

Department of Computer Science and Engineering

Examination: Final
Semester: Spring 2023

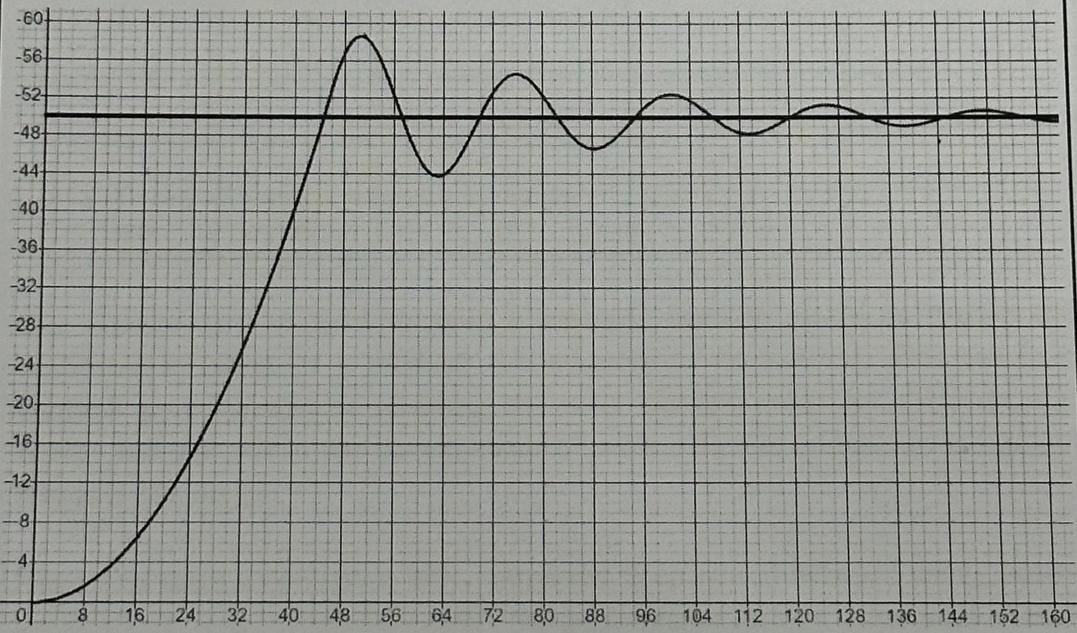
Duration: 1.50 Hours
Full Marks: 32

SET- A

CSE 461: Introduction to Robotics

Name: Washik Al Mahmud ID: 18101179 Section: 05

1. (CO1, CO2)	<p>Suppose you have a start-up company and you are looking for a robotic business. You found that recently it became a trend to keep a pet like a cat. Keeping a cat as a pet is excellent but it requires caring and cleaning issues. You want to target that community group and provide some solution. Firstly, you want to design some solutions that can help people to take care of pets and cleaning so that they can travel a distance without having any extra tension. Secondly you want to design a robot that will have the features like a pet.</p> <p>(a) Identify the features that can help to take care of pets and design the solutions with a sense-plan-act paradigm. [2 Marks]</p> <p>(b) What kind of feasible features do you want to integrate in a pet like robot? Why do you think those are feasible? [1]</p> <p>(c) Design a pet robot using advanced technologies like ChatGPT, CNN, IoT etc. [2.5 Marks]</p> <p>(d) You also want to embed some warning system inside the Robot so that it can identify gas leakage or intruder in home? How can it be possible? [2 Mark]</p>	7.5
2. (CO3)	<p>Mita was a scientist working for a wildlife conservation organization. Her latest project was to study the behavior of a rare nocturnal species of animals. To accomplish this, she decided to use advanced technology which includes vision and perception sensors. Firstly, Mita strategically placed a number of high-quality cameras around the habitat of the animals. These cameras were programmed to take photographs at precise intervals, allowing Mita to collect data from multiple sources and gain a more complete picture of the animals' behavior. This gave her valuable insights into their movements, interactions, and habits. Moreover, She also installed a network of cutting-edge sensors around the habitat. These advanced sensors were designed to accurately measure the distance between the animals and any obstacles in their path, allowing Mita to analyze their movements and behavior patterns. Finally, Mita integrated a</p>	7.5

	<p>system of sensors, which enabled her to monitor the animals' movements. These advanced sensors were specifically designed to operate in low-light conditions, allowing Mita to track the animals even in complete darkness. By combining the data from those sensors, Mita gained a comprehensive understanding of the animals' lives which would be invaluable to protect the species and their habitat.</p> <p>(a) Which camera sensor did Mita use in her camera setup, and justify why she chose that particular sensor? [2.5 Marks] (b) What sensor did Mita use to analyze the movements and behavior patterns of the animals, and Explain how that sensor works to capture the necessary data? [2.5 Marks] (c) Which sensor did Mita use to track animals in low-light conditions, and Explain the working principle of that sensor's [2.5 Marks]</p>	
3. (CO2)	<p>You are working to develop a system where desired value is 50 units and desired fluctuation is 4%. After a substantial amount of analysis, you found the following system response graph.</p>  <p>(a) What do you understand by overshoot? Find the percentage overshoot from the graph. [1+1 = 2 marks] (b) What do you understand about rise time? Find the rise time from the graph. [1+1 = 2 marks] (c) What do you understand by settling time? Find the settling time from the graph. [1+1.5 = 2.5 marks] (d) What is the difference between open loop and closed loop system? [1 mark]</p>	7.5

**4.
(CO3)**

The dataset consists of performance ratings of medical robots based on their success rate of surgeries, surgery time, patient recovery time, complications per surgery, and accuracy of diagnosis. The performance ratings are provided by medical experts who have evaluated the robots based on their ability to perform surgical procedures accurately and efficiently.

9.5

The rating is provided on a scale of 0 to 10, with higher ratings indicating better performance.

Success Rate of Surgeries	Surgery Time (Minutes)	Patient Recovery Time (Days)	Complications per Surgery	Performance Rating
0.95	120	10	1	8.7
0.92	90	7	2	8.1
0.98	150	12	0	9.2
...
...
...
0.88	180	15	3	7.5

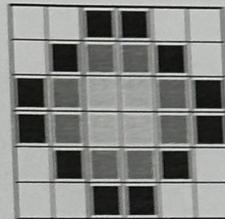
The dataset can be used to train a machine learning model to predict the performance rating of a medical robot based on its features. This can help medical professionals in selecting the most suitable robot for their specific needs, and can aid in the development of more efficient and accurate medical robots in the future.

Now, you want to design a fully connected deep neural network using these 4 attributes as inputs that may predict the performance ratings. After a lot of trials and discussions with experts, you found a handsome network that has 2 hidden layers. The first hidden layer has 3 neurons, the next one has 5 neurons.

- (a) What type of Machine Learning Problem is this and Why? Draw the structure of the neural network. [1.5 +2 Marks]
- (b) To make the prediction more accurate, we can use medical images such as X-rays, CT scans, and MRI scans. These images can provide additional information about the patient's condition, which can be used along with the performance ratings of medical robots to improve the

accuracy of the prediction. An image, its pixel values and a kernel are given below. Apply Convolution on the image by using the kernel. [4 Marks]

kernel		
1	0	-1
1	0	-1
1	0	-1



11	11	00	00	11	11
11	00	01	01	00	11
00	01	10	10	01	00
00	01	10	10	01	00
11	00	01	01	00	11
11	11	00	00	11	11

(c) Apply 2x2 Max Pooling to the resulting images. [2 Marks]