their precise control, high accuracy and reliability. Write any five applications of servo motors in the robotics field. | CO3 | A | 5 |
|  |  |  |  |  |  |
| 20. | a. | Explain in detail the classification of electric drives based on their development. | CO4 | An | 6 |
|  | b. | Explain any three closed loop control methods of electric drives to improve the steady state accuracy. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the operation of a half wave rectifier, full wave bridge rectifier and full wave centre-tapped full wave rectifier with a neat circuit diagram. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the basic structure and operation of a MOSFET with a neat diagram. | CO5 | A | 6 |
|  | b. | Explain the torque-speed characteristics of a three-phase induction motor with a neat diagram. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | A 3-phase induction motor runs at almost 1200 rpm at no load and 1140 rpm at full load when supplied with power from a 60Hz, 3 -phase line. i) How many poles does the motor have?  ii) What is the percentage slip at full load?  iii) What is the corresponding frequency of the rotor voltage?  iv) At what speed will the rotor rotate at 10% slip?  v) What is the rotor frequency at this speed? | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write in detail the working of a controlled rectifier fed DC motor drive with a neat circuit diagram and graph. | CO6 | A | 6 |
|  | b. | Write in detail the two techniques used to control the speed of a DC motor using Ward-Leonard method, with a neat circuit diagram and graph. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Explain the operating principles of DC and AC motors. |
| CO2 | Explain the various method of speed control of DC and AC motors. |
| CO3 | Describe the factors for selection of drive, various load patterns and determine their power rating. |
| CO4 | Discuss the working of various power semiconductor devices. |
| CO5 | Demonstrate the working of various power converters and inverters. |
| CO6 | Apply and Analyze the control of DC and AC motors with solid state power converters and inverters. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 3 | 2 | 18 | - | - | - | 23 |
| CO2 | 1 | 12 | 12 | 4 | - | - | 29 |
| CO3 | 1 | 1 | 15 | - | - | - | 17 |
| CO4 | 1 | - | 9 | 7 | - | - | 17 |
| CO5 | - | 1 | 21 | - | - | - | 22 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- |
| **Course Code** | **22RO2003** | **Duration** | **3hrs** |
| **Course Name** | **SENSOR SIGNAL CONDITIONING CIRCUITS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | A differential amplifier has a differential voltage gain of 2000 and common mode gain of 0.2. Determine CMRR. | | CO1 | U | 1 |
| 2. | Define Slew Rate. | | CO1 | R | 1 |
| 3. | List the features of an instrumentation amplifier. | | CO2 | R | 1 |
| 4. | Enumerate the applications of a compartor. | | CO2 | R | 1 |
| 5. | Sketch the circuit diagram for a multiplier circuit. | | CO2 | A | 1 |
| 6. | Recall the applications of monostable multivibrator circuit using IC741. | | CO3 | R | 1 |
| 7. | Calculate the frequency and duty cycle for a 555 timer astable multivibrator with R1=10Kohm, R2= 5K ohm and C-0.01 µF. | | CO3 | A | 1 |
| 8. | Voltage Controlled Oscillator is called as voltage to frequency converter? Why? | | CO4 | R | 1 |
| 9. | Classify the types of Analog-to-Digital Converters (ADCs) based on their conversion methods. | | CO5 | U | 1 |
| 10. | Summarize the advantages of an integrated circuit. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Design an adder circuit using an opamp to get the output expression as Vo= - (0.1 V1+V2+10V3). | | CO1 | An | 3 |
| 12. | Sketch the basic circuit using op amp to perform the mathematical operation of differentiation and explain. | | CO2 | A | 3 |
| 13. | Draw sine to square wave generator diagram using basic comparator circuit, also draw its input and output waveform. | | CO3 | U | 3 |
| 14. | Explain the Amplitude modulation used in a phase locked loop. | | CO4 | U | 3 |
| 15. | Classify the types of Analog-to-Digital Converters (ADCs) based on their conversion methods. | | CO6 | U | 3 |
| 16. | Enumerate the key steps comprising the basic planar process employed in chip manufacturing. | | 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. | Show with the help of circuit diagram an op-amp that can be used as,  i) Inverting Amplifier ii) Non-Inverting Amplifier | CO1 | R | 6 |
