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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18RO2002** | **Duration** | **3hrs** |
| **Course Title** | **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. | Distinguish closed, open and isolated system. | | CO1 | R | 1 |
| 2. | Define a quasistatic process. | | CO1 | R | 1 |
| 3. | What is meant by thermodynamic equilibrium? | | CO2 | U | 1 |
| 4. | Explain Boyle’s law and Charles law. | | CO2 | An | 1 |
| 5. | Write the efficiency formula for diesel cycle. | | CO3 | R | 1 |
| 6. | List out two air standard cycles. | | CO3 | R | 1 |
| 7. | State the assumptions made in Bernoulli's equation. | | CO4 | R | 1 |
| 8. | State the Archimedes principle. | | CO4 | R | 1 |
| 9. | State the Law of superposition. | | CO5 | An | 1 |
| 10. | Explain Lami’s theorem with neat diagram. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | | Differentiate macroscopic approach from microscopic approach? | CO1 | An | 3 |
| 12. | | The piston of an oil engine, of area 0.0045 m2, moves downwards 75 mm, drawing in 0.00028 m3 of fresh air from the atmosphere. The pressure in the cylinder is uniform during the process at 80 kPa, while the atmospheric pressure is 101.325 kPa, the difference being due to the flow resistance in the induction pipe and the inlet valve. Estimate the displacement work done by the air finally in the cylinder. | CO2 | R | 3 |
| 13. | | Draw Carnot cycle and label the processes. | CO3 | A | 3 |
| 14. | | A semi-circular plane area of diameter 1 m, is subjected to a uniform gas pressure of 420 kN/m2. Estimate the moment of thrust (approximately) on the area about its straight edge? | CO4 | E | 3 |
| 15. | | If point A is in equilibrium under theaction of the applied forces, Estimate the values oftension TAB and TAC are respectively. | CO5 | A | 3 |
| 16. | | Explain work, energy, power and momentum. | CO6 | E | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. | a. | State zeroth law of thermodynamics and list out its merits and demerits. | CO1 | An | 4 |
|  | b. | Explain the following thermodynamic systems - closed, open and isolated system. | CO1 | U | 4 |
|  | c. | Explain about property, state, path and process, quasistatic process in thermodynamics. | CO1 | U | 4 |
| 18. |  | Evaluate the expression for work done in constant volume, and constant pressure, isothermal, adiabatic and polytrophic process. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | An air standard Otto cycle has thermal efficiency of 0.5 and the mean effective pressure of the cycle is 1000 kPa. For air, assume specific heat ratio γ = 1.4 and specific gas constant R = 0.287 kJ/kg.K, If the pressure and temperature at the beginning of the compression stroke are 100 kPa and 300 K, respectively, then evaluate the specific network output of the cycle (in kJ/kg). | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Derive the Euler’s equation of motion along a stream line and obtain Bernoulli’s equation by its integration. Also write its assumptions. | CO4 | An | 12 |
| 21. | a. | State and prove Lami’s theorem. | CO5 | U | 5 |
|  | b. | Two cylinders are kept in a channel as shown in figure. Determine the reactions at all the contact points A, B, C and D. Assume the contact Surfaces are smooth. | CO5 | E | 7 |
|  |  |  |  |  |  |
| 22. | a. | A mass m1 of 100 kg travelling with a uniform velocity of 5 m/s along a line collides with a stationary mass m2 of 1000 kg. After the collision, both the masses travel together with the same velocity. Determine the coefficient of restitution? | CO6 | An | 5 |
| b. | An engine equipped with a cylinder having a bore of 15 cm and a stroke of 45 cm operates on an Otto cycle. If the clearance volume is 2000 cm3. Compute the air standard efficiency? | CO3 | E | 7 |
|  |  |  |  |  |  |
| 23. | a. | Explain free body diagram with suitable sketches. Describe the importance of FBD. | CO5 | U | 6 |
|  | b. | Two spheres of weight P and Q rest inside a hollow cylinder which is resting on a horizontal force. Draw the free body diagram of both the spheres, together and separately. | CO5 | E | 6 |
|  | **COMPULSORY** | | | | |
| 24. | a. | A train weighting 107N is running on a level track with uniform speed of 36 km/h. The frictional force is 0.5 kgf per quintal. What is the power of the engine? | CO6 | A | 6 |
| b. | A ball of mass 0.1 kg, initially at rest, is dropped from height of 1 m. Ball hits the ground and bounces off the ground. Upon impact with the ground, the velocity reduces by 20%. Find the height (in m) to which the ball will rise? | CO6 | An | 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 Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 8 | - | 7 | - | - | 17 |
| CO2 | 3 | 1 | 12 | 1 | - | - | 17 |
| CO3 | 2 | - | 3 | - | 19 | - | 24 |
| CO4 | 2 | - | - | 12 | 3 | - | 17 |
| CO5 | - | 11 | 4 | 1 | 13 | - | 29 |
| CO6 | - | - | 6 | 11 | 3 | - | 20 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18RO2008** | **Duration** | **3hrs** |
| **Course Title** | **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. | How to specify the robot? | | CO1 | | U | | 1 |
| 2. | A 1 DoF robot has a revolving joint with a full range of 150 degrees. If the robot's control memory has a 12bit storage capacity, determine the control resolution of the robot. | | CO1 | | A | | 1 |
| 3. | Prove that the inverse of a rotational matrix is equal to its transpose and specify the reason for the same. | | CO2 | | A | | 1 |
| 4. | Compute the Euclidean norm between the vectors a and b | | CO2 | | A | | 1 |
| 5. | Indicate the factors that determine the work volume of a robot. | | CO3 | | U | | 1 |
| 6. | Sketch the shape of the work volume swept by the manipulator configuration shown in Figure below. | | CO3 | | A | | 1 |
| 7. | State three conditions that lead to degeneracy of a robot manipulator. | | CO4 | | R | | 1 |
| 8. | Compare Kinematic with Differential Kinematic Analysis of a robot. | | CO4 | | An | | 1 |
| 9. | Identify the dynamic analysis approach that is based on the differentiation of energy terms with respect to the system variables. | | CO5 | | R | | 1 |
| 10. | Differentiate path and trajectory of a robot with a relevant example. | | CO6 | | An | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Summarize the evolution of the Unimate robot and its role in revolutionizing the field of industrial robotics. | | CO1 | | An | | 3 |
| 12. | Specify the components of the Homogeneous Transformation Matrix and indicate the significance of each one. | | CO2 | | U | | 3 |
| 13. | A Frame B was rotated about the current o-axis by 90 degrees, then it was translated about the x-axis by 3 inches before it was rotated about the z-axis by 90 degrees. It was further translated about the current o-axis by 5 inches. Write the transformation equation that describes the motion. | | CO3 | | A | | 3 |
| 14. | Differentiate Boundary Singularity and Interior Singularity Conditions of a robot manipulator with a relevant example. | | CO4 | | An | | 3 |
| 15. | Analyze the impact of effective inertia at a particular joint on the torque experienced by the actuator at that joint. | | CO5 | | An | | 3 |
| 16. | Compare Joint Space and Cartesian Space method of description of a robot trajectory. | | 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. | Categorize industrial robots based on the following factors and give an example under each category.   1. Manipulator Configuration 2. Path Control Technique 3. Shape of Work Volume | | CO1 | | U | 12 |
|  |  |  | |  | |  |  |
| 18. | a. | Derive the mathematical relation associated with the mapping that involves (i)  pure translation (ii) pure rotation (iii) translation and rotation. | | CO2 | | A | 6 |
|  | b. | A Co-ordinate Frame F was subjected to the following transformations in order.   1. rotation about the x-axis by 90degrees. 2. rotation about the a-axis by 30degrees. 3. translation of 5 units along the n-axis, 3 units along o-axis and 2 units along a-axis, and finally 4. translation of 4 units along the x-axis, 2 units along y-axis and 1 unit along z-axis.   Determine the total transformation matrix. | | CO2 | | A | 6 |
|  |  |  | |  | |  |  |
| 19. | a. | A major automotive manufacturer deploys robots with a combination of vision systems, AI-based defect detection, and precise sensors to inspect assembled parts. The robots can identify misaligned components, detect surface defects, and verify dimensions with high accuracy.  Analyze the potential challenges in this system on issues such as maintenance, data management, and the adaptability of these robots to new models or assembly changes. Suggest suitable strategies to address the challenges. | | CO3 | | An | 8 |
|  | b. | Indicate the need for structured illumination in the workspace of a robot system. | | CO3 | | U | 4 |
|  |  |  | |  | |  |  |
| 20. | a. | Derive the Jacobian Equation of a 3 link RR manipulator to analyse the differential kinematic behavior of the robot. | | CO4 | | A | 6 |
|  | b. | Comment on the resolved rate motion control technique used for robot motion control. | | CO4 | | An | 6 |
|  |  |  | |  | |  |  |
| 21. | a. | Derive the Equation of Motion of a Cart-Spring system using Lagrange approach for dynamic analysis. | | CO5 | | A | 4 |
|  | b. | Apply a systematic approach to arrive at the Torque Equation of the 2-link manipulator in Fig.2. using energy-based approach for dynamic analysis.    Fig.2. Two Link Planar Manipulator | | CO5 | | A | 8 |
|  |  |  | |  | |  |  |
| 22. | a. | Analyze the factors that affect the speed of motion of a robot and comment on the trade-off between speed and accuracy. | | CO1 | | A | 6 |
|  | b. | Describe the features of a robot that determine its precision of movement and highlight the significance of each parameter on the performance of the robot. | | CO1 | | U | 6 |
|  |  |  | |  | |  |  |
| 23. | a. | Derive the orthogonal matrix that represents a pure rotation of a frame about the x-axis of the reference frame. | | CO2 | | A | 6 |
|  | b. | Determine the arm equation of the 3-link cylindrical robot whose kinematic diagram is given in Fig.3.    ***d1***  Fig.3. Link Cylindrical Robot | | CO2 | | A | 6 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | a. | Compare the non-normalized and normalized techniques used in Joint Space Trajectory Description. | | CO6 | | An | 6 |
|  | b. | It is desired to have the third joint of a 6-axis robot go from an initial angle of 20 degrees to a final angle of 80 degrees in 4 seconds. Calculate the coefficients for a third-order polynomial joint-space trajectory. The robot starts from rest but should have a final velocity of 5degrees /sec. | | CO6 | | A | 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 analyse 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** |  | 19 | 7 | 3 |  |  | 29 |
| **CO2** |  | 3 | 26 |  |  |  | 29 |
| **CO3** |  | 5 | 4 | 8 |  |  | 17 |
| **CO4** | 1 |  | 6 | 10 |  |  | 17 |
| **CO5** | 1 |  | 12 | 3 |  |  | 16 |
| **CO6** |  |  | 6 | 10 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the components of the human eye involved in visual perception. | | CO1 | R | 1 |
| 2. | Indicate the function of rods in human vision in low-light conditions. | | CO1 | U | 1 |
| 3. | Name the dimensions that define the digital representation of an image. | | CO2 | R | 1 |
| 4. | Identify the technique that is used to separate a foreground object from its background. | | CO2 | U | 1 |
| 5. | List two common applications of high-level vision algorithms. | | CO3 | R | 1 |
| 6. | Define region-based segmentation. | | CO3 | R | 1 |
| 7. | Indicate the two fundamental approaches to human object recognition based on vision. | | CO4 | U | 1 |
| 8. | Enumerate the common challenges faced during object recognition processes. | | CO4 | R | 1 |
| 9. | Define landmark spatiogram. | | CO5 | R | 1 |
| 10. | State the role of master node in ROS architecture. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the organization of pixels in an image and their significance in digital photography. | | CO1 | U | 3 |
| 12. | Describe the purpose of edge detection operators in image processing applications. | | CO2 | U | 3 |
| 13. | Enumerate the steps involved in pattern recognition. | | CO3 | U | 3 |
| 14. | Discuss the significance of multi-view approaches in improving object recognition accuracy across different perspectives. | | CO4 | U | 3 |
| 15. | List the intrinsic and extrinsic parameters for calibration of camera. | | CO5 | U | 3 |
| 16. | Summarize the key features of the meta-operating system for a robot. | | 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 process of image formation in human eye under varying lighting conditions. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Apply 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 characteristics of sampling and quantization in digital images. | CO2 | U | 2 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the role of boundary descriptors within an object recognition model, highlighting their significance and applications in enhancing the recognition accuracy. | CO3 | U | 6 |
|  | b. | Explain the sequence of erosion and dilation operations utilized for noise removal in images. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate with an example, the modeling of objects in an image by applying the technique of combining two images to recognize the object. | CO4 | A | 6 |
|  | b. | Explain the object recognition technique within a high-level digital image processing system with a suitable block diagram. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Analyze the usage of digital image processing techniques to transform the sensor readings in smart home environments. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the different illumination techniques used in photography, assessing their impact on image quality and visual perception. | CO1 | U | 7 |
|  | b. | Discuss the gray level transformation techniques in image processing to enhance visual information. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 23. | a. | Explain the EM clustering algorithm with a suitable block diagram. | CO5 | U | 4 |
|  | b. | Illustrate with neat sketch, the mapping of sonar data to detect target objects ­­­in real-world environment. | CO5 | An | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Classify the different computer vision algorithms in OpenCV that can be integrated into ROS to improve robotic vision capabilities. | CO6 | An | 5 |
|  | b. | Explain the functionalities of ArbotiX and Stage simulator in enabling robots to interact with real-world environments. | CO6 | An | 7 |

