BRAC UNIVERSITY

Department of Computer Science and Engineering

Examination: Midterm **Duration: 1 Hour 10 mins**
Semester: Fall 2022 **Full Marks: 25**

CSE 461: Introduction to Robotics