|  | b. | Explain the impact of input offset voltage on the accuracy and precision of DC amplifier circuits utilizing the IC 741 op-amp. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the circuit diagram of an instrumentation amplifier featuring adjustable gain control and elucidate the operational concept behind its variable gain functionality. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Analyze the relationship between the operational principles behind logarithmic amplifier computations using the IC741 op-amp and the corresponding mathematical equations, emphasizing their interdependence and significance in circuit design. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the operation of 555 timers as monostable multivibrators using a functional diagram and derive the frequency expression for oscillation with relevant waveforms. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the design choices made in an IC741 low pass filter circuit, examining the selection of components, topology, and their impact on filter performance. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Given a block diagram of a PLL, illustrate the connections and interactions between its functional modules. | CO4 | A | 6 |
|  | b. | Derive the free-running range of voltage-controlled oscillators with necessary circuit diagrams. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Sketch the circuit diagram for the Wien bridge oscillator and derive an expression for the frequency of oscillation of the circuit. | CO2 | A | 12 |
|  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compare and contrast the operational principles of flash type converters and successive approximation type, Analog to Digital Converters, highlighting their respective advantages and disadvantages. | CO5 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Infer operational amplifiers' DC and AC characteristics. |
| **CO2** | Discuss the linear and non-linear applications for an op-amp. |
| **CO3** | Classify the working of multivibrators using the general-purpose op-amp and specific application IC 555. |
| **CO4** | Outline the functionalities of specific ICs such as voltage regulators and PLLs. |
| **CO5** | Demonstrate the working of data converters. |
| **CO6** | Summarize the techniques of IC fabrication |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 7 |  | 3 |  |  | 17 |
| **CO2** | 2 | 12 | 16 | 12 |  |  | 42 |
| **CO3** | 1 | 15 | 1 |  |  |  | 17 |
| **CO4** | 1 | 3 |  | 12 |  |  | 16 |
| **CO5** |  | 10 | 18 |  |  |  | 28 |
| **CO6** | 4 |  |  |  |  |  | 4 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **22RO2011** | **Duration** | **3hrs** |
| **Course Name** | **ROBOTIC PROCESS AUTOMATION** | **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 need for UiPath in RPA. | | CO1 | U | 1 |
| 2. | UiPath is the most preferred RPA tool in industry. Justify. | | CO1 | R | 1 |
| 3. | Recall the various types of recordings available in UiPath. | | CO2 | U | 1 |
| 4. | Name the properties of UiPath. | | CO2 | R | 1 |
| 5. | Recognize the need of anchor base activity. | | CO3 | U | 1 |
| 6. | Tabulate the special skills to handle RPA operations. | | CO3 | U | 1 |
| 7. | List the various types of activities used in UiPath for data entry. | | CO4 | R | 1 |
| 8. | RPA is used to automate any business function. Justify | | CO4 | U | 1 |
| 9. | Tabulate the reason RPA is the world's fastest-growing enterprise software. | | CO5 | R | 1 |
| 10. | Mention the email protocol in Uipath. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |  |  | R |
| 11. | Mention the applications of RPA. | | CO1 | U | 3 |
| 12. | List sections which are available in UiPath. | | CO2 | R | 3 |
| 13. | Highlight the features of RPA. | | CO3 | U | 3 |
| 14. | Differentiate between read range and write range. | | CO4 | U | 3 |
| 15. | Examine the applications of input dialog box. | | CO5 | R | 3 |
| 16. | Enumerate the limitations of robotic process automation. | | 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 in detail about the   1. Evolution RPA. 2. Consumer willingness for automation. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the automation process flow of copying data from the browser and saving in notepad. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain in detail about browser automation using UiPath-Recording. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Subtract two numbers by passing the variables and arguments. | CO3 | A | 6 |
|  | b. | Explain briefly about sequence and flowchart in RPA | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | With neat sketch, explain the process flow of finding odd number using UiPath activity. | CO3 | U | 6 |
|  | b. | Explain the process flow of PDF automation using UiPath. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | With neat sketch, explain the data- scraping automation using UiPath. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the RPA Challenge automation process. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze how an e-mail is communicated using UiPath. | CO5 | A | 6 |
|  | b. | Summarize the future trends and orchestrator in UiPath. | CO6 | U | 6 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Relate RPA, where it can be applied and how it's implemented. |
| CO2 | Outline the different types of variables, Control Flow and data manipulation techniques. |