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

|  |  |
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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 23 | - | - | - | - | 24 |
| **CO2** | 1 | 11 | 10 | - | - | - | 22 |
| **CO3** | 2 | 15 | - | - | - | - | 17 |
| **CO4** | 1 | 4 | 12 | - | - | - | 17 |
| **CO5** | 1 | 7 | - | 20 | - | - | 28 |
| **CO6** | 1 | 3 | - | 12 | - |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two actuators. | | CO1 | R | 1 |
| 2. | State the need for relay in PLC controlled systems. | | CO1 | U | 1 |
| 3. | Name any two PLC manufacturers. | | CO2 | R | 1 |
| 4. | Find the time taken for a scan cycle in PLC. | | CO2 | U | 1 |
| 5. | Identify the location used to store the program stored in PLC | | CO3 | U | 1 |
| 6. | Implement a ladder diagram to count 10. | | CO3 | U | 1 |
| 7. | State Bit follow in PLC | | CO4 | R | 1 |
| 8. | Draw the PLC function for Shift register. | | CO4 | R | 1 |
| 9. | Name the PLC that uses text display. | | CO5 | U | 1 |
| 10. | Name the technologies used for industrial automation. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the evolution of industrial automation. | | CO1 | R | 3 |
| 12. | Mention the necessity of isolators in the PLC. | | CO2 | U | 3 |
| 13. | Draw an equivalent ladder logic program for the NAND gate. | | CO3 | A | 3 |
| 14. | Explain the PID function. | | CO4 | U | 3 |
| 15. | List the advantages of text displays. | | CO5 | U | 3 |
| 16. | State the maintenance procedure in PLC. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate the automation pyramid with relevant examples. | CO1 | U | 6 |
|  | b. | List and discuss the sensors used for industrial automation. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. |  | Elaborate on the architecture of PLC with required block diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Write a program to implement the process illustrated in Figure. An up-counter must be programmed as part of a batch-counting operation to sort parts automatically for quality control. The counter is installed to divert 1 part out of every1000 for quality control or inspection purposes.    The circuit operates as follows:  • A start/stop pushbutton station is used to turn the conveyor motor   on and off.  • A proximity sensor counts the parts as they pass by on the   conveyor.  • When a count of 1000 is reached, the counter’s output activates   the gate solenoid, diverting the part to the inspection line.  • The gate solenoid is energized for 2 s, which allows enough time   for the part to continue to the quality control line.  • The gate returns to its normal position when the 2-s time period   ends.  • The counter resets to 0 and continues to accumulate counts.  • A reset pushbutton is provided to reset the counter manually | CO3 | A | 8 |
|  | b. | Write a program that will latch on a light 20 s after an input switch has been turned on. The timer will continue to cycle up to 20 s and reset itself until the input switch has been turned off. After the third time the timer has timed to 20 s, the light will be unlatched. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Examine the operation of sequence function with help of an example. | CO4 | A | 8 |
|  | b. | Discuss the programming used in instruction list for PLC. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. |  | With a help of a case study explain need and advantage of industrial automation | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A conveyor is run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. For the conveyor a sorting system is added. Gages have been attached that indicate good or bad. If the part is good, it continues on. If the part is bad, we do not want to delay for 2 seconds, but instead actuate a pneumatic cylinder. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the timers and counters functions used in PLC. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With relevant diagrams, explain the WIFI architecture and its role in the industrial automation. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **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** | 10 | 7 |  |  |  |  | 17 |
| **CO2** | 1 | 16 |  |  |  |  | 17 |
| **CO3** |  | 18 | 11 |  |  |  | 29 |
| **CO4** | 2 | 15 | 12 |  |  |  | 29 |
| **CO5** | 1 | 16 |  |  |  |  | 17 |
| **CO6** | 3 | 12 |  |  |  |  | 15 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the function of PAC. | | CO1 | U | 1 |
| 2. | Mention the components involved in the operator level of industrial automation. | | CO1 | U | 1 |
| 3. | Write the types/variants of WinCC software. | | CO2 | R | 1 |
| 4. | Define tag logging. | | CO2 | R | 1 |
| 5. | Define protocol. | | CO3 | R | 1 |
| 6. | Write the use of OPC UA. | | CO3 | U | 1 |
| 7. | In multiuser server-client configuration, how many clients can be configured? | | CO4 | A | 1 |
| 8. | Write the function of the communication interface of DCS. | | CO5 | R | 1 |
| 9. | Name any one application of DCS. | | CO5 | A | 1 |
| 10. | In this type of plant layout, the machines are arranged together in one place. Name the type of plant layout. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Draw the structure of vertical integration of industrial automation. | | CO1 | U | 3 |
| 12. | Compare internal and external tags. | | CO2 | An | 3 |
| 13. | Define DDE. Also, write its features. | | CO3 | R | 3 |
| 14. | Redundancy is important for DCS. Justify. | | CO4 | An | 3 |
| 15. | Write the role of General-purpose computers in DCS. | | CO5 | U | 3 |
| 16. | List the factors affecting the design of the plant layout | | 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 various levels of components in TIA with relevant diagrams. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Write the necessity of HMI systems. Also, explain the types of HMI in detail. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the hardware and software architecture of the SCADA system. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Write the detailed procedure to create a Trend screen in the SCADA system. | CO2 | A | 6 |
|  | b. | Explain the procedure for the report generation. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Write the step-by-step procedure for interfacing SCADA with PLC. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Draw the functional block diagram of the Local Control Unit of DCS. Explain the features of each component in detail. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the Low-level, and high-level Engineering Interfaces of DCS in detail. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the industrial plant sequencing with an example. | CO6 | U | 6 |
|  | b. | Write down the factors involved in selecting automation cables. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **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 | 12 |  |  |  | 29 |
| **CO2** | 2 | 12 | 12 | 3 |  |  | 29 |
| **CO3** | 4 | 13 |  |  |  |  | 17 |
| **CO4** |  |  | 13 | 3 |  |  | 16 |
| **CO5** | 1 | 15 | 1 |  |  |  | 17 |
| **CO6** |  | 10 | 6 |  |  |  | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO1001** | **Duration** | **3hrs** |
| **Course Title** | **MATERIAL SCIENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term atomic packing factors in crystal structures. | | CO1 | U | 1 |
| 2. | Summarize the importance of phase diagram. | | CO1 | R | 1 |
| 3. | Specify the temperature at which iron undergoes a structural transition from BCC to FCC. | | CO2 | U | 1 |
| 4. | State the principle of Conduction band in semiconductor material. | | CO2 | R | 1 |
| 5. | Identify the material used as cathode (tool) in the Electron beam Machining Process. | | CO3 | U | 1 |
| 6. | Define the principle of magnetostriction. | | CO3 | R | 1 |
| 7. | Explain the principle of grain boundary strengthening . | | CO4 | U | 1 |
| 8. | Ferroelectric materials exhibit reversible electric polarization under an external electric field, this character is referred as? | | CO4 | R | 1 |
| 9. | Indicate an example for super conducting material. | | CO5 | U | 1 |
| 10. | State any two applications of nano composite material. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between Body-center cubic and hexagonal closed-packed crystal structure. | | CO1 | U | 3 |
| 12. | **Mention** the phases involved in the hypereutectoid steel transformation. | | CO2 | U | 3 |
| 13. | Enumerate the functions of Dielectric Fluid used in electric chemical machining process. | | CO3 | A | 3 |
| 14. | Distinguish between elastic and plastic deformation in metals. | | CO4 | An | 3 |
| 15. | Explain the S-N curve fatigue for mild steel with neat sketch. | | CO4 | A | 3 |
| 16. | Explain the impact of polarization on the dielectric properties of materials. | | 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. |  | Discuss the different types of interatomic bonding in atomic structures, providing examples of each and analyzing their impact on the properties of materials. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain in detail the different phases in Iron carbon diagram with microstructural changes on cooling. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the principle of diffusion with simple sketch. | CO2 | U | 8 |
|  | b. | Explain the salient features in classical free electron theory. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Describe the working principle of electron beam machining process in detail with major components and draw its schematic diagram | CO3 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Indicate the importance of stress-strain curve for ductile material and it’s salient features with a simple sketch | CO4 | A | 8 |
|  | b. | Outline the key factors that contribute to the effectiveness of solid solution strengthening in enhancing the mechanical properties of alloys. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 22. |  | Explain the importance of the S-N curve in fatigue testing and describe how it helps determine the fatigue life of materials subjected to repeated stress cycles. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Examine the hysteresis loops of hard and soft magnetic materials, and explain how their distinct properties affect their use in various practical applications. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explore the different types of liquid crystals and photonic crystals, and analyse their applications, especially in the context of display technologies. | CO6 |  | 12 |

