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**Presidency University**

**Bengaluru**

**School Of Computer Science and Engineering & Information Science**

**Summer Term End-Term Examinations, August 2024**

**Date**: 05/08/2024

**Time**: 9.30am to 12.30pm

**Max Marks**: 100

**Weightage**: 50%

**Odd Semester**: 2023 - 24

**Course Code**: CSE3076

**Course Name**: Artificial Intelligence for Robotics

**Department:** ISR

**Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Do not write any matter on the question paper other than roll number.*

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| **Q.No** | **Questions** | **Marks** | **CO** | **RBT** |
| 1 | 1. Define Artificial Intelligence and What are the Key Features of ROS? | 4 | CO1 | L1 |
| 1. Illustrate a closed-loop control system for maintaining a constant temperature in a pot of water. Describe how the components in this system—such as the valve, temperature sensor, and controller—collaborate to maintain the desired temperature. What are the advantages of using a closed-loop control system in this scenario? | 6 | CO1 | L2 |
| 1. Bring out the difference between Hard Real Time System and Soft Real Time System | 10 | CO1 | L3 |
| OR | | | | |
| 2 | 1. Explain four R's of Robotics? | 4 | CO1 | L1 |
| 1. How does the control loop described, with a timer as the control mechanism and a 4-second set point for a robot moving 3 inches per second, help ensure precise control over the robot's movement? Could you explain the role of the error signal in this process and how it influences the control decisions, especially when the robot needs to stop? | 6 | CO1 | L2 |
| 1. Imagine you are a robotics programmer working on a project to design a robot capable of picking up a toy and dropping it into a toy box. To illustrate the robot's behavior, draw a state machine diagram that outlines the steps involved in this process, including the various states and transitions the robot goes through to complete the task. | 10 | CO1 | L3 |

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| 3 | 1. Explain Motors or effectors in detail. | 4 | CO2 | L1 |
| 1. Imagine you are a robotics engineer tasked with designing a robot for a warehouse environment where it needs to navigate, avoid obstacles, and transport items efficiently. Describe how you would implement the Subsumption architecture in your robot's design. Highlight specific scenarios within the warehouse, and explain how the layers of the Subsumption architecture contribute to the robot's behavior in each situation. | 6 | CO2 | L2 |
| 1. You are a robotics enthusiast who has decided to participate in an Unmanned Ground Robotics Competition. In this competition, the task is to design a robot capable of navigating through a series of challenging obstacles and completing specific objectives. You want to ensure your robot is well-prepared and competitive. What are the steps involved in designing your robot for this Unmanned Ground Robotics Competition? | 10 | CO2 | L3 |
| OR | | | | |
| 4 | 1. List and explain some the hardware needs of a robot | 4 | CO2 | L1 |
| 1. As a robotics enthusiast gearing up for an Unmanned Ground Robotics Competition, outline the strategic steps you would take to design a competitive robot. Discuss the key considerations, planning, and technical aspects involved in ensuring your robot can adeptly navigate through challenging obstacles and successfully accomplish the specified objectives of the competition. | 6 | CO2 | L2 |
| 1. c. In your storyboard, describe the sequence of actions the robot should take when picking up a toy and placing it in the toy box. Consider the placement of the toy, the robot's movements, any safety measures, and how the robot should ensure the toy ends up inside the box. What key steps and visual elements will you include to make this process easily understandable to a non-technical audience? | 10 | CO2 | L3 |

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| 5 | 1. Explain Artificial Neural Network with a neat diagram? | 4 | CO3 | L1 |
| 1. b. Imagine you are designing an artificial neural network (ANN) to recognize handwritten digits for a digit recognition system. Create a neat diagram illustrating the architecture of the ANN for this specific task. Subsequently, explain the components of the architecture, including input layer, hidden layers, output layer, activation functions, and connections between neurons. | 6 | CO3 | L2 |
| 1. Imagine you are a machine learning engineer working on developing a deep neural network for a complex pattern recognition task. During the training process, you encounter challenges in achieving convergence and improving the model's performance. Explain the concept of activation functions, their role in neural networks, and discuss five commonly used activation functions, highlighting their characteristics and applications. | 10 | CO3 | L3 |
| OR | | | | |
| 6 | 1. List and explain are the types of image recognition? | 4 | CO3 | L1 |
| 1. A data scientist is working on a project involving image classification. The project has a limited labeled dataset, and training a deep learning model from scratch might be challenging due to resource constraints. Explain the concept of Transfer Learning and discuss its advantages in the context of this scenario. | 6 | CO3 | L2 |
| 1. You are a machine learning engineer tasked with developing a deep learning model for image recognition. As part of your project, you decide to use a Convolutional Neural Network (CNN) due to its effectiveness in handling image data. Explain the key types of layers in a CNN, namely the Convolution Layer, Pooling Layer, and Fully Connected Layer. Provide a detailed description of each layer's purpose, operation, and significance in the overall architecture of the CNN. | 10 | CO3 | L3 |

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| 7 | 1. List applications or areas where speech recognition can be used. | 4 | CO4 | L1 |
| 1. A computer vision project involves recognizing objects in high-resolution images with a focus on addressing the challenges of training very deep networks. Explain the architecture of ResNet and provide a neat diagram illustrating its key components, particularly emphasizing the concept of residual learning. | 6 | CO4 | L2 |
| 1. Provide a comprehensive list of various image recognition use cases, and for each use case, explain how image recognition technology can be applied to address specific challenges or improve existing processes. | 10 | CO4 | L3 |
| OR | | | | |
| 8 | 1. Explain any two Activation function. | 4 | CO4 | L1 |
| 1. Define Data Augmentation and explain its role in enhancing the diversity of a dataset during training and Provide examples of real-world applications where CNNs are utilized for real-time. | 6 | CO4 | L2 |
| 1. Find the weights required to perform the following classification using perception network. The vectors (1,1,1,1) and (-1,1, -1, -1) are belonging to the class 1, vector (1,1,1, -1) and (1, -1, -1,1) are belonging to the class -1.  Assume learning rate as 1, and initial weights as 0 and bias as 0. | 10 | CO4 | L3 |

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| 9 | 1. Explain the importance of a "Radio or datalink" in a robot in two points. | 4 | CO3 | L1 |
| 1. You are a computer vision researcher working on a project that involves classifying handwritten digits and recognizing more complex objects in images. For the handwritten digit recognition part, you are considering LeNet-5, and for the more complex object recognition, you are exploring VGG16. Explain the architectures of LeNet-5 and VGG16, highlighting their key features, and provide neat diagrams for each to illustrate their components. | 6 | CO3 | L2 |
| 1. Imagine a future scenario where a family relies on robotic assistance in their daily lives. Describe how robots play crucial roles in various aspects, such as computer-assisted manufacturing for household appliances, military applications for security, medical assistance for family health, space exploration for scientific curiosity, and personal use for household chores and communication. Highlight specific examples of robots in each category and discuss their significance in enhancing the family's quality of life | 10 | CO3 | L3 |
| OR | | | | |
| 10 | 1. Explain the importance of a "**Controller**" in a robot. | 4 | CO4 | L1 |
| 1. As a software engineer your tasked with developing a speech recognition system for a virtual assistant that will be used in a noisy environment, such as a bustling office or a busy street. Explain the various processes involved in speech recognition | 6 | CO4 | L2 |
| 1. What are the four different approaches to designing intelligent systems, and how do they differ in terms of whether they prioritize modelling human behaviour or maximizing performance? | 10 | CO4 | L3 |