| CO3 | Identify and understand Image, Text and Data Tables Automation. |
| CO4 | Interpret how to handle the User Events and various types of Exceptions and strategies. |
| CO5 | Illustrate the RPA interfacing aspects with E-mail Automation |
| CO6 | Understand the Deployment of the Robot and to maintain the connection. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 |  |  |  |  | 17 |
| CO2 | 4 | 1 | 24 |  |  |  | 29 |
| CO3 |  | 5 | 18 |  |  |  | 23 |
| CO4 | 1 | 4 | 6 |  |  |  | 11 |
| CO5 | 4 |  | 18 |  |  |  | 22 |
| CO6 |  | 4 | 18 |  |  |  | 22 |
|  | | | | | | | **124** |

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

|  |  |  |  |
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| **Course Code** | **23RO1001** | **Duration** | **3hrs** |
| **Course Name** | **PROGRAMMING IN C** | **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 logical operator || represents \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | Predict the output of the program :  #include<stdio.h>  int main()  {  char a[] = "Programming";  printf ("%s\n", a);  return 0;  } | | CO1 | A | 1 |
| 3. | Predict the output of the program :  #include <stdio.h>  int main()  {  int a = 2;  a = --a;  printf ("\nThe value of a = %d ", a);  return 0;  } | | CO2 | A | 1 |
| 4. | Predict the output of the program :  #include<stdio.h>  int main()  {  int a;  for (a = 1;a <= 5;a++)  {  if (a == 4)  {  break;  }  printf ("%d ", a);  }  return 0;  } | | CO2 | A | 1 |
| 5. | Express the syntax of a one-dimensional array. | | CO3 | U | 1 |
| 6. | An array can be initialized in C programming during \_\_\_\_\_\_ and \_\_\_\_\_\_ time. | | CO3 | R | 1 |
| 7. | Give an example where the concept of an array can be used. | | CO4 | U | 1 |
| 8. | Name a type of sorting algorithm in C language. | | CO4 | R | 1 |
| 9. | Identify the keyword used to declare structure in C. | | CO5 | U | 1 |
| 10. | Express the syntax of malloc() function | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Outline the structure of a C program. | | CO1 | R | 3 |
| 12. | Draw the flowchart showing the operation of a Nested-if statement. | | CO2 | A | 3 |
| 13. | Indicate the four aspects of function calling in C programming. | | CO3 | U | 3 |
| 14. | Identify the steps involved in linear search algorithm. | | CO4 | U | 3 |
| 15. | Express the syntax of ‘structures’ in C. | | CO5 | U | 3 |
| 16. | Differentiate between static memory allocation and dynamic memory allocation. | | 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. | Discuss about types of error that can occur during the compilation and execution of the program. | CO1 | U | 6 |
|  | b. | Write a C program to perform division and multiplication of two numbers. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Write a program to calculate the gross salary for the conditions given below:   |  |  |  |  | | --- | --- | --- | --- | | **Basic salary (Rs.)** | **DA (Rs.)** | **HRA (Rs.)** | **Conveyance (Rs.)** | | bs>=5000 | 10% of basic | 20% of basic | 500 | | bs>=3000 &&  bs<5000 | 100% of basic | 15% of basic | 400 | | bs<3000 | 90% of basic | 10% of basic | 300 | | CO2 | A | 7 |
|  | b. | Write a C program to find the factorial of the given number. | CO2 | A | 5 |
|  |  |  |  |  |  |
| 19. | a. | Write a C program to exhibit “Function with argument and with return value” aspect of function calling. | CO3 | A | 6 |
|  | b. | Write a C program to exhibit the three different aspects of a C function. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Write a program to subtract two matrices using multidimensional arrays. | CO4 | A | 6 |
|  | b. | Write a C program to perform the sum of all elements stored in an array. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Compare the array with structure in C. | CO5 | An | 5 |
|  | b. | Write C program to accept the details of employee and display them using structure. The details consist of Employee ID, Name, Designation, Department, Salary. | CO5 | A | 7 |
|  |  |  |  |  |  |
| 22. | a. | Write a C program for passing a parameter from one place of a program to another using ‘Call by Value’ function. | CO3 | A | 7 |
|  | b. | Explain the concept of ‘Bubble Sorting Algorithm’ with an example. | CO4 | U | 5 |
|  |  |  |  |  |  |
| 23. | a. | Write a program to print the result of a student as per the following condition: a student is declared pass if he scores 50 marks and above in all subjects (Take 3 subjects) and declared to be fail otherwise (use AND operator) | CO2 | A | 8 |
|  | b. | Write a program to demonstrate the usage of increment and decrement operators. | CO1 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write a C program to allocate memory dynamically using calloc() function. | CO6 | A | 8 |
|  | b. | Write a Program using pointers in C to swap two numbers without using the 3rd variable. | CO6 | A | 4 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Develop simple programs by understanding the fundamentals of C programming language. |