**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 | 4 | 12 | - | - | - | 17 |
| **CO2** | 1 | 16 | 12 | - | - | - | 29 |
| **CO3** | 13 | 1 | 3 | - | - | - | 17 |
| **CO4** | 1 | 9 | 7 | 3 | - | - | 20 |
| **CO5** | 6 | 5 | 8 | 6 | - | - | 25 |
| **CO6** | 1 | 3 | 6 | 6 | - | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO1002** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING PRACTICES** | **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. | Name the tool used for marking the carpentry work piece | | CO1 | R | 1 |
| 2. | A tool which is used for removing small unwanted parts of wood from the work piece is called \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Name one type of commercial wiring. | | CO2 | R | 1 |
| 4. | The safety tripper is used for \_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Expand DSO. | | CO3 | R | 1 |
| 6. | The instrument which measures signal of any type is called as \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Name one type of AC motor. | | CO4 | R | 1 |
| 8. | If the torque of a motor is less then only \_\_\_\_\_\_\_\_\_\_ load can be applied. | | CO4 | U | 1 |
| 9. | Expand PCB. | | CO5 | R | 1 |
| 10. | \_\_\_\_\_\_\_\_\_ is used for etching the masked PCB. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | How do you make a simple joint in carpentry? | | CO1 | U | 3 |
| 12. | State the principle of a motor. | | CO2 | U | 3 |
| 13. | A square wave has high duty cycle of 10%. State the problem the incoming signal has with diagram. | | CO3 | R | 3 |
| 14. | Differentiate AC and DC motors. | | CO4 | U | 3 |
| 15. | Justify the use of rats nest in a PCB design. | | CO5 | R | 3 |
| 16. | Give steps for merging two objects using TINKER CAD. | | 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. |  | Give detailed procedures for using a voltmeter and an ammeter for measuring the current and voltage with necessary circuit diagrams. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | List different types of commercial wiring and explain any two in details with circuit diagrams. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss briefly about the characteristics of a DSO with neat diagrams. | CO3 | An | 6 |
|  | b. | Discuss about the Function Generator and justify the need for generating different signals in real time with practical procedures. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Elaborate on the step by step PCB designing procedure of an AND/OR gate with suitable diagram. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss in detail about the fabrication process of the printed circuit board using subtractive etching. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the practical procedure to measure a given signal and elaborate on how a signal’s characteristics are measured. | CO3 | A | 8 |
|  | b. | Give insights on TINKERCAD Software. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Give detailed procedure for trouble shooting an AC Motor with necessary diagrams. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Give detailed procedure for creating the following 3-D models using TINKER CAD/Blender Software:   1. Heart 2. RNA 3. Prosthetic Leg | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Assemble mechanical devices and equipment by applying basic carpentry. |
| CO2 | Design simple electric circuits and apply different types of wiring. |
| CO3 | Identify the operation and handling of measuring instruments. |
| CO4 | Perform troubleshooting of electric motors |
| CO5 | Fabricate PCB boards for specific applications. |
| CO6 | Create and fabricate 3-D models |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | - | - | - | - | 5 |
| CO2 | 2 | 3 | 12 | - | - | - | 17 |
| CO3 | 5 | 6 | 20 | 6 | - | - | 37 |
| CO4 | 1 | 4 | 12 | - | - | - | 17 |
| CO5 | 5 | - | 12 | 12 | - | - | 29 |
| CO6 | 3 | - | 4 | 12 | - | - | 19 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the components in NC that are attached to the position feedback package. | | CO1 | R | 1 |
| 2. | Identify the motion control system used in CNC. | | CO1 | R | 1 |
| 3. | Indicate the component that translates the part program into internal commands for moving tools and executing auxiliary functions in a CNC system. | | CO2 | U | 1 |
| 4. | Define Position error. | | CO3 | R | 1 |
| 5. | Name a resistive type transducer. | | CO4 | R | 1 |
| 6. | Identify the use of limit switches in CNC. | | CO4 | R | 1 |
| 7. | Interpret the fourth axis in a CNC machine. | | CO5 | U | 1 |
| 8. | Write the CNC codes for dwell and skip functions | | CO5 | U | 1 |
| 9. | In the CNC statement, G71 P100 Q200 U0.2 W.05. P and Q refers to \_\_\_\_\_\_\_\_ | | CO5 | U | 1 |
| 10. | State the importance of earthing in CNC machine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between absolute and incremental system in CNC. | | CO1 | U | 3 |
| 12. | Specify the role of a servo motor in a CNC machine. | | CO2 | A | 3 |
| 13. | Compare encoder and resolver. | | CO4 | U | 3 |
| 14. | Define tool compensation, and explain why it is necessary in CNC programming? | | CO5 | An | 3 |
| 15. | Describe the purpose of canned cycles in CNC programming. | | CO5 | U | 3 |
| 16. | List the cost of operation factors influencing the manufacturing setting. | | 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 construction of CNC machines with conventional machines? | CO1 | A | 5 |
|  | b. | Analyze the role and effectiveness of CNC machines in enhancing efficiency and quality in batch production. | CO1 | An | 7 |
|  |  |  |  |  |  |
| 18. |  | Explain the architecture of CNC and discuss its major components, | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Analyze the functions of feed and spindle mechanisms in CNC machines and their role in the machining process. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the elements of Programmable logic control and why it is preferred for real time applications. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the role of feedback and control systems in CNC machines, and evaluate how they help maintain accuracy and prevent defects in manufacturing processes. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Develop the CNC program for the below shaft. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Construct the CNC program for the profile shown in figure. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the factors influencing the selection of CNC machines in industries. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **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 a component. |
| **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 5 | 7 |  |  | 17 |
| **CO2** |  | 16 | 12 | 12 |  |  | 40 |
| **CO3** | 1 |  |  |  |  |  | 1 |
| **CO4** | 2 | 3 |  | 12 |  |  | 17 |
| **CO5** |  | 6 | 24 | 3 |  |  | 33 |
| **CO6** |  | 4 |  | 12 |  |  | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **19RO2002** | **Duration** | **3hrs** |
| **Course Title** | **AUTONOMOUS VEHICLES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Specify the types of chassis frames in a car. | | CO1 | U | 1 |
| 2. | List the components of ECU. | | CO2 | R | 1 |
| 3. | Write the types of drive system in AV. | | CO2 | R | 1 |
| 4. | Specify the types of Night Vision Technology. | | CO3 | U | 1 |
| 5. | List the Components of Machine Vision System. | | CO2 | U | 1 |
| 6. | Define a Passive Sonar System. | | CO3 | R | 1 |
| 7. | List the application of LIDAR. | | CO5 | U | 1 |
| 8. | Define DSRC. | | CO2 | U | 1 |
| 9. | Mention the challenges in Inter Vehicle Communications. | | CO4 | A | 1 |
| 10. | Specify the Legal Issues in AV. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the Entertainment services available in Car. | | CO1 | R | 3 |
| 12. | List the challenges in Autonomous Vehicle. | | CO2 | R | 3 |
| 13. | Specify the factors considered to choose between complementary and competitive fusion techniques for a specific data fusion application. | | CO3 | R | 3 |
| 14. | List the different communication technologies in AV. | | CO4 | R | 3 |
| 15. | Specify the vulnerabilities in IVC. | | CO5 | U | 3 |
| 16. | Write the primary purpose of OBD in Vehicles. | | 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. |  | Describe the key features of Advanced Driver Assistance Systems (ADAS) and evaluate their role in enhancing vehicle safety and driver convenience. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the working principle of an Electronic Control Unit (ECU), evaluating its role in controlling vehicle systems. | CO2 | U | 6 |
|  | b. | Explain the various types of car chassis, using a detailed diagram to illustrate their structures, and analyze the advantages of each type for specific applications. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Describe the working of Adaptive Cruise Control using LIDAR, and analyze how it enhances vehicle safety and driving efficiency. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain how a night vision system works in an autonomous vehicle and its role in enhancing safety. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze how the different components of a Multi-sensor Data Fusion system work together to achieve data integration. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the significant features in connected car technology using DSRC, and evaluate their potential impact on vehicle communication and safety. | CO6 | U | 6 |
|  | b. | Explain the Intelligent Connected Vehicle with its IEEE standards for vehicular communications. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain the role of the ROS framework in autonomous vehicles, and evaluate its contribution to system integration and functionality. | CO4 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the risks associated with third-party software updates as potential attack gateways in autonomous vehicle platforms, and assess the impact on system integrity. | CO6 | An | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the evolution of Automotive Electronics and the operation of ECUs. |
| **CO2** | Compare the different type of sensing mechanisms involved in Autonomous Vehicles. |
| **CO3** | Discuss about the use of computer vision and learning algorithms in vehicles. |
| **CO4** | Summarize the aspects of connectivity fundamentals existing in a driverless car. |
| **CO5** | Identify the different levels of automation involved in an Autonomous Vehicle. |
| **CO6** | Outline the various controllers employed in vehicle actuation. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 3 | 13 | - | - | - | - | 16 |
| **CO2** | 5 | 14 | - | - | - | - | 19 |
| **CO3** | 16 | 1 | - | - | - | - | 17 |
| **CO4** | 15 | - | 13 | - | - | - | 28 |
| **CO5** | - | 4 | - | 12 | - | - | 16 |
| **CO6** | - | 15 | - | 13 | - | - | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2005** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Illustrate that the word Robot comes from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | CO1 | U | 1 |
| 2. | Write down the establishment year of the first mobile robot. | | CO1 | A | 1 |
| 3. | List any one type of robot interface method. | | CO2 | R | 1 |
| 4. | Mention the average size of the paint droplet. | | CO3 | U | 1 |
| 5. | Write the temperature range of the welding. | | CO3 | A | 1 |
| 6. | What is the use of the Dyson DC06 Robot? | | CO4 | U | 1 |
| 7. | List the disadvantages of vacuum Grippers. | | CO4 | R | 1 |
| 8. | List the prominent uses of industrial robots. | | CO5 | R | 1 |
| 9. | Illustrate the types of barcodes. | | CO6 | U | 1 |
| 10. | Write the stacking load height of the unit load ASRS. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate an in-line robot work cell. | | CO1 | A | 3 |
| 12. | List the different types of optical aids used in visual inspection. | | CO2 | R | 3 |
| 13. | State the importance of micro class remotely operated underwater vehicles (ROV). | | CO3 | R | 3 |
| 14. | Define degrees of freedom and mention its importance. | | CO4 | R | 3 |
| 15. | Write short notes on robot controller features. | | CO5 | U | 3 |
| 16. | Discuss industrial monorails. | | 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. |  | Discuss in detail the various types of industrial robots. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe robotic vision systems and the process involved in various applications. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the features and procedures of robotic cleaning. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate a detailed discussion on active and passive grippers. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the various influencing factors for selecting a robot. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the working procedure of the robotic machine loading and unloading process. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the characteristics of various underwater applications of robots. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain automated guided vehicle systems. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 25 | 4 | - | - | - | 29 |
| **CO2** | 4 | 12 | - | - | - | - | 16 |
| **CO3** | 3 | 13 | 1 | 12 | - | - | 29 |
| **CO4** | 4 | 13 | - | - | - | - | 17 |
| **CO5** | 1 | 12 | 3 | - | - | - | 16 |
| **CO6** | - | 16 | 1 | - | - | - | 17 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **19RO2007** | **Duration** | **3hrs** |
| **Course Title** | **COGNITIVE ROBOTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the three cognitive levels in robotics. | | CO1 | U | 1 |
| 2. | Define cognition. | | CO1 | R | 1 |
| 3. | Identify a software used for simulating robot. | | CO2 | R | 1 |
| 4. | Define Roadmap. | | CO2 | R | 1 |
| 5. | State one limitations of voronai diagram in road map. | | CO3 | U | 1 |
| 6. | List two applications of Simultaneous Localization and Mapping (SLAM). | | CO3 | R | 1 |
| 7. | List the types of data structures in road map. | | CO4 | U | 1 |
| 8. | State the significance of using landmarks in SLAM. | | CO4 | R | 1 |
| 9. | Identify the role of Sound Navigation and Ranging (SONAR) in robotics | | CO5 | U | 1 |
| 10. | List one application for autonomous navigation robot. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate supervised and unsupervised learning. | | CO1 | An | 3 |
| 12. | Discuss the feature based model in cognition. | | CO2 | U | 3 |
| 13. | Compare the repulsion forces exerted by boundaries and obstacles in feature mapping. | | CO3 | An | 3 |
| 14. | List the disadvantages of graph-based optimization techniques. | | CO4 | U | 3 |
| 15. | Describe the significance of wandering within the workspace in cognitive robotics. | | CO5 | An | 3 |
| 16. | State the factors that influence imaging geometry in robot vision systems. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify the cycles of cognition based on its functionality. | CO1 | A | 6 |
|  | b. | Compare supervised learning with reinforcement learning highlighting its applications. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the process of constructing a 2D world map for robotic applications with flow diagram. | CO2 | An | 6 |
|  | b. | Illustrate with an example, the transverse boundary procedures for moving a robot around an obstacle. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the process of constructing a voronoi diagram and its usage in robot path planning. | CO3 | U | 6 |
| b. | Consider a mobile robot with a range sensor rotating in an anticlockwise direction. Obstacles are shown in grey color in the figure. Based on the robot's visibility, construct the active list, edges (E), and vertices (v) that define the environment of the robot. | CO3 | A | 6 |
| 20. | a. | Explain the use of the extended kalman filter in Simultaneous Localization and Mapping (SLAM) highlighting its limitations. | CO4 | U | 6 |
|  | b. | Illustrate with example, the three taxonomies used in the SLAM navigation. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Compare tele-operation with autonomous navigation in cognitive robotics. | CO5 | An | 6 |
|  | b. | Develop an algorithm for BotSpeak robot to control movements and actions in dynamic environment. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain the server-client communication in an autonomous robot with a flow diagram. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Develop a path optimization algorithm using a quadtree approach for the 2D world map shown in figure. The obstacles are denoted by shaded regions. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the challenges in achieving 3D reconstruction of image in vision system, highlighting its importance in dynamic environment. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Discuss about the basics of robot cognition and perception |
| CO2 | Illustrate the different methods of map building and the robot simulation and execution of a program |
| CO3 | Analyze the various path planning techniques by briefing about the robot’s environment and explaining about the programs used |
| CO4 | Develop knowledge about simultaneous localization and mapping based techniques and paradigms. |
| CO5 | Elaborate the various robot programming packages for display, tele-operation and other applications. |
| CO6 | Describe the aspects of Imaging Techniques used in Robotic 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 | 9 | - | - | 17 |
| CO2 | 2 | 3 | 6 | 6 | - | - | 17 |
| CO3 | 1 | 7 | 18 | 3 | - | - | 29 |
| CO4 | 1 | 10 | 6 | - | - | - | 17 |
| CO5 | - | 13 | 12 | 3 | - | - | 28 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2009** | **Duration** | **3hrs** |
| **Course Title** | **MEDICAL ROBOTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Motion replication. | | CO1 | U | 1 |
| 2. | List two famous medical robots. | | CO1 | R | 1 |
| 3. | Indicate any two functions of GPS in surgical robots. | | CO2 | R | 1 |
| 4. | Identify a sensor that tracks the position of robotic arms in real-time during surgery. | | CO2 | R | 1 |
| 5. | List two methods for localization in neurosurgery. | | CO3 | U | 1 |
| 6. | Specify any two features of gamma knife system in radiosurgery. | | CO3 | R | 1 |
| 7. | Define OCT. | | CO4 | U | 1 |
| 8. | Identify the signal that measures the electrical activity of human muscle. | | CO4 | R | 1 |
| 9. | Give two examples of self balancing wheelchair robot. | | CO5 | U | 1 |
| 10. | Name one paediatric exoskeleton. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between robotic surgery and traditional surgery. | | CO1 | An | 3 |
| 12. | Explain Calypso-Varian system, its features and applications in medical treatments. | | CO2 | U | 3 |
| 13. | Describe the features of metal frame constructed by Scientist Lars Leksell. | | CO3 | U | 3 |
| 14. | Explain the working of the tendon-drive hand system which is the basic rehabilitation device | | CO4 | U | 3 |
| 15. | State the importance of the treatment that heals bone or muscle injury effectively. | | CO5 | U | 3 |
| 16. | Differentiate between a cardiac surgeon and a cardiothoracic surgeon. | | 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. | Illustrate the advantages of using medical robots in surgical procedures. | CO1 | U | 6 |
|  | b. | Categorize medical robots based on the generations of its evolution. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Analyze the key features of rehabilitation robots and discuss their impact on patient recovery. | CO2 | An | 6 |
|  | b. | Explain the functioning of two different position sensors which are used in robotics surgery. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Analyze the functioning of the cardiac system with relevant diagrams and critically discuss the steps involved in performing cardiac surgery. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Assess the role of rehabilitation robots in improving the physical and emotional well-being of the elderly, and evaluate their impact on enhancing independence and quality of life. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the operation of rehabilitation robots for limb recovery with suitable diagrams. | CO4 | U | 6 |
|  | b. | Illustrate the procedure involved in orthopedic surgery, highlighting key steps and discussing the rationale behind each stage. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Describe the construction and functioning of deep brain stimulation, highlighting the underlying mechanisms, components involved, and its therapeutic applications. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Summarize the steps involved in radiosurgery and explain the types of radiosurgeries in detail. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the concept of tele robotics, its key components, working principle, and applications. | CO6 | A | 6 |
|  | b. | Describe the analysis of the medical surgical gestures that are used in the medical surgery. | CO6 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the types of medical robots and the concepts of navigation and motion replication |
| **CO2** | Discuss about the sensors used for localization and tracking |
| **CO3** | Summarize the applications of surgical robotics |
| **CO4** | Outline the concepts in Rehabilitation of limbs and brain machine interface |
| **CO5** | Classify the types of assistive robots |
| **CO6** | Analyze the design characteristics, methodology and technological choices for medical robots |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 10 | - | 3 | - | - | 20 |
| **CO2** | 8 | 3 | - | 6 | - | - | 17 |
| **CO3** | 1 | 4 | - | 12 | - | - | 17 |
| **CO4** | 1 | 22 | 6 | 12 | - | - | 41 |
| **CO5** | - | 16 | - | - | - | - | 16 |
| **CO6** | - | 7 | 3 | 3 | - | - | 13 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the Bayes’ theorem. | | CO1 | R | 1 |
| 2. | Identify the v’s given in a Big Data. | | CO1 | R | 1 |
| 3. | **Compare** the performance of KNN classifier with K-mean clustering technique**.** | | CO2 | U | 1 |
| 4. | Define entropy measure in a decision tree technique. | | CO2 | R | 1 |
| 5. | Define posterior probability in Naïve Bayesian Classifier. | | CO3 | U | 1 |
| 6. | Name the performance metrices used in regression models. | | CO3 | R | 1 |
| 7. | Indicate the steps involved in PCA. | | CO4 | R | 1 |
| 8. | List two clustering techniques used in machine learning. | | CO4 | R | 1 |
| 9. | Define the function of an axon in a biological neuron. | | CO5 | U | 1 |
| 10. | List two types of activation functions used in neural networks. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between the machine learning and traditional programming. | | CO1 | R | 3 |
| 12. | Describe the effects of different distance metrics (e.g., Euclidean, Manhattan) on the KNN classifier's performance. How might these metrics impact the classification results? | | CO2 | U | 3 |
| 13. | **Explain** the role of the kernel function in SVM. | | CO3 | U | 3 |
| 14. | Differentiate divisive and agglomerative clustering in terms of their approaches to grouping data | | CO4 | An | 3 |
| 15. | Compare and contrast biological neural networks and artificial neural network. | | CO5 | U | 3 |
| 16. | Interpret the following problems with respect to Tasks, Performance, and Experience: i) A Checkers learning problem ii) A Robot driving learning problem. | | 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. | Examine the various types of learning within the realm of machine learning. Provide definitions and concise descriptions for the following learning categories: supervised learning, unsupervised learning, and reinforcement learning. | CO1 | A | 6 |
|  | b. | Calculate the Accuracy, Specificity, Sensitivity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and F1 Score for the data given in the confusion matrix. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | The multivariate Iris flower data collection contains the morphological differences of Iris flowers from three closely related species, including Setoso, Virginica and Verscicolor. Each sample is used to collect two characteristics: sepal length and sepal width. Categorize three species using the KNN Classifier algorithm.   |  |  |  | | --- | --- | --- | | Sepal Length | Sepal Width | Species | | 5.3 | 3.7 | Setosa | | 5.1 | 3.8 | Setosa | | 7.2 | 3.0 | Virginica | | 5.4 | 3.4 | Setosa | | 5.1 | 3.3 | Setosa | | 5.4 | 3.9 | Setosa | | 7.4 | 2.8 | Virginica | | 6.1 | 2.8 | Versicolor | | 7.3 | 2.9 | Virginica | | 6.0 | 2.7 | Versicolor | | 5.8 | 2.8 | Virginica | | 6.3 | 2.3 | Versicolor | | 5.1 | 2.5 | Versicolor | | 6.3 | 2.5 | Versicolor | | 5.5 | 2.4 | Versicolor |   **Sepal length= 5.2, Sepal width=3.4 and Species=?.** | CO2 | An | 6 |
|  | b. | Explain logistic regression for binary classification by deriving the gradient of the log-likelihood function. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the support vector machine with an example for a binary classification problem. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | **Apply the K-means clustering algorithm using Euclidean distance to categorize the following 8 data points 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).**  **Given the initial cluster centers as A1, A4 and A7, execute the K-means clustering algorithm for 2 epochs. At the conclusion of these epochs, provide the following:**  a) Determine the new clusters, detailing the specific data points assigned to each cluster after the first and second epochs.  b)Calculate the new centers of each cluster after both epochs, and evaluate how well these centers represent the assigned data points. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain in detail the Hebbian Learning Rule and the Perceptron Learning Rule used in Artificial Neural Networks (ANNs). Include appropriate mathematical equations and an example to illustrate your answer. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Given a dataset for a decision tree model whether tennis can be played based on the features such as **Outlook** {Sunny,Overcast,Rain}, **Temperature** {Hot,Mild,Cool}, **Humidity** {High,Normal, and **Wind** {Weak,Strong}: Analyze the information gain calculations for each feature (Outlook, Temperature, Humidity, and Wind) and determine how the data is split based on each attribute’s values.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Day | Outlook | Temperature | Humidity | Wind | Play Tennis | | 1 | Sunny | Hot | High | Weak | No | | 2 | Sunny | Hot | High | Strong | No | | 3 | Overcast | Hot | High | Weak | Yes | | 4 | Rain | Mild | High | Weak | Yes | | 5 | Rain | Cool | Normal | Weak | Yes | | 6 | Rain | Cool | Normal | Strong | No | | 7 | Overcast | Cool | Normal | Strong | Yes | | 8 | Sunny | Mild | High | Weak | No | | 9 | Sunny | Cool | Normal | Weak | Yes | | 10 | Rain | Mild | Normal | Weak | Yes | | 11 | Sunny | Mild | Normal | Strong | Yes | | 12 | Overcast | Mild | High | Strong | Yes | | 13 | Overcast | Hot | Normal | Weak | Yes | | 14 | Rain | Mild | High | Strong | No | | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Given a dataset of stolen vehicles with features such as color (e.g., Red, Yellow), type (e.g., Sports, SUV), and origin (e.g., Domestic, Foreign), apply the Naïve Bayesian classifier to classify a new vehicle with the following attributes: **Color: Red**, **Type: SUV**, **Origin: Domestic**.  **Apply** the Naïve Bayesian classification method to determine the likelihood of the new data being classified as a stolen vehicle based on the provided attributes.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | S. No | Color | Type | | Origin | Stolen | | 1 | Red | Sports | Domestic | | Yes | | 2 | Red | Sports | Domestic | | No | | 3 | Red | Sports | Domestic | | Yes | | 4 | Yellow | Sports | Domestic | | No | | 5 | Yellow | Sports | Foreign | | Yes | | 6 | Yellow | SUV | Foreign | | No | | 7 | Yellow | SUV | Foreign | | Yes | | 8 | Yellow | SUV | Domestic | | No | | 9 | Red | SUV | Foreign | | No | | 10 | Red | Sports | Foreign | | Yes | | CO3 | A | 6 |
|  | b. | Given a dataset containing the following features: **Years of Experience** (in years) and **Salary** (in thousands).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Years of Experience | 1.1 | 1.3 | 1.5 | 2 | 2.2 | | Salary | 39343 | 46205 | 37731 | 43525 | 39891 |   **Apply** the linear regression model to the dataset to predict the salary based on years of experience and estimate the coefficients using least squares. | CO3 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | **Explain the neural network model to train the mobile robot to perform** obstacle avoidance and navigation tasks. | CO6 | A | 12 |

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

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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** | Compare the learning methodologies and dimensionality concepts |
| **CO6** | Summarize the applications of neural networks in robotic applications. |

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

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2014** | **Duration** | **3hrs** |
| **Course Name** | **ROBOTICS AND AUTOMATION IN FOOD INDUSTRY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the primary objective of automation in the food industry. | | CO1 | U | 1 |
| 2. | What does the term "process control system" refer to? | | CO1 | R | 1 |
| 3. | List any two special considerations when selecting sensors for food processing applications. | | CO2 | R | 1 |
| 4. | What is its role of SCADA in the food industry? | | CO2 | R | 1 |
| 5. | What is a suction gripper, and how does it function in food processing? | | CO3 | U | 1 |
| 6. | Define "pinching grippers" and provide one example of their application in food handling. | | CO3 | R | 1 |
| 7. | What is a wireless sensor network (WSN), and why is it important in agriculture? | | CO4 | U | 1 |
| 8. | List any two applications of wireless sensor networks in food production. | | CO4 | R | 1 |
| 9. | Define a batch-fed reactor. | | CO5 | U | 1 |
| 10. | Name two methods used for chilling food products. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Identify three key specifications that should be considered when designing a robot for the food sector. | | CO1 | U | 3 |
| 12. | Discuss the significance of device integration in automated food processing systems. | | CO2 | U | 3 |
| 13. | Compare and contrast penetrating grippers and suction grippers in terms of their application in the food industry. | | CO3 | An | 3 |
| 14. | Discuss two benefits of implementing intelligent control systems in food production using fuzzy logic. | | CO4 | U | 3 |
| 15. | Describe the main stages of a bio-conversion process. | | CO5 | U | 3 |
| 16. | Discuss two challenges faced by the poultry industry in terms of processing and safety. | | 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. |  | Evaluate the impact of robotics on the efficiency and quality of food production processes with suitable examples. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Examine the future trends in sensor technology and machine vision for the food industry. | CO2 | E | 6 |
|  | b. | Explain how SCADA systems interact with sensors and measurement methods using ladder logic circuits. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Analyze the different types of grippers used in the food industry, including pinching, enclosing, and surface effect grippers. Discuss their specific applications and advantages. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the role of wireless sensor networks in optimizing resource management in agriculture. Include specific examples of how these networks can improve crop yield and sustainability. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze a case study of bio-conversion in a batch-fed reactor, focusing on the process parameters and their impact on product yield and quality. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Discuss the processing techniques specific to the confectionery industry, including ingredients and equipment used. How do these techniques impact product quality? | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the different methods of food chilling used across the meat, poultry, and seafood industries. Discuss how these methods affect product shelf life and safety. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design a PID controller for a fed-batch process. Include an explanation of how tuning parameters can affect system performance. | CO5 | C | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Specify the characteristics of robots used in food industry |
| **CO2** | Identify the applications of sensors in food industry. |
| **CO3** | Describe about the different types of gripper mechanisms |
| **CO4** | Describe the use of sensor networks and quality control in food sector |
| **CO5** | Discuss about the advanced methods for control of food process. |
| **CO6** | Summarize the applications of automation and robotics in food industry |

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

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **19RO2015** | **Duration** | **3hrs** |
| **Course Title** | **NEURAL NETWORKS AND FUZZY SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the two types of synapses present in a biological neuron. | | CO1 | R | 1 |
| 2. | Name any two types of activation functions used in ANN. | | CO1 | R | 1 |
| 3. | What is the significance behind the concept of neural control? | | CO2 | U | 1 |
| 4. | Indicate the type of memory that retrieves a piece of data from only a tiny sample of itself. | | CO2 | U | 1 |
| 5. | List any one application of deep learning algorithm. | | CO3 | R | 1 |
| 6. | Define deep learning. | | CO3 | R | 1 |
| 7. | State De-Morgan’s law. | | CO4 | R | 1 |
| 8. | Define Fuzzification. | | CO4 | R | 1 |
| 9. | Name the theory proposed by Charles Darwin. | | CO5 | R | 1 |
| 10. | List two applications of a neural network control system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the anatomy of a neuron and label its key components. Also, provide a process flow diagram explaining its function. | | CO1 | A | 3 |
| 12. | Analyze the structure and function of the direct neural control topology with a block diagram. | | CO2 | An | 3 |
| 13. | Explain any one application of deep architecture in the field of computer vision. | | CO3 | A | 3 |
| 14. | Identify the properties that have to be satisfied in equivalence relation. | | CO4 | U | 3 |
| 15. | 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 |
| 16. | Sketch the block diagram of a fuzzy logic system to control an air-conditioner and give a brief explanation. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the workflow and algorithm of an ADALINE (Adaptive Linear Neuron) and MADALINE (Multiple Adaptive Linear Neuron) neural network with a neat diagram. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Using Hebb Rule, find weights required to perform the following classifications of given input patterns ‘+’ symbols, which represent the value 1 and empty squares, which indicate -1. Consider **‘P’** belongs to the members of class (target value 1) and **‘Q’** does not belong to the members of class (target value = -1).    **‘P’ ‘Q’** | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the architecture of the convolution neural network with a neat diagram. | CO3 | An | 8 |
|  | b. | Sketch the architecture of *AlexNNet* with a neat diagram. | CO3 | An | 4 |
|  |  |  |  |  |  |
| 20. |  | In the given two fuzzy sets,  Find the following:   1. b) c) d) e)   f) g)  k) l) | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Compute the defuzzified value of the trapezoidal functions given in the figure below using center of sums defuzzification method. | CO5 | A | 8 |
|  | b. | In the 2 fuzzy sets A and B defined on the universe of discourse X, determine (AUB)0.6 using Zadin’s notation   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | X1 | X2 | X3 | X4 | X5 | | A | 0.7 | 0.5 | 0.4 | 0.1 | 0.9 | | B | 0.4 | 0.9 | 0.6 | 0.3 | 0.1 | | CO5 | A | 4 |
|  |  |  |  |  |  |
| 22. | a. | Given two fuzzy sets,  compute the following: a) Algebraic sum b) Algebraic product  c) Bounded sum d) Bounded difference | CO5 | A | 8 |
|  | b. | Given: X = {1, 3, 5}; Y = {1, 3, 5};  R = {(x, y)|y = x + 2}; S = {(x, y)|x < y}.  Here, R and S is on X × Y. Find R and S. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | In the following set of input training vectors of AND 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 | An | 12 |
|  | | | | | |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Develop a neuro-controller that learns to counteract a disturbance occurring in a non-linear system such an inverted pendulum using an adaptive neural network. | CO6 | A | 12 |

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

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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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | - | 15 | - | - | - | 17 |
| **CO2** | - | 2 | - | 27 | - | - | 29 |
| **CO3** | 2 | - | 3 | 12 | - | - | 17 |
| **CO4** | 2 | 3 | 4 | 12 | - | - | 21 |
| **CO5** | 1 | - | 24 | 3 | - | - | 24 |
| **CO6** | 1 | - | 15 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2016** | **Duration** | **3hrs** |
| **Course Title** | **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 addressing mode used in the instruction  MOVX A, @R1 | | | CO1 | R | | 1 | |
| 2. | State the internal ROM capacity of 8051microcontroller | | | CO1 | R | | 1 | |
| 3. | Give an example for an 8051instruction that uses immediate addressing mode. | | | CO2 | U | | 1 | |
| 4. | Name a register that holds the address of the next instruction to be fetched by the microcontroller | | | CO2 | R | | 1 | |
| 5. | Calculate the step size for a 10 bit ADC with a voltage reference of +5V. | | | CO3 | U | | 1 | |
| 6. | State the functions of Zigbee protocol. | | | CO3 | R | | 1 | |
| 7. | Specify three pipelining hazards in ARM 9 processor | | | CO4 | U | | 1 | |
| 8. | Identify the instruction that is used to transfer the content of the R1 register to the R0 register in the ARM9 processor. | | | CO4 | R | | 1 | |
| 9. | Name the type of mode used for exception handling in the ARM Cortex M4. | | | CO5 | R | | 1 | |
| 10. | List two examples of digital sensors. | | | CO6 | U | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Determine the content of address 3000h after the execution of the following code  MOV A, #3C RRC MOV DPTR, #3000 MOVX @DPTR, A | | | CO1 | A | | 3 | |
| 12. | Classify the instruction sets of 8051 microcontroller based on their functions/ | | | CO2 | U | | 3 | |
| 13. | Compare asynchronous and synchronous mode of communication | | | CO3 | An | | 3 | |
| 14. | Indicate the function of Nested Vectored Interrupt Controller. | | | CO4 | U | | 3 | |
| 15. | Specify the significance of thread mode in ARM cortex M4 processor | | | CO5 | An | | 3 | |
| 16. | Summarize the function of the ULN2003A driver in interfacing a stepper motor with a microcontroller. | | | 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. | Design an interfacing system which connects 8KB of RAM and 8KB of EPROM with 8051 microcontroller. | CO1 | | | An | | 6 |
|  | b. | Highlight the significant features of an embedded system that makes it suitable for real time applications. | CO1 | | | U | | 6 |
|  |  |  |  | | |  | |  |
| 18. | a. | Develop an assembly language program to find the smallest number in an array of 10 numbers | CO2 | | | A | | 6 |
|  | b. | Illustrate the instruction formats in the 8051 microcontroller with examples. | CO2 | | | A | | 6 |
|  |  |  |  | | |  | |  |
| 19. | a. | Compare SPI and I2C communication protocols in terms of data transfer and hardware requirements. | CO3 | | | An | | 6 |
|  | b. | Develop an interfacing circuit to connect the 8051 microcontroller with a Bluetooth module. | CO3 | | | A | | 6 |
|  |  |  |  | | |  | |  |
| 20. | a. | Classify the instruction set of ARM 9 processor based on their applications with examples. | CO4 | | | A | | 6 |
|  | b. | Analyze the role of the ARM 9 functional blocks in optimizing system-level performance. | CO4 | | | An | | 6 |
|  |  |  |  | | |  | |  |
| 21. | a. | Develop an embedded C program to perform addition of two 32 bit numbers in ARM 9. | CO5 | | | A | | 6 |
|  | b. | Describe how the memory map in ARM 9 processor affects the speed of data access depending on the memory region. | CO5 | | | U | | 6 |
|  |  |  |  | | |  | |  |
| 22. | a. | Summarize the role of the stack during mode switching in ARM 9 processor | CO4 | | | U | | 6 |
|  | b. | Indicate the addressing modes for the following instructions in 8051.  MOV DPTR, #4300  MOV A, R5  MOV @R1, 80H  MOVC A,@DPTR  SWAP A  MOV R2, 45H | CO2 | | | U | | 6 |
|  |  |  |  | | |  | |  |
| 23. | a. | Draw the architecture of 8051 microcontroller highlighting the functions of each component. | CO1 | | | U | | 6 |
|  | b. | Calculate the time taken for the overflow flag to set when the timer operates in mode1 given the clock frequency of 8051 is 6MHz. | CO3 | | | A | | 6 |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | a. | Develop a circuit diagram showing the connection between the 8051 microcontroller and 16x2 LCD to display the message 'HELLO'. | CO6 | | | A | | 6 |
|  | b. | Illustrate with relevant diagrams, the process of controlling the speed of a DC motor by interfacing with 8051 microcontroller. | CO6 | | | A | | 6 |