| CO2 | Formulate innovative solutions for the problems using the concept of branching and looping. |
| CO3 | Analyze a problem and avoid rewriting the same logic repeatedly in a program using Functions. |
| CO4 | Evaluate complex data structures and algorithms effectively with arrays. |
| CO5 | Categorize different types of items into a single type using structures. |
| CO6 | Describe arrays and structures handling methods more efficiently using pointers. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 3 | 7 | 11 | - | - | - | 21 |
| CO2 | - | 1 | 24 | - | - | - | 25 |
| CO3 | 1 | 4 | 19 | - | - | - | 24 |
| CO4 | 1 | 9 | 12 | - | - | - | 22 |
| CO5 | - | 4 | 7 | 5 | - | - | 16 |
| CO6 | - | 1 | 12 | 3 | - | - | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23RO1003** | **Duration** | **3hrs** |
| **Course Name** | **FUNDAMENTALS OF PYTHON PROGRAMMING FOR ROBOTICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List two features of python. | | CO1 | R | 1 |
| 2. | Identify the method that removes any whitespace from the beginning or the end. | | CO1 | R | 1 |
| 3. | Name any two operators in python. | | CO2 | R | 1 |
| 4. | Find the output for the following python code.  x = 2  for i in range(x):  x += 1  print (x) | | CO2 | A | 1 |
| 5. | Name the function used to write all the characters in python. | | CO3 | R | 1 |
| 6. | Which command is used for getting Current Working Directory (CWD)? | | CO3 | R | 1 |
| 7. | Write syntax to determine how many items are there in list. | | CO4 | U | 1 |
| 8. | Identify the output of the following python code  >>>t=(1,2,4,3)  >>>t[1:3] | | CO4 | A | 1 |
| 9. | How do you instantiate a class in python? | | CO5 | R | 1 |
| 10. | Define polymorphism. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between Interpreter and compiler. | | CO1 | An | 3 |
| 12. | Develop a python code to find the sum of the all numbers between 1 and 10. | | CO2 | A | 3 |
| 13. | Classify different modes in python files. | | CO3 | U | 3 |
| 14. | Differentiate: Del, remove and pop in python. | | CO4 | An | 3 |
| 15. | Create a class named Person, use the \_\_init\_\_() function to assign values for name and age. | | CO5 | A | 3 |
| 16. | Outline the steps in programming ESP32 with Micropython. | | 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. | Develop a python code to calculate the sum of first 10 natural number. | CO1 | An | 6 |
|  | b. | Summarize different data types in python. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Build a python code to convert Celsius to Fahrenheit. | CO2 | A | 6 |
|  | b. | Create python script to calculate the surface area and volume of a cube with the length of an edge as input. | CO2 | A | 6 |
| 19. |  | Develop python code for encrypt and decrypt Strings. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Create a python code to check if an item exists in the Tuple. | CO4 | A | 6 |
|  | b. | Write a function that takes two numbers as arguments and returns their sum. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Implement a class called Circle with attributes radius and methods to calculate its area and circumference. | CO5 | A | 6 |
|  | b. | Discuss Polymorphism with example | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Write a python program to reverse the given string. | CO3 | A | 6 |
|  | b. | Develop a python code to append the content of the second file to the content of the first file. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Create a Python program to replace the last value of tuples in a list.  Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]  Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)] | CO4 | A | 6 |
|  | b. | Find the output of the following code  list = [ 'hello', 123 , 6.23, 'karunya', 70.2 ]  tinylist = [123, 'john']  print (list)  print (list[0])  print (list[1:3])  print (list[2:])  print (tinylist \* 2)  (list + tinylist) | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the steps involved in programming unmanned aerial vehicle with Micropython. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Outline the structure and components of a python program. |
| **CO2** | Describe loops and decision statements in python. |
| **CO3** | Illustrate class inheritance in python for reusability. |
| **CO4** | Apply lists, tuples and dictionary concepts in python programs. |
| **CO5** | Assess object‐oriented programs with python classes and GUI. |
| **CO6** | Develop simple codes for robotic applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 6 |  | 9 |  |  | 17 |
| **CO2** | 1 |  | 16 |  |  |  | 17 |
| **CO3** | 2 | 3 | 24 |  |  |  | 29 |
| **CO4** |  | 7 | 13 | 9 |  |  | 29 |
| **CO5** | 2 | 6 | 9 |  |  |  | 17 |
| **CO6** |  | 15 |  |  |  |  | 15 |
|  | | | | | | | **124** |