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

|  |  |
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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 | 3 | 6 | - | - | 23 |
| CO2 | 1 | 10 | 12 | - | - | - | 23 |
| CO3 | 1 | 1 | 12 | 9 | - | - | 23 |
| CO4 | 1 | 10 | 6 | 6 | - | - | 23 |
| CO5 | - | 7 | 6 | 3 | - | - | 16 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO1004** | **Duration** | **3hrs** |
| **Course Title** | **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. | Mention the zeroth law of robotics formulated by Isaac Asimov. | | CO1 | R | 1 |
| 2. | Write the main characteristic of a robotic workspace. | | CO1 | U | 1 |
| 3. | Define an actuator. | | CO2 | R | 1 |
| 4. | List any two types of proximity sensors. | | CO2 | R | 1 |
| 5. | Define an intelligent robot. | | CO3 | R | 1 |
| 6. | Outline the advantage of teach pendant method. | | CO3 | R | 1 |
| 7. | Identify the tasks performed by robotic assembly system. | | CO4 | U | 1 |
| 8. | Give an example of soft robot. | | CO4 | R | 1 |
| 9. | Express the significant challenges faced by industry 4.0. | | CO5 | U | 1 |
| 10. | Describe building automation system. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Identify which type of robots can ease the life of humans. | | CO1 | U | 3 |
| 12. | Mention how sensors are being utilized in robots. | | CO2 | U | 3 |
| 13. | Summarize the advantages of LEAD through method. | | CO3 | U | 3 |
| 14. | Give examples of medical robots. | | CO4 | U | 3 |
| 15. | Write a short note on the several issues faced in automation in the robotics field. | | CO5 | A | 3 |
| 16. | Explain how air filters are monitored in a building automation system with a neat sketch. | | 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. | List the origin of robotics through the most important moments to the present day. | CO1 | R | 6 |
|  | b. | Illustrate the different types of robot configurations with a neat diagram. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare hydraulic and electric actuators. | CO2 | An | 5 |
|  | b. | Describe an end effector. Classify their common types and examine how the design/choice of end effectors affects the overall performance of the robot. | CO2 | A | 7 |
|  |  |  |  |  |  |
| 19. | a. | Explain the fundamentals of the powerful open-source framework, robotic operating system for building robotic applications. | CO3 | A | 6 |
|  | b. | Consider the forward transformation of the three-joint manipulator. Given that the length of joint 1, L1 = 12 in., the length of joint 2, L2 = 10 in., the length of joint 3, L3 = 8 in., the angle Ɵ1 = 30°, the angle Ɵ2 = 45° and the angle Ɵ3 = 45°. Compute the coordinate position (x and y coordinates) for the end-of-the-arm P. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Robot process automation can offer several benefits to organizations. Justify. | CO4 | E | 4 |
|  | b. | Analyze the significant economic and social implications of the increasing use of robots in various industries. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 21. | a. | Categorize the several common types of automation in the field of robotics. | CO5 | An | 7 |
|  | b. | Demonstrate how PLCS are a critical component of many robotic systems by summarizing their advantages. | CO5 | A | 5 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the different stages involved in an industrial automation process with a neat block diagram along with the hierarchical three level representation triangle of a typical industrial automation application. | CO6 | A | 8 |
|  | b. | Explain with examples how smart city technologies create a sustainable and comfortable urban environment. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Deduce the goals of automation in the robotics field to assess the effectiveness of an automated process and identify the areas for improvement. | CO5 | An | 5 |
|  | b. | Explain the key elements associated with industry 4.0 to revolutionize and improve the efficiency in manufacturing process industries. | CO5 | An | 7 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the steps followed in a home automation system with a neat block diagram. | CO6 | A | 4 |
|  | b. | Design a home automation process that incorporates an effective and reliable automated security system at home. | CO6 | C | 8 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the evolution of robots and their classification. |
| CO2 | Analyse the applications of sensors and actuators in robotics. |
| CO3 | Describe the kinematics and dynamic behaviour 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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 7 | 4 | 6 | - | - | - | 17 |
| CO2 | 2 | 3 | 7 | 5 | - | - | 17 |
| CO3 | 2 | 3 | 12 | - | - | - | 17 |
| CO4 | 1 | 4 | - | 8 | 4 | - | 17 |
| CO5 | - | 1 | 8 | 19 | - | - | 28 |
| CO6 | - | 1 | 19 | - | - | 8 | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the term Young’s modulus. | | CO1 | R | 1 |
| 2. | Discuss about Hooke’s law. | | CO2 | U | 1 |
| 3. | Indicate the relation between young’s modulus; modulus of rigidity and Poisson’s ratio. | | CO3 | U | 1 |
| 4. | Describe the term ‘bulk modulus’. | | CO3 | U | 1 |
| 5. | What is fixed beam? | | CO4 | R | 1 |
| 6. | Discuss the term ‘point of contraflexure’. | | CO4 | U | 1 |
| 7. | State the bending equation. | | CO5 | R | 1 |
| 8. | Define the term section modulus. | | CO5 | R | 1 |
| 9. | Name the types of springs. | | CO5 | R | 1 |
| 10. | Illustrate the term ‘principal plane’. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | A hollow cylinder 2 m long has an outside diameter of 50 mm and inside diameter of 30 mm. If the cylinder is carrying a load of 25 kN, compute the stress in the cylinder. The value of modulus of elasticity for the cylinder material is 100 × 103 N/mm2. | | CO2 | A | 3 |
| 12. | If the values of modulus of elasticity and Poisson’s ratio for an alloy material is 150 x 103 N/mm2 and 0.25 respectively, calculate the value of Bulk modulus for the alloy. | | CO3 | A | 3 |
| 13. | Sketch the shear force and bending moment diagram of a cantilever beam of length ‘l’, carrying a point load P at the free end. | | CO4 | A | 3 |
| 14. | Write the expression for section modulus of a hollow rectangular section. | | CO5 | A | 3 |
| 15. | List the assumptions made in theory of pure torsion. | | CO5 | U | 3 |
| 16. | Summarize on Mohr’s circle of stresses. | | 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 rod is 2 m long at a temperature of 10 ºC. Determine the expansion of the rod when the temperature is raised to 80 ºC. If this expansion is prevented, find the stress induced in the material of the rod. Take E = 1.0 x 105 MN/m2 and α = 0.000012 per ºC. | CO1 | A | 4 |
|  | b. | A steel rod of cross-sectional area 800 mm2 and two brass rods each of cross-sectional area 500 mm2 together support a load of 25 kN as shown in the figure.  Calculate the stresses in the rods. Take Young’s Modulus (E) for steel as 2x105 N/mm2 and for brass as 1x105 N/mm2. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 18. |  | A steel rod 5 m long and 30 mm in diameter is subjected to an axial tensile load of 50 kN. Compute the change in length; diameter and volume of the rod. Take E= 2 x 105 N/mm2 and Poisson’s ratio = 0.25. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A simply supported beam 5 m long is loaded with a uniformly distributed load of 10 kN/m over a length of 2 m as shown in figure. Illustrate and sketch the shear force and bending moment diagrams for the beam indicating the value of maximum bending moment. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | A simply supported beam carries a uniformly distributed load of 40 kN/m run over the entire span. The section of the beam is rectangular having a depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm2 and moment of inertia of the section is 7 x 108 mm4, evaluate the span of the beam. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | A steel shaft transmits 105 kW at 160 rpm. If the shaft is 100 mm in diameter, calculate the torque in the shaft and the maximum shear stress induced. Estimate also the twist of the shaft in a length of 6 m. Take C = 8 x 104 N/mm2. | CO5 | An | 6 |
|  |  | A closely coiled helical spring of round steel wire 10 mm in diameter having 10 complete turns with a mean diameter of 120 mm, is subjected to an axial load of 200 N. Determine: (i) the deflection of the spring; (ii) maximum shear stress in the wire; (iii) stiffness of the spring. Take C = 8 x 104 N/mm2. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | 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, if any. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | A steel bar ABCD 4 m long is subjected to forces as shown in figure. Estimate the elongation of the bar. Take E for the steel as 200 GPa. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm2 and 60 N/mm2. Calculate the normal, tangential and resultant stresses on a plane inclined at 30º to the axis of the minor stress. (Solve using either Analytical method or Graphical method) | 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 Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | - | 4 | - | - | - | 5 |
| CO2 | - | 1 | 3 | 20 | - | - | 24 |
| CO3 | - | 2 | 15 | - | - | - | 17 |
| CO4 | 1 | 1 | 3 | 24 | - | - | 29 |
| CO5 | 3 | - | 12 | 18 | - | - | 33 |
| CO6 | - | 1 | 3 | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define sensitivity. | | CO1 | U | 1 |
| 2. | Give the SI unit of flow. | | CO1 | R | 1 |
| 3. | Give an example of semiconductor based temperature sensor. | | CO2 | R | 1 |
| 4. | Describe the primary sensor used in load cell. | | CO2 | R | 1 |
| 5. | Identify the sensors that can be connected to voltage divider circuit | | CO3 | A | 1 |
| 6. | Identify the sensor that is used to detect metal objects on a conveyor belt. | | CO3 | A | 1 |
| 7. | State the principle of Tacheogenerator. | | CO4 | U | 1 |
| 8. | List the sensors used in cars. | | CO4 | R | 1 |
| 9. | Expand I2C. | | CO5 | R | 1 |
| 10. | Give the operational frequency of WiFi. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define active and passive sensors. | | CO1 | U | 3 |
| 12. | State the principle of thermocouple. | | CO2 | U | 3 |
| 13. | Define mutual inductance. | | CO3 | U | 3 |
| 14. | Identify the simple method used to measure level in a tank draw and illustrate the working. | | CO4 | R | 3 |
| 15. | List the differences of I2C and SPI. | | CO5 | U | 3 |
| 16. | Summarize the merits and demerits of Zigbee protocol. | | 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. | Elaborate on the various parameters that are used for selection of a senor. | CO1 | U | 8 |
|  | b. | Justify the process of calibration and the steps for correcting or modifying the equipment. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain the various circuits used along with strain gauge for conversion of the generated resistance into voltage. | CO2 | A | 6 |
|  | b. | Explain the construction and working of thermocouple. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | With neat diagrams explain the construction and working of potentiometer. | CO3 | A | 6 |
|  | b. | Discuss the function and operation of resolver. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Construct and describe the working flow meter using electromagnets. | CO4 | A | 6 |
|  | b. | Elucidate on the noncontact type of level sensor and give its applications. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the operation of RS232 with the required diagrams. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | A venturi meter of 15 cm inlet diameter and 10 cm throat is laid horizontally in a pipe to measure the flow of oil of 0.9 specific gravity. The reading of a mercury manometer is 20 cm. Calculate the discharge in lit/min. | CO4 | A | 6 |
|  | b. | A 12Kohm resistive based sensor is used for angular measurement, has a reading of 40% of the full scale. The interface circuit for the angular sensor behave as a resistive load of 10kOhms. Find the current flowing thru the interfacing circuit.(Assume a 12 Volt Power supply) | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | With neat diagram illustrate the working of encoders. | CO3 | U | 6 |
|  | b. | Analyze the types of errors and the sources from which the errors are generated in sensor measurement. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With neat diagram, explain the operation of WiFi protocols and give its merits and demerits. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **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** | 1 | 12 | 4 |  |  |  | 17 |
| **CO2** | 2 | 9 | 12 |  |  |  | 23 |
| **CO3** |  | 9 | 20 |  |  |  | 29 |
| **CO4** | 4 | 1 | 18 |  |  |  | 23 |
| **CO5** | 1 | 15 |  |  |  |  | 16 |
| **CO6** | 4 | 12 |  |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20RO2007** | **Duration** | **3hrs** |
| **Course Title** | **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)** | | | | | |
| 1. | Recall a sensor commonly used for monitoring weather conditions. | | CO1 | R | 1 |
| 2. | Identify the component necessary to connect a capacitive sensor to a microcontroller. | | CO1 | U | 1 |
| 3. | Recognize the type of sensor used for non-contact distance measurements. | | CO2 | R | 1 |
| 4. | Name the modes of operation of a photo sensor. | | CO2 | U | 1 |
| 5. | State the frequency range typically used for RFID communication. | | CO3 | U | 1 |
| 6. | Find the amplifier with unity gain. | | CO3 | R | 1 |
| 7. | Specify the maximum operational distance for Zigbee communication. | | CO4 | R | 1 |
| 8. | Name one benefit of using LoRaWAN in IoT applications. | | CO4 | U | 1 |
| 9. | Name a microcontroller family frequently used for rapid IoT prototyping. | | CO5 | R | 1 |
| 10. | List the components of a smart sensor. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define the Seebeck effect. | | CO1 | A | 3 |
| 12. | Illustrate a circuit diagram of a voltage divider and list the sensors that can be integrated to the circuit. | | CO2 | A | 3 |
| 13. | Describe the characteristics and usage of a high-pass filter. | | CO3 | An | 3 |
| 14. | List and describe three benefits of incorporating wireless technology with sensors. | | CO4 | U | 3 |
| 15. | Describe the function and role of ADCs in smart sensor systems. | | CO5 | An | 3 |
| 16. | Outline the significance of using open-source platforms in the development of IoT sensor projects. | | 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 construction and working of a CO2 sensor with a diagram. | CO1 | U | 6 |
|  | b. | List and explain key criteria for selecting a sensor for IoT applications. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Analyze how a resistive temperature sensor(NTC) works and derive its operation equation. | CO2 | An | 6 |
|  | b. | Design a band-pass filter circuit and discuss its application in signal conditioning | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the characteristics of an operational amplifier and its role in signal amplification. | CO3 | U | 6 |
|  | b. | Derive the expression for a summing amplifier and explain its use in data aggregation. | C03 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain the architecture of Bluetooth and its role in wireless IoT sensor communication. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the progression of sensor technology leading to the development of smart sensors. | CO5 | R | 8 |
|  | b. | Evaluate the advantages of smart sensors in industrial use. | CO5 | E | 4 |
|  |  |  |  |  |  |
| 22. |  | Design an instrumentation amplifier for temperature sensing and illustrate with a circuit diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the construction and working principle of an RTD with an illustrative diagram. | CO1 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the contribution of IoT sensors to smart city applications, and discuss their benefits and challenges. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 7 | 15 |  |  |  | 29 |
| **CO2** | 1 | 1 | 9 | 6 |  |  | 17 |
| **CO3** | 1 | 7 | 18 | 3 |  |  | 29 |
| **CO4** | 1 | 16 |  |  |  |  | 17 |
| **CO5** | 9 |  |  | 3 | 4 |  | 16 |
| **CO6** |  | 4 |  | 12 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20RO3005** | **Duration** | **3hrs** |
| **Course Title** | **EMBEDDED 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. | Illustrate the structural units of an embedded processor and their roles. | CO1 | U | 8 |
|  | b. | Enlighten on the memory management methods used in embedded systems. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. |  | Examine the operation of RS 232 with the relevant mechanical and electrical specifications | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Interpret the concept of multiple interrupts and the role of ISRs in handling them | CO3 | A | 8 |
|  | b. | Discuss task communication methods such as shared memory and message passing. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the features and capabilities of the Beagle Board as an embedded platform | CO4 | A | 10 |
|  | b. | Describe the key features of open-source hardware and their licensing terms. | CO4 | R | 6 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the different types of operators in Java, providing examples relevant to embedded applications | CO5 | U | 8 |
|  | b. | Illustrate the use and configuration of Connected Limited Device Configuration (CLDC) in embedded Java | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Justify the need for timer and counting devices in embedded systems with relevant operational working. | CO1 | A | 8 |
|  | b. | Analyze the effect of context switching on the performance of an embedded system. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | List the methods of sharing an information between process and infer the need for each method. | CO3 | An | 8 |
|  | b. | Explain the development process of MIDP applications and their benefits in embedded systems. | CO5 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Elaborate on the software development for smart card applications using embedded systems. | CO6 | A | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic concepts of embedded systems |
| CO2 | Summarize the concepts of embedded networking and interrupt service mechanisms. |
| CO3 | Identification of various RTOS features for real time applications |
| CO4 | Analyze the scope of UML for creating visual models of software-intensive systems. |
| CO5 | Describe the basic concepts of embedded OS |
| CO6 | Design real time embedded systems using the concepts of RTOS. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 8 | 16 |  |  |  | 24 |
| CO2 |  |  | 16 | 8 |  |  | 24 |
| CO3 |  | 8 | 8 | 8 |  |  | 24 |
| CO4 | 6 |  | 10 |  |  |  | 16 |
| CO5 |  | 16 |  | 8 |  |  | 24 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20RO3013** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED EMBEDDED PROCESSORS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Compare the interrupt handling mechanisms in an 8-bit microcontroller with those in a 16-bit microcontroller. | CO1 | An | 10 |
|  | b. | Design a system using an 8-bit microcontroller to interface with a temperature sensor, incorporating an ADC and UART for communication. | CO1 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Develop an embedded C program to interface analog sensor with 8051 microcontroller. | CO2 | E | 10 |
|  | b. | Design an embedded system that implements interrupt-driven UART communication for efficient, high-speed data transmission between a microcontroller and a PC. | CO2 | C | 10 |
|  |  |  |  |  |  |
| 3. |  | A real-time video streaming application is being developed for a smart TV using an ARM processor. The application needs to process video frames and handle user input simultaneously. Discuss the role of ARM register organization and pipeline design in enabling smooth video rendering and responsive user interface interaction in a video streaming application. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Assess the role of the ARM MMU (Memory Management Unit) in supporting virtual memory, page tables, and fast context switching in real-time systems. | CO4 | E | 10 |
|  | b. | Examine the role of memory protection units (MPU) in managing protected regions within ARM-based embedded systems. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Develop an assembly program that implements a lookup table to compute a series of values based on input data. | CO5 | E | 10 |
|  | b. | Assess the trade-offs between division and bit-shifting techniques in assembly programs for performing integer division. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Create a memory protection scheme using the ARM MPU to safeguard critical sections of an embedded system, ensuring data integrity in a real-time environment. | CO1 | C | 20 |
|  |  |  |  |  |  |
| 7. |  | A complex ARM-based embedded system is being developed for automotive diagnostics. The system needs to handle numerous interrupts generated by vehicle sensors, handle time-sensitive control signals, and interface with diagnostic tools. Discuss the configuration of the interrupt handling scheme to prioritize critical interrupts, such as engine temperature monitoring, while ensuring that lower-priority tasks do not interfere with critical operations. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Develop a python program to interface with LCD with ARM processor to display the message “Welcome”. | CO6 | C | 10 |
|  | b. | Assess the advantages and limitations of using I2C to interface multiple sensor in an onboard diagnostic system. | CO6 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | An onboard processor is used to monitor various vehicle health metrics in real-time. The processor needs to handle sensor data acquisition, serial communication for diagnostics, and provide feedback to the user interface. Discuss the strategies used to manage multitasking environment ensuring that sensor data collection and diagnostic processes can operate without conflicts. | CO6 | An | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the architectural overview of 8 bit processor |
| CO2 | Discuss interfacing concepts in AVR microcontroller |
| CO3 | Apply instruction set of ARM processors to create simple embedded programs. |
| CO4 | Explain interrupts and memory concepts of ARM processor |
| CO5 | Create simple C/ASM program with ARM microcontroller |
| CO6 | Elaborate the integrated Development Environment and programming with Rasbian |

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

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the significance of eigenvalues in PCA and outline the steps involved in the computation. | CO1 | U | 6 |
|  | b. | Given the dataset: (2.8, 3.4), (0.4, 0.9), (2.4, 2.9), (3.9, 4.2), (5.1, 3.0), perform the Principal Component Analysis (PCA) algorithm step-by-step. Identify the principal components, compute the variance for each component, and assess whether dimensionality reduction is suitable for this dataset. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 2. | a. | Explain the concepts of **Linear Regression** and **Multivariate Regression**, highlighting their differences and uses in predictive modeling. | CO2 | U | 6 |
|  | b. | Analyze the relationship between correlation and covariance in detail, explaining how each measure reflects associations between variables. Using the given data set, apply your knowledge to compute the Pearson correlation coefficient and Spearman rank correlation coefficient, interpreting the results for each measure.   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | X | 15 | 19 | 5 | 11 | 12 | 8 | 13 | 2 | 17 | 7 | | Y | 7 | 6 | 2 | 9 | 5 | 3 | 4 | 8 | 5 | 2 | | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | Construct a dendrogram using the Single Linkage method for the provided data points (P1-P6) and interpret the clustering results. Analyze the clusters formed and their relationship to the data points.   |  |  |  | | --- | --- | --- | |  | X | Y | | P1 | 0.25 | 0.63 | | P2 | 0.42 | 0.78 | | P3 | 0.35 | 0.52 | | P4 | 0.16 | 0.29 | | P5 | 0.88 | 0.41 | | P6 | 0.75 | 0.50 | | CO3 | An | 16 |
|  |  |  |  |  |  |
| 4. |  | The Iris flower dataset is a well-known multivariate collection that captures the morphological characteristics of Iris flowers from three distinct species: **Setoflora**, **Florica**, and **Versiflor**. Each sample in the dataset is characterized by four features: **sepal length**, **sepal width**, **petal length**, and **petal width**. These attributes are used to classify the flowers into their respective species based on their physical traits. Use the **K-Nearest Neighbors (KNN) classifier** with **k=3** to predict the species of the following new flower sample. Based on the provided dataset, what is the predicted species for this flower?   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Sepal Length (cm)** | **Sepal Width (cm)** | **Petal Length (cm)** | **Petal Width**  **(cm)** | **Species** | | 5.1 | 3.5 | 1.4 | 0.2 | Setoflora | | 4.9 | 3 | 1.4 | 0.2 | Setoflora | | 6.5 | 3 | 5.2 | 2 | Florica | | 5.9 | 3.2 | 4.8 | 1.8 | Versiflor | | 5 | 3.6 | 1.4 | 0.2 | Setoflora | | 6.7 | 3.1 | 4.4 | 1.4 | Versiflor | | 6.3 | 2.9 | 5.6 | 1.8 | Florica | | 5.4 | 3.4 | 1.5 | 0.2 | Setaflora | | 6.1 | 2.8 | 4.5 | 1.5 | Florica | | 6.8 | 3.2 | 5.9 | 2.3 | Versiflor |   **Sepal length= 5.2, Sepal width=3.4 .Petal Length=1.5 and Petal Width=0.1, Species =?.** | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. | a. | Apply the support vector machine from the perspective of the nonlinear Kernel by means of an algorithm. Derive the margin of the support vectors with an example and depict it with necessary diagrams. | CO4 | A | 10 |
|  | b. | Given two classes of data points on a 2D plane, with the closest points to the decision boundary being (2, 3) and (4, 5), calculate the distance from the decision boundary to these points; assuming the SVM model has correctly separated the two classes. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 6. |  | Given a dataset about whether tennis can be played based on the features  **Outlook** {Sunny,Overcast,Rain}, **Temperature** {Hot,Mild,Cool}, **Humidity** {High,Normal, and **Wind** {Weak,Strong}: Analyze the information gain calculations for each feature (Outlook, Temperature, Humidity, and Wind) and determine how the data is split based on each attribute’s values.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Day | Outlook | Temperature | Humidity | Wind | Play Tennis | | 1 | Sunny | Hot | High | Weak | No | | 2 | Sunny | Hot | High | Strong | No | | 3 | Overcast | Hot | High | Weak | Yes | | 4 | Rain | Mild | High | Weak | Yes | | 5 | Rain | Cool | Normal | Weak | Yes | | 6 | Rain | Cool | Normal | Strong | No | | 7 | Overcast | Cool | Normal | Strong | Yes | | 8 | Sunny | Mild | High | Weak | No | | 9 | Sunny | Cool | Normal | Weak | Yes | | 10 | Rain | Mild | Normal | Weak | Yes | | 11 | Sunny | Mild | Normal | Strong | Yes | | 12 | Overcast | Mild | High | Strong | Yes | | 13 | Overcast | Hot | Normal | Weak | Yes | | 14 | Rain | Mild | High | Strong | No | | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Given the following 8 data points: A1 = (2,10), A2 = (2,5), A3 = (8,4), A4 = (5,8), A5 = (7,5), A6 = (6,4), A7 = (1,2), and A8 = (4,9). **Apply the K-means clustering algorithm** using Euclidean distance to categorize these 8 data points into 3 clusters. Begin with initial cluster centers: A1=(2,10)), A4=(5,8), and A7=(1,2). Perform the algorithm for **two epochs** iterations. **Analyze** the results of clustering at the end of each epoch, providing a detailed breakdown of the **specific data points** assigned to each cluster. **Calculate the new centers of each cluster** after both epochs. Evaluate the effectiveness of these cluster centers in representing the data points assigned to each cluster. Discuss how well the new cluster centers reflect the characteristics of the data points in their respective clusters. | CO3 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Examine how the Apriori algorithm finds large item sets with a given minimum support by creating a hypothetical instance of a compact market basket dataset. Construct a single example of an association rule using the given dataset, then determine its confidence and support.   | **Transaction ID** | **Items Bought** | | --- | --- | | 1 | {Bread, Milk, Eggs} | | 2 | {Bread, Diapers, Beer, Eggs} | | 3 | {Milk, Diapers, Beer, Coke} | | 4 | {Bread, Milk, Diapers, Beer} | | 5 | {Bread, Milk, Diapers, Coke} | | CO6 | A | 20 |

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

|  |  |
| --- | --- |
|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 6 | 10 |  |  |  | 16 |
| CO2 |  | 6 |  | 10 |  |  | 16 |
| CO3 |  |  | 16 | 16 |  |  | 32 |
| CO4 |  |  | 32 |  |  |  | 32 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20RO3023** | **Duration** | **3hrs** |
| **Course Title** | **VIRTUAL REALITY AND AUGMENTED REALITY** | **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 fundamental characteristics and architecture of AR/VR systems, highlighting their significance in contemporary technology. | CO1 | U | 8 |
|  | b. | Analyze the differences between AR and VR technology, highlighting the immersive experience in real-world applications. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. |  | Write the hardware requirements for developing effective AR/VR applications and its impact on user experience in dynamic environment. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the software development aspects for AR/VR based on the databases to enhance user interaction within virtual environments. | CO3 | U | 10 |
|  | b. | Summarize the significance of scripting and interaction design in enhancing user engagement within VR environments. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 4. |  | Analyze the significance of photoreceptors in human vision and their role in the design of VR environments. | CO4 | An | 16 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the pitch, roll, and yaw transformations involved in rendering 3D objects in AR/VR and their implications for user perception. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. | a. | Summarize the role of visual displays in creating immersive experiences in AR/VR applications. | CO2 | U | 8 |
|  | b. | Describe the role of different input devices on user interaction in AR/VR. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 7. |  | Analyze the industrial applications of AR/VR in medical and education field, highlighting their benefits. | CO6 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Illustrate the application of AR technology in health care sector to enhance medical education. | CO6 | An | 10 |
|  | b. | Evaluate the impact of VR technologies on educational practices, providing examples of successful implementations and areas for future research. | CO6 | A | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Summarize the characteristics, fundamentals and architecture of AR /VR |
| CO2 | Analyze the Hardware Requirement, Selection of Hardware for the AR / VR application development |
| CO3 | Analyze the software development aspects for AR / VR |
| CO4 | Design and develop the interactive AR / VR applications |
| CO5 | Understand the geometry of visual world |
| CO6 | Analyze and build AR/VR applications for chosen industry, healthcare, education case study |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 8 | - | 8 | - | - | 16 |
| CO2 | - | 16 | 16 | - | - | - | 32 |
| CO3 | - | 16 | - | - | - | - | 16 |
| CO4 | - | - | - | 16 | - | - | 16 |
| CO5 | - | - | 16 | - | - | - | 16 |
| CO6 | - | - | 10 | 26 | - | - | 36 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21RO2001** | **Duration** | **3hrs** |
| **Course Title** | **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. | State Newton’s second law of Motion. | | CO1 | U | 1 |
| 2. | Mention one key feature of a free body diagram (FBD). | | CO1 | R | 1 |
| 3. | Define the second moment of area. | | CO2 | A | 1 |
| 4. | State the centroid location for a rectangle. | | CO2 | U | 1 |
| 5. | Identify the principle that relates force to the change in momentum of a body. | | CO3 | U | 1 |
| 6. | Mention the kinematic quantity that remains constant during uniform circular motion of a rigid body. | | CO3 | U | 1 |
| 7. | Explain the term kinetics. | | CO4 | R | 1 |
| 8. | Define the momentum of a particle. | | CO4 | R | 1 |
| 9. | Identify the principle that governs the mobility of a mechanism based on the number of links and joints. | | CO5 | U | 1 |
| 10. | Specify the term used for a combination of kinematic links that produces constrained motion. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the difference between scalar and vector quantities with examples. | | CO1 | U | 3 |
| 12. | Analyze the importance of resolving forces into their components in engineering applications. | | CO2 | U | 3 |
| 13. | Describe the steps to find the second moment of area for a composite shape made up of simple geometric areas | | CO3 | U | 3 |
| 14. | An automobile is decelerating from a speed of 65km/h at the rate of 1.5 m/s2 . How long will it take to come to rest and how far will it have gone? | | 4 | A | 3 |
| 15. | Outline the steps involved in applying the Work-Energy Principle to a rigid body under varying force. | | CO4 | A | 3 |
| 16. | Differentiate between the Kutzbach criterion and Grubler criterion, emphasizing their distinctions and applications. | | 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. |  | An eye bolt is being pulled from ground by three forces as shown in Fig. Determine the equilibrant on the eye bolt which resist to come out. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Find the resultant of following force system and also find the equivalent force and couple at point A of the same force system shown in Fig. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | 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 | U | 10 |
|  | b. | Illustrate the resolution of forces with suitable examples. | CO2 | A | 2 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate how the centroid of a semi-circular area can be determined using the direct integration method | CO3 | U | 6 |
|  | b. | Discuss the parallel axis theorem and its practical application in calculating the second moment of area for a composite structure. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Evaluate the centroid of the figure given below. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the concept of relative velocity in the motion of rigid bodies with an example, and describe how this concept is used in engineering applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Illustrate the four-bar chain mechanism and its different configurations with simple sketches. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the basic procedure of machine design with suitable case study. | CO6 | R | 12 |

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

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|  | **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 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21RO2002** | **Duration** | **3hrs** |
| **Course Title** | **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 **M** – MARKS ALLOTTED

|  |  |
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|  | **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 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21RO2012** | **Duration** | **3hrs** |
| **Course Title** | **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 DOF. | | CO1 | U | 1 |
| 2. | List the types of Robot Joints. | | CO1 | R | 1 |
| 3. | Specify the sensor characteristics. | | CO2 | R | 1 |
| 4. | Define electric actuator. | | CO2 | R | 1 |
| 5. | Distinguish forward and inverse kinematics | | CO3 | U | 1 |
| 6. | Classify serial chain manipulator. | | CO3 | R | 1 |
| 7. | Specify the key issues in locomotion. | | CO4 | U | 1 |
| 8. | Indicate the matrices used in dynamics of mobile robots to represent the robot's motion and dynamics. | | CO4 | R | 1 |
| 9. | Write the DOF of Humanoid. | | CO5 | U | 1 |
| 10. | List the Medical applications of Robot. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Specify the Laws of Robotics. | | CO1 | An | 3 |
| 12. | Distinguish Hydraulic and Pneumatic Actuator. | | CO2 | U | 3 |
| 13. | List the End Effectors. | | CO3 | An | 3 |
| 14. | Define Maneuverability. | | CO4 | U | 3 |
| 15. | Write the main purpose of Collaborative Robot. | | CO5 | An | 3 |
| 16. | List the domestic applications of Robots. | | 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. |  | Illustrate Robot Anatomy and the different types of joints. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain in brief about the position sensor with a neat sketch. | CO2 | U | 6 |
|  | b. | Describe the various Sensor characteristics with an example. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | 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. |  | Describe an End effector. Classify the common types of end-effectors based on the application and the task that the robot is designed to perform. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain in brief the spray-painting application of robots that are becoming increasingly popular in the automotive industry with a neat block diagram. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain in brief the application of robotic assembly system for pick and place operations with a neat block diagram. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the various factors that affect the stability of a mobile robot. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Sketch the steps followed in a robot-assisted surgery with a neat block diagram | CO6 | A | 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** | Analyze the working principle of the serial chain manipulators |
| **CO4** | Analyze 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** | 13 | 1 | - | 3 | - | - | 17 |
| **CO2** | 2 | 15 | - | - | - | - | 17 |
| **CO3** | 13 | 1 | - | 3 | - | - | 17 |
| **CO4** | 13 | 4 | - | - | - | - | 17 |
| **CO5** | 12 | 13 | - | 3 | - | - | 28 |
| **CO6** | - | 4 | 12 | 12 | - | - | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21RO3001** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL 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. | Write the reasons for automating the process of an industry. | CO1 | U | 8 |
|  | b. | Draw the configurations of the automated production line in detail. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | A 20-station transfer line has an ideal cycle time of Tc = 1.2 mins. The probability of station breakdown per cycle is equal for all stations & P = 0.005 breakdowns/cycle. The average downtime per line stop will be 8.0 minutes. For each of the upper bound & lower bound determine:  a) frequency of line stops per cycle  b) average actual production rate  c) line efficiency | CO1 | An | 10 |
|  | b. | Write the reasons for using buffer storage zones in automated production lines in detail. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 3. | a. | The following list defines the precedence relationships and element times for a new model toy:      (a) Construct the precedence diagram for this job.  (b) If the ideal cycle time is 1.0 min, what is the theoretical minimum number of stations required to minimize the balance delay?  (c) Compute the balance delay.  (d) Determine the assignment of work elements to stations using the Ranked positional weights method.  (e) How many stations are required?  (f) Compute the balance delay | CO2 | An | 12 |
|  | b. | Write the three processes used to assemble the components in detail. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 4. |  | With relevant diagrams, explain the functions of the Vibratory bowl feeder, Part Orienting Systems, Feed tracks, Escapements, and part placing  mechanism in detail | CO2 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Mention the types of Material handling equipment. Explain the Identification and Control Equipment in detail. | CO3 | A | 8 |
|  | b. | Write the objectives and benefits of material handling systems in the industry. | CO3 | R | 8 |
|  |  |  |  |  |  |
| 6. | a. | Write the factors that affect the storage system performance. Explain. | CO4 | U | 8 |
|  | b. | Compare the Fixed Aisle storage system and Carousel storage system in detail. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | Sketch and describe the functions of Coordinate Measuring Machines (CMM). | CO5 | U | 8 |
|  | b. | Explain Automated Inspection Principles and Methods in detail. | CO5 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain a simple Robotic Arm for automatically picking up and placing Light Objects using PLC with relevant diagrams. | CO6 | A | 10 |
|  | b. | Describe the functions of the Barrel Filling System for Dry Bulk Material in detail. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basics of Industrial Automation |
| CO2 | Familiarize the concepts of Assembly systems and Line Balancing |
| CO3 | Explain the concepts of Material Handling systems |
| CO4 | Understand the in-depth concepts of Automated Storage and Retrieval System |
| CO5 | Apply the concept to automate the industrial inspection |
| CO6 | Create solutions to automate industrial robotics |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  | 16 |  |  | 32 |
| CO2 |  | 20 |  | 12 |  |  | 32 |
| CO3 | 8 |  | 8 |  |  |  | 16 |
| CO4 |  | 8 |  | 8 |  |  | 16 |
| CO5 |  | 16 |  |  |  |  | 16 |
| CO6 |  |  | 20 |  |  |  | 20 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21RO3002** | **Duration** | **3hrs** |
| **Course Title** | **MOBILE ROBOTICS** | **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 various robot locomotion mechanisms with necessary diagrams and explanations. | CO2 | R | 8 |
|  | b. | Analyze the role of the kinematic model in representing a robot’s position and evaluate the constraints that impact its accuracy and functionality. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 2. | a. | Elaborate the static and dynamic characteristics of a mobile robot with examples. | CO1 | R | 8 |
|  | b. | Describe the types and features of mobile robot sensor. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Specify the selection criteria to choose the right DC motor in mobile robot applications. | CO2 | U | 8 |
|  | b. | Write the factors that affect the use of global positioning system in Mobile robot localization. | CO3 | R | 8 |
|  |  |  |  |  |  |
| 4. | a. | Outline the functional components of the vision system used in Autonomous mobile robot. | CO3 | U | 8 |
|  | b. | Differentiate between hydraulic and pneumatic actuation mechanisms, and specify the types of applications for each. | CO3 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Compare sector and topological mapping techniques with relevant examples. | CO4 | U | 8 |
|  | b. | Describe the Kalman filter estimation algorithm in mobile robot localization. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 6. |  | Explain how visibility graphs & Voronoi diagrams are applied in roadmap approaches for path planning, and analyse their significance in optimizing pathfinding. | CO4 | An | 16 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the mobile robot localization phenomena with the help of a general schematic diagram. | CO5 | U | 8 |
|  | b. | Summarize the challenges involved in mobile robot localization for specific applications. | CO2 | R | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain the significance of mobile robot techniques used for military applications. | CO6 | A | 10 |
|  | b. | Describe the key principles behind soccer robots and evaluate recent advancements in this technology. | CO6 | An | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Classify and describe the various types of Mobile Robots, kinematics and dynamic analysis |
| CO2 | Identify different sensor for mobile robots |
| CO3 | Describe the actuators of Robots |
| CO4 | Classify different localization and mapping of mobile robots |
| CO5 | Create solutions to plan and navigate the mobile robots using various techniques |
| CO6 | Apply the concept of mobile robots in various applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 8 | - | 8 | - | - | - | 16 |
| CO2 | 8 | 8 | - | 8 | - | - | 24 |
| CO3 | 16 | 8 | - | - | - | - | 24 |
| CO4 | - | 8 | 8 | 16 | - | - | 32 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | - | - | 10 | 10 | - | - | 20 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21RO3005** | **Duration** | **3hrs** |
| **Course Title** | **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

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|  | **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 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Coordination number in crystal structures. | | CO1 | U | 1 |
| 2. | Distinguish between Face centered cubic and Body centered cubic in crystal structure. | | CO1 | R | 1 |
| 3. | Identify the temperature at which Gamma Ferrite Phase (γ-Fe) retained in microstructure of Iron. | | CO2 | U | 1 |
| 4. | State the principle of Conduction band in semiconductor material. | | CO2 | R | 1 |
| 5. | Define the principle of magnetostriction. | | CO3 | U | 1 |
| 6. | Identify the material used as tool in the Electric Discharge Machining (EDM) Process. | | CO3 | R | 1 |
| 7. | Identify the mechanism involved in atomic dislocation of materials. | | CO4 | U | 1 |
| 8. | Explain the principle of grain boundary strengthening . | | CO4 | R | 1 |
| 9. | Indicate an example for strong magnetic material. | | CO5 | U | 1 |
| 10. | State any two applications of nano composite material. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the principle of Ionic bond with an example. | | CO1 | U | 3 |
| 12. | Summarize the importance of phase diagram in engineering materials. | | CO2 | U | 3 |
| 13. | Explain the principle of plasma arc machining process. | | CO3 | A | 3 |
| 14. | Distinguish the properties of elastic and plastic deformation. | | CO4 | An | 3 |
| 15. | Explain any two factors influencing creep behavior in materials. | | 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 Hexagonal Centered cubic and body centered cubic structure. Determine its coordination number and atomic packing factor. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the Vanderwaal’s bond in atomic boning structure with neat sketch. | CO2 | U | 4 |
|  | b. | Illustrate the principle of diffusion and its mechanism with simple sketch | CO2 | U | 8 |
|  |  |  |  |  |  |
| 19. |  | Explain in detail the different phases in Iron carbon diagram with microstructural changes on cooling. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the working principle of electron beam machining process in detail with major components and draw its schematic diagram | CO3 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the salient features in classical free electron theory. | CO4 | A | 4 |
|  | b. | Illustrate the details involved in Vickers hardness test in analyzing the hardness of a given material with necessary diagram. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Explain with neat sketch the S-N Curve in fatigue test. | 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 an example. | CO5 | R | 6 |
|  | b. | Illustrate the types of superconductors and its properties in detail. | CO5 | An | 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 | 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 | 4 | 12 | - | - | - | 17 |
| **CO2** | 1 | 16 | 12 | - | - | - | 29 |
| **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 – NOV / DEC 2024**

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| **Course Code** | **22RO2001** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRICAL CIRCUIT ANALYSIS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define mesh. | | CO1 | R | 1 |
| 2. | Determine the current I3 for the given circuit using Kirchhoff’s Current Law. | | CO1 | U | 1 |
| 3. | In the circuit shown in Figure. Determine the value of load resistance when the load resistance draws maximum power. | | CO2 | A | 1 |
| 4. | A resistance R and capacitance C are connected in series with the DC supply. Write the expression for the time constant. | | CO3 | R | 1 |
| 5. | State the condition for under under-damped response of the series RLC circuit. | | CO3 | U | 1 |
| 6. | Identify the relationship between the phase voltage and line voltage in the three-phase Delta-connected load. | | CO4 | U | 1 |
| 7. | Define the RMS value of alternating signal. | | CO4 | R | 1 |
| 8. | Define convolution integral. | | CO5 | R | 1 |
| 9. | Indicate one application of ABCD parameters. | | CO6 | U | 1 |
| 10. | Identify the condition for symmetrical network interns of h parameters. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Determine the voltage across the 5Ω resistor in the circuit shown in the figure. | | CO1 | A | 3 |
| 12. | Define the Reciprocity theorem. Write the procedure to verify the Reciprocity theorem for any given circuit. | | CO2 | U | 3 |
| 13. | Define natural and forced response and estimate initial and final value of the following response. | | CO3 | A | 3 |
| 14. | Two coupled coils have self-inductances L1=50mH, L2=200mH. If the coupling coefficient is 0.5, calculate the mutual inductance between the coils. | | CO4 | A | 3 |
| 15. | Determine the poles and zeros of the given function and draw the pole-zero diagram.  V(s)= | | CO5 | An | 3 |
| 16. | In the 2-port network given, compute h-parameters from the following details.   1. With the output port short circuit, V1=25V, I1=1A, I2=2A 2. With the input port open circuit, V1=10V, V2=50, I2=2A | | 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. | Compute the load current using mesh analysis.  A diagram of a circuit  Description automatically generated | CO1 | A | 6 |
|  | b. | Determine the current through R3 using node analysis. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Determine Norton’s equivalent circuit at terminals AB for the circuit shown in Figure. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Calculate the current I in the circuit shown in Figure by using the superposition theorem. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | A series RL circuit with R = 30Ω and L = 15H has a constant voltage V = 60 V applied at t = 0 as shown in Figure. Determine the expression for the current i(t), the voltage across the resistor, and the voltage across the inductor. | CO3 | An | 6 |
|  | b. | A series RC circuit consists of a resistor of 10 Ω and a capacitor of 0.1 F as shown in Figure. A constant voltage of 20 V is applied to the circuit at t=0. Obtain the current equation. Determine the voltages across the resistor and the capacitor. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Construct the dual network for the given network shown in Figure. | CO1 | A | 6 |
|  | b. | Compute the current in each branch of the circuit shown in the Figure using the mesh method. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | In the circuit shown in Figure. Determine the total impedance, current I, phase angle u, and the voltage across each element. | CO4 | A | 8 |
|  | b. | Calculate the effective inductive of the network given below. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | A steady state is reached in the circuit shown in the figure when the switch is in position 1. At t=0, the switch is moved to position 2. Determine the expression for the current at both positions of the switch using the Laplace transformation method. | CO5 | An | 6 |
|  | b. | Compute the frequency (magnitude and phase) response of the RL series circuit. Assume R=5Ω and L=2H. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Determine the impedance (Z) parameters of the network given in the figure. Check whether the given network is symmetrical or reciprocal. Also, draw the equivalent circuit using Z parameters. | CO6 | A | 12 |

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

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|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 1 | 28 |  |  |  | 29 |
| **CO2** |  | 3 | 25 |  |  |  | 28 |
| **CO3** | 1 | 1 | 15 | 3 |  |  | 17 |
| **CO4** | 1 |  | 16 |  |  |  | 17 |
| **CO5** | 1 |  | 12 | 3 |  |  | 16 |
| **CO6** |  | 2 | 12 | 3 |  |  | 17 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain the concept of plugging in three-phase induction motors. | | CO1 | U | 1 |
| 2. | Indicate the purpose of employing an auxiliary winding in a reluctance motor. | | CO1 | U | 1 |
| 3. | Find the synchronous speed of a 4 pole induction motor which operates at 60 Hz. | | CO2 | A | 1 |
| 4. | Sketch the speed-torque characteristics of a synchronous motor. | | CO2 | A | 1 |
| 5. | Summarize the damages caused due to the high starting current. | | CO3 | U | 1 |
| 6. | List the disadvantages of using mechanical brakes. | | CO3 | R | 1 |
| 7. | Define an electric drive. | | CO4 | U | 1 |
| 8. | Classify electric drives based on the control parameter . | | CO4 | U | 1 |
| 9. | Describe a rectifier. | | CO5 | R | 1 |
| 10. | List the two types of Ward-Leonard control techniques. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State Fleming’s right hand rule. | | CO1 | An | 3 |
| 12. | The step angle of a stepper motor is 5 degrees. If the stepping frequency is 3600 pulses per second, find the shaft speed of the stepper motor. | | CO2 | A | 3 |
| 13. | List the three types of electric braking used for shunt and series DC Motor. | | CO3 | A | 3 |
| 14. | Sketch the components of a basic electrical drive system. | | CO4 | U | 3 |
| 15. | Explain the structure of a MOSFET with a neat diagram. | | CO5 | U | 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. |  | Compare a squirrel cage induction motor with a wound rotor induction motor. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | A 3-phase Induction motor runs at almost 1500 rpm at no load and 1200 rpm at full load when supplied with power from a 50Hz, 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 5% slip?  v) What is the rotor frequency at this speed? | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Write the potential applications of a Stepper motor in the field of robotics. | CO3 | A | 6 |
|  | b. | Permanent magnet synchronous motors (PMSMs) are popular due to their high efficiency, power density and controllability. Write the applications of a PMSM in the field of robotics. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain in detail the classification of electric drives based on their development. | CO4 | An | 6 |
|  | b. | Analyze the factors that govern the selection of an electric drive for a particular application. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the structure and symbol of a Silicon Controlled Rectifier (SCR). Explain its operation under the three different modes of operation and discuss the corresponding V-I characteristics. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22 |  | Analyzeandderive the heating curve equation of a motor explaining the underlying principles with a neat diagram. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Illustrate the operation of a half wave rectifier, a full wave bridge rectifier and a full wave centre-tapped full wave rectifier with a neat circuit diagram. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | 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 |
|  | b. | Explain the working of a chopper fed DC motor drive with a neat circuit diagram. | CO6 | A | 6 |

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

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|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 2 | - | 15 | - | - | 17 |
| **CO2** | - | - | 5 | 12 | - | - | 17 |
| **CO3** | 1 | 1 | 15 | - | - | - | 17 |
| **CO4** | - | 5 | 12 | 12 | - | - | 29 |
| **CO5** | 1 | 3 | 24 | - | - | - | 28 |
| **CO6** | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22RO2003** | **Duration** | **3hrs** |
| **Course Title** | **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 |  | 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 – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **22RO2011** | **Duration** | **3hrs** |
| **Course Title** | **ROBOTIC PROCESS AUTOMATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the debugging procedures in Uipath. | | CO1 | R | 1 |
| 2. | Justify the statement: Robotic Process Automation is similar to Artificial Intelligence. | | CO1 | U | 1 |
| 3. | Classify the types of recordings available in UiPath. | | CO2 | U | 1 |
| 4. | List the applications of UiPath. | | CO2 | R | 1 |
| 5. | Mention the advantage of ‘click activity’ in UiPath. | | CO3 | U | 1 |
| 6. | State the advantages of scraping the screen. | | CO3 | R | 1 |
| 7. | List the types of activities used in UiPath for data entry. | | CO4 | U | 1 |
| 8. | List the reasons that leads to the failure of RPA projects. | | CO4 | U | 1 |
| 9. | Name the port number of SMTP Gmail. | | CO5 | U | 1 |
| 10. | Name the email protocol in Uipath. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the advantages of RPA. | | CO1 | U | 3 |
| 12. | Analyze the properties in UiPath. | | CO2 | An | 3 |
| 13. | List the advantages of ‘get password’ activity. | | CO3 | U | 3 |
| 14. | Differentiate between read range and write range activity in UiPath. | | CO4 | U | 3 |
| 15. | Compare sequences and flowchart**.** | | CO5 | U | 3 |
| 16. | Explain the components of Orchestrator. | | 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 evaluation of Robotic Process Automation and its benefits in various applications. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Sketch the process flow of notepad automation in RPA and explain. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain browser automation using UiPath-Recording. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Calculate addition and subtract two numbers by passing the variables and arguments using UiPath. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Sketch the process flow diagram sof finding odd number using UiPath activity and explain. | CO3 | U | 6 |
|  | b. | Explain the process flow of PDF automation using UiPath. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain data- scraping automation using UiPath. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Summarize the RPA Challenge in automation of data entry process. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze how an e-mail is communicated using UiPath. | CO5 | An | 6 |
|  | b. | Summarize the future trends and orchestrator in UiPath. | CO6 | U | 6 |

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

|  |  |
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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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 16 | - | - | - | - | 17 |
| **CO2** | 1 | 1 | 24 | 3 | - | - | 29 |
| **CO3** | 1 | 10 | 12 | - | - | - | 23 |
| **CO4** | - | 11 | - | - | - | - | 11 |
| **CO5** | - | 4 | 12 | 6 | - | - | 22 |
| **CO6** | - | 10 | 12 | - | - | - | 22 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22RO3005** | **Duration** | **3hrs** |
| **Course Title** | **REAL-TIME OPERATING SYSTEM** | **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. | Analyze the role of BIOS in modern computers highlighting its interacts with the bootloader and operating system to prepare the hardware for operation. | CO1 | An | 10 |
|  | b. | Compare the performance of different scheduling strategies in RTOS, considering factors like process priority, response time, and CPU efficiency. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Develop an architecture for an RTOS that supports both preemptive and non-preemptive multitasking, ensuring minimal task delays and real-time responsiveness.. | CO2 | E | 10 |
|  | b. | Examine the limitations of an RTOS kernel in terms of its ability to handle complex real-time applications. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Design a mechanism for thread synchronization in a system that uses mutex and condition variables to ensure thread safety in a banking application, where multiple threads perform deposit and withdrawal operations on shared accounts. | CO3 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Design a task scheduling mechanism for smooth execution of tasks in an embedded system. | CO4 | C | 10 |
|  | b. | Summarize the role of priority inversion in system performance for a real-time embedded system. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the trade-offs between static and dynamic stack management in real-time applications, focusing on buffer size and memory utilization. | CO5 | An | 10 |
|  | b. | Evaluate the role of real-time garbage collection in memory management for systems with stringent timing requirements. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | In a satellite system, RTOS is used to monitor and control communication with ground stations for data collection and processing. Apply the concept of round robin scheduling strategy to ensure effective data management. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the concept of thread synchronization in multi-threaded applications, focusing on the effects of deadlocks and race conditions. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the role of inter-task communication mechanisms like semaphores, message queues, and shared memory in ensuring real-time data exchange in POSIX systems. | CO6 | C | 10 |
|  | b. | Assess the suitability of VxWorks for embedded systems in terms of real-time performance, process states, and inter-task communication. | CO6 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Create a kernel design for ulTRON RTOS to handle interrupt service routines and system resource management. | CO6 | C | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the fundamental concepts of operating systems |
| CO2 | Outline the concepts of RTOS |
| CO3 | Summarize process management in RTOS |
| CO4 | Categorize inter process communication techniques |
| CO5 | Interpret memory management in RTOS |
| CO6 | Develop real time application programs using RTOS |

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

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| --- | --- | --- | --- |
| **Course Code** | **23RO1001** | **Duration** | **3hrs** |
| **Course Title** | **PROGRAMMING IN C** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the logical operator in this expression: (a > b) && (c < d) | | CO1 | R | 1 |
| 2. | Evaluate the expression 11%3. | | CO1 | A | 1 |
| 3. | State the use of the `continue` statement. | | CO2 | U | 1 |
| 4. | Define `do-while` loop. | | CO2 | R | 1 |
| 5. | Name a function that returns no value. | | CO3 | R | 1 |
| 6. | Identify the value passed to a function when an array is used as an argument. | | CO3 | U | 1 |
| 7. | List the application of a two-dimensional array. | | CO4 | R | 1 |
| 8. | Determine which element of the array is being referenced by the expression `num[4]`. | | CO4 | A | 1 |
| 9. | Specify the syntax for defining a structure. | | CO5 | R | 1 |
| 10. | Identify a function used for dynamic memory allocation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the process of error diagnostics in C programming and identify two common syntax errors that may occur during compilation, including ways to resolve them. | | CO1 | U | 3 |
| 12. | Distinguish “if statement” and switch statement”. | | CO2 | An | 3 |
| 13. | Compute the output for the following with the reasoning  main( )  {  int i = 40,c;  c = check(i);  printf(“\n%d”,c);  }  check(int ch)  {  if(ch>=40)  return(100);  else  return(10\*10);  } | | CO3 | A | 3 |
| 14. | Analyze the difference between the usage of `5` in the expressions  int num[5]; and num[5] = 11;. | | CO4 | An | 3 |
| 15. | Define Structures. | | CO5 | R | 3 |
| 16. | Illustrate the purpose of the \* and & operators in C with basic examples. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | State the purpose and application of arithmetic, relational, and logical operators in C, and include examples to illustrate each type. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Develop a program to find whether the input number is a palindrome or not. | CO2 | A | 6 |
|  | b. | Illustrate the use of `switch` cases with multiple conditions. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Write a program that uses a function to check whether the given number is divisible by 11 or not by using the algorithm which states that a number is divisible by 11 if and only if the difference of the sums of digits at odd positions and even positions is either zero or divisible by 11. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate linear search algorithm to find an element in an array | CO4 | U | 6 |
|  | b. | Write a program that will read an array of integers. The program should display the elements appearing at even and odd subscript positions separately. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Differentiate between arrays and structures with examples. | CO5 | U | 6 |
|  | b. | Explain how to access and modify members of a structure using both the dot operator and the arrow operator in C. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Identify and explain the major components of a C program, and analyze the significance attached to the main function. | CO1 | An | 6 |
|  | b. | Differentiate between assignment and conditional operators in C. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Develop a program to process student data using structures in C | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe null pointers and their applications. | CO6 | U | 6 |
|  | b. | Explain dynamic memory allocation and deallocation with `malloc` and `free`. | CO6 | U | 6 |

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

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|  | **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 Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 3 | 13 | 6 |  |  | 23 |
| **CO2** | 1 | 13 | 6 | 3 |  |  | 23 |
| **CO3** | 1 | 1 | 15 |  |  |  | 17 |
| **CO4** | 1 | 6 | 7 | 3 |  |  | 17 |
| **CO5** | 4 | 12 | 12 |  |  |  | 7 |
| **CO6** | 1 | 15 |  |  |  |  | 7 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23RO2004** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRON DEVICES AND CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Specify the purpose of a filter in a DC power supply. | | CO1 | R | 1 |
| 2. | List the applications of diodes in electronic circuits. | | CO2 | R | 1 |
| 3. | Define Q-Point. | | CO3 | R | 1 |
| 4. | Write the key difference between series and shunt regulators in their operation. | | CO4 | U | 1 |
| 5. | Specify the dopants of semiconductor materials. | | CO5 | U | 1 |
| 6. | Define Avalanche breakdown. | | CO1 | R | 1 |
| 7. | Write the main difference between center tapped and Bridge fullwave rectifier. | | CO4 | R | 1 |
| 8. | State the IC number of Negative fixed voltage regulator. | | CO2 | U | 1 |
| 9. | List the advantages of multistage amplifier. | | CO6 | U | 1 |
| 10. | Specify the frequency determining elements in phase shift oscillator. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write how thermal energy leads to the generation of electrons and holes in a semiconductor material. | | CO1 | U | 3 |
| 12. | Draw the circuit diagram for Common Collector (CC) configuration using both NPN and PNP transistors. | | CO2 | U | 3 |
| 13. | Specify the reason for the collector region of a transistor being larger than the emitter. | | CO3 | U | 3 |
| 14. | Specify the role of electrons and holes in the conduction process of a semiconductor. | | CO4 | R | 3 |
| 15. | Differentiate the features of BJT and a FET device. | | CO5 | R | 3 |
| 16. | Classify amplifiers based on the coupling 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. | A transistor is connected in common emitter (CE) configuration in which collector supply is 8 V and the voltage drop across resistance RCconnected in the collector circuit is 0.5 V. The value of RC = 800 Ω. If α = 0.96, determine: (i) collector-emitter voltage (ii) base current. | CO1 | A | 6 |
|  | b. | Explain the concept of the valence band and conduction band in a semiconductor. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Analyze the VI characteristics of a PN junction of diode under forward and reverse bias conditions. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the working of a Half Wave Bridge Rectifier with the help of a neat circuit diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the various configurations of Full wave rectifier with Capacitor and Inductor filters. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Sketch the input and output characteristic curves of a Common Emitter BJT configuration and explain the behaviour. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the current flow and gate-source voltage characteristics of both N-channel and P-channel JFETs. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the working of feedback and differential amplifiers, highlighting the differences between them. | CO3 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the performance of a Colpitts oscillator in terms of frequency stability and amplitude stability for high-frequency applications. | CO6 | E | 6 |
|  | b. | Analyze the effect of changing the resistor or capacitor values on the output waveform of an astable multivibrator. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Determine the characteristics of solid-state devices like diode and transistor. |
| **CO2** | Select suitable components for electronic circuit design |
| **CO3** | Design power supply circuits, amplifiers and oscillators. |
| **CO4** | Analyze the amplitude and frequency response of amplifier circuits. |
| **CO5** | Apply field effect transistor circuits in electronic systems. |
| **CO6** | Develop electronic circuits for specific applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 9 | 6 | - | - | - | 19 |
| **CO2** | 1 | 4 | - | 12 | - | - | 17 |
| **CO3** | 13 | 3 | 12 | - | - | - | 28 |
| **CO4** | 4 | 13 | - | - | - | - | 17 |
| **CO5** | 15 | 13 | - | - | - | - | 28 |
| **CO6** | - | 5 | - | 6 | 6 | - | 17 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23RO2005** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRICAL MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define cogging in induction motor. | | CO1 | R | 1 |
| 2. | List two applications of Universal motor. | | CO1 | R | 1 |
| 3. | Indicate the role of hall effect sensors in the operation of a BLDC motor. | | CO2 | U | 1 |
| 4. | Identify one key difference between a Brushless DC motor and a brushed DC motor. | | CO2 | R | 1 |
| 5. | State the working principle of a linear induction motor. | | CO3 | U | 1 |
| 6. | Identify a variable speed motor. | | CO3 | U | 1 |
| 7. | Define reluctance torque. | | CO4 | R | 1 |
| 8. | Sketch the torque-speed characteristics of a permanent magnet synchronous motor. | | CO4 | U | 1 |
| 9. | Identify the sensors used in field oriented control of permanent magnet synchronous motor. | | CO5 | R | 1 |
| 10. | List two applications of a BLDC Motor. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A DC shunt motor is also called as a constant speed motor. Explain. | | CO1 | U | 3 |
| 12. | List the design features of a Linear Induction Motor. | | CO2 | R | 3 |
| 13. | Explain the principle of magnetic locking with a neat diagram. | | CO3 | A | 3 |
| 14. | Describe the torque-speed characteristics of a two-phase induction Motor with a neat sketch. | | CO4 | U | 3 |
| 15. | Indicate the different types of techniques used to drive a stepper motor. | | CO5 | U | 3 |
| 16. | Write the main areas of application of linear motors. | | 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. |  | Differentiate between a Squirrel Cage Induction Motor and a Wound Rotor Induction Motor. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the construction of a Field controlled and an Armature Controlled DC Servo Motor with the help of a neat circuit diagram. | CO2 | U | 6 |
|  | b. | Describe the construction of different types of stepper motors based on the basis of rotor design. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the working principle of an AC Servo Motor with the help of a circuit diagram. | CO3 | U | 6 |
|  | b. | Discuss the principle of operation of a linear induction motor with a neat diagram. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Derive the emf and torque equations of a permanent magnet synchronous motor and also explain the torque-speed characteristics. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the basic scheme of stepper motor control and specify how open-loop model varies from a closed-loop model. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the emf and torque equations of a brushed DC motor and explain the torque-speed characteristics. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the issues and challenges faced after implementing stepper motor in CNC milling machines and provide solutions to ensure precise cutting and shaping of materials. | CO6 | An | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The Tesla Model 3 is a compact electric sedan using BLDC motors, which play a critical role in its operation in maintaining high performance and efficiency. Analyze the issues identified after implementing BLDC motor in Tesla Model 3 and provide solutions to ensure its reliable performance. | CO6 | An | 12 |
|  |  |  |  |  |  |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Discuss the basics of different types of DC and AC motor. |
| **CO2** | Explain the constructional features of different Motors. |
| **CO3** | Demonstrate the working principle of various types of Motors. |
| **CO4** | Relate the torque speed characteristics of several Motors. |
| **CO5** | Describe the various method of speed control of motors used for Automation. |
| **CO6** | Analyze the different types of motors used for Automation with case studies. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | - | - | - | 17 |
| **CO2** | 1 | 16 | - | - | - | - | 17 |
| **CO3** | - | 14 | 3 | - | - | - | 17 |
| **CO4** | 1 | 4 | - | 24 | - | - | 29 |
| **CO5** | 1 | 3 | 12 | - | - | - | 16 |
| **CO6** | 1 | - | 3 | 24 | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23RO2006** | **Duration** | **3hrs** |
| **Course Title** | **AUTOMATIC CONTROL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Sketch the rule for eliminating the negative feedback loop. | | CO1 | A | 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 | A | 1 |
| 5. | Define gain margin. | | CO3 | R | 1 |
| 6. | The first column of the Routh array is 5, 3, 2, 4, -3. Calculate the number of roots in right half of s-plane. | | CO4 | A | 1 |
| 7. | Define BIBO stability. | | CO4 | R | 1 |
| 8. | List the advantages of state space analysis. | | CO5 | R | 1 |
| 9. | Define the concepts of state variables. | | CO5 | R | 1 |
| 10. | Write the transfer function of PI controller. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the force balance equation of ideal mass element. | | CO1 | A | 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 | A | 3 |
| 13. | Sketch Polar plot for the transfer function | | CO3 | A | 3 |
| 14. | Explain the conditions for stability. | | CO4 | U | 3 |
| 15. | Sketch the signal flow graph representation of state model. | | CO5 | A | 3 |
| 16. | Write the transfer function of PID controller. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Determine the overall transfer function of the system for the signal flow graph shown below. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Compare open loop with closed loop control systems with suitable example. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Analyze the response of first order system when the input is unit step. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Sketch Bode plot for the following transfer function and calculate the gain and phase cross over frequencies , . | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | 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. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Calculate the state estimation matrix, .  . | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Summarize the steps involved in the design of PID Controller in frequency domain. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the stability of the system represented by the characteristic equation. Comment on the location of the roots of characteristic equation. | CO4 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Develop mathematical models of control components and physical systems. |
| **CO2** | Analyze the time domain responses of LTI systems. |
| **CO3** | Determine the frequency domain specifications of the LTI systems. |
| **CO4** | Investigate the stability of systems based on frequency domain using different techniques. |
| **CO5** | Derive equivalent transfer function and state space model for a given system. |
| **CO6** | Design controllers for practical applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 13 | - | 16 | - | - | - | 29 |
| **CO2** | 1 | - | 4 | 12 | - | - | 17 |
| **CO3** | 1 | - | 27 | - | - | - | 28 |
| **CO4** | 1 | 3 | 1 | 12 | - | - | 17 |
| **CO5** | 2 | - | 15 | - | - | - | 17 |
| **CO6** | - | 12 | 4 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23RO2019** | **Duration** | **3hrs** |
| **Course Title** | **DRONE TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Expand the acronym DRONE. | | CO1 | R | 1 |
| 2. | Why can't all drones be classified as UAVs? | | CO1 | U | 1 |
| 3. | List any one advantage of multicopter drones compared to fixed-wing drones. | | CO2 | U | 1 |
| 4. | State the role of a barometric sensor on a drone. | | CO2 | R | 1 |
| 5. | List the advantage of using a closed-loop system in drones. | | CO3 | U | 1 |
| 6. | PID in a controller stands for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Define endurance. | | CO4 | R | 1 |
| 8. | What does the term “Yaw” mean in the context of quadcopter control. | | CO4 | R | 1 |
| 9. | List two advantages of using drones for aerial surveying. | | CO5 | U | 1 |
| 10. | Which type of drone is typically suitable for package delivery? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | What are the charge rate and discharge rating in batteries? | | CO1 | R | 3 |
| 12. | List two advantages and two disadvantages of multicopter drones. | | CO2 | R | 3 |
| 13. | Why is performing regular maintenance important for drones? | | CO3 | U | 3 |
| 14. | What are the six degrees of freedom in the operation of drones? | | CO4 | U | 3 |
| 15. | Differentiate between dispensable and non-dispensable payloads with an example. | | CO5 | R | 3 |
| 16. | Write a short note on the use of drones in healthcare. | | 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. |  | Describe different materials and shapes used in drone airframes. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the vertical, lateral, and rotational movements achieved in quadcopters with suitable diagrams. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the types of motors used in drones and the factors to consider when choosing the right motor. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the key flight safety rules that must be followed during drone operations. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze common causes of drone crashes and describe the key features involved in post-crash analysis. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the various radar imaging payloads used in drones and their advantages over electro-optic payloads. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Examine the use of drones in smart agriculture and explain how they can optimize farming practices. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the potential applications and future developments of drones in everyday life. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Outline the basic concepts in Flight Dynamics |
| **CO2** | Identify the hardware requirements for a Drone |
| **CO3** | Illustrate the key aspect of maintenance in a Drone |
| **CO4** | Analyze the performance of Drone |
| **CO5** | Assess the required payload for a Drone |
| **CO6** | Develop applications using Drones |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 16 | 1 | - | - | - | - | 17 |
| **CO2** | 4 | 13 | - | - | - | - | 17 |
| **CO3** | 1 | 28 | - | - | - | - | 29 |
| **CO4** | 2 | 15 | - | - | - | - | 17 |
| **CO5** | 3 | 13 | - | - | - | - | 16 |
| **CO6** | 1 | 3 | 24 | - | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23RO3001** | **Duration** | **3hrs** |
| **Course Title** | **ROBOTICS: SYSTEM AND ANALYSIS** | **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. | Categorize industrial based on the shape of their work volume with relevant diagrams and examples. | CO1 | U | 8 |
|  | b. | Compare the features of Hydraulic, Pneumatic and Electric Actuators with reference to the performance characteristics of a robot. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | A Coordinate Frame B is rotated about the Y axis by an angle α. Derive the rotational transformation matrix that is used to map the rotation with respect to the reference frame. | CO2 | A | 8 |
|  | b. | A point P in space is defined as P (2, 3, 5) relative to frame B which is attached to the reference frame A. Apply the following transformations to frame B and find P relative to frame A.   1. Rotate 30 degrees about x-axis 2. Rotate 60 degrees about local a-axis 3. Translate 2 units about y-, 3 units about z-, and 4 units about x-axes. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Determine the arm equation of the SCARA Robot shown in Fig. below. | CO3 | A | 8 |
|  | b. | Derive the forward and inverse kinematic equations of a 2 link planar RR manipulator. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | Derive the Jacobian Equation that relates to the joint velocity and end effector velocity in a 3-link manipulator. | CO4 | An | 8 |
|  | b. | Summarize the conditions of a robot manipulator that lead to its degeneracy condition and mention the methods to resolve it. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Examine the effect of Coriolis Force and Coupling inertia between two consecutive robot joints on the torque experienced by the actuators at the respective joints. | CO5 | A | 8 |
|  | b. | Derive the Equation of Motion of a 2 link manipulator with concentrated masses shown in Fig. Below..    Two Link Planar Manipulator | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Analyze the stages involved in the implementation of Resolved Rate Motion Control of an industrial robotic arm and highlight the significance of this method of motion control. | CO4 | An | 8 |
|  | b. | It is desired to design a serial manipulator that picks an object of desired shape and places it on a conveyor belt. Develop a vision based robot integration system for this application highlighting the robot configuration, sensors to be integrated and the gripping mechanism involved. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Write the general form of Homogeneous Transformation Matrix and describe the significance of each component. Prove that its inverse is equal to its transpose. | CO3 | A | 8 |
|  | b. | A 2 DoF serial manipulator has its joint angles θ1 = 30 degrees and θ2 = 60 degrees. The length of the joints is L1 = 12 inches, L2 = 10 inches. Use forward kinematic equations to determine the values of cartesian coordinates x and y. | CO3 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Summarize the types of trajectory description techniques used in path planning of a robot. | CO6 | An | 10 |
|  | b. | The second joint of a 5-axis robot is to go from an initial angle of 30 degrees to an intermediate angle of 60 degrees in 5 seconds and continue to its destination of 45 degrees in another 3 seconds. Calculate the coefficients for third-order polynomials in joint-space. Assume the joint stops at intermediate points. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Compare the anatomy of robot configurations |
| CO2 | Analyze the representation of a point in space |
| CO3 | Solve forward and inverse kinematic problems |
| CO4 | Perform differential kinematic analysis using Jacobian matrix |
| CO5 | Derive the robot dynamic equations. |
| CO6 | Simulate the path and trajectory planning applications for Robots. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 | 8 |  |  |  | 24 |
| CO2 |  |  | 16 | 8 |  |  | 24 |
| CO3 |  |  | 32 |  |  |  | 32 |
| CO4 |  |  |  | 16 |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 10 | 10 |  |  | 20 |
|  | | | | | | | **132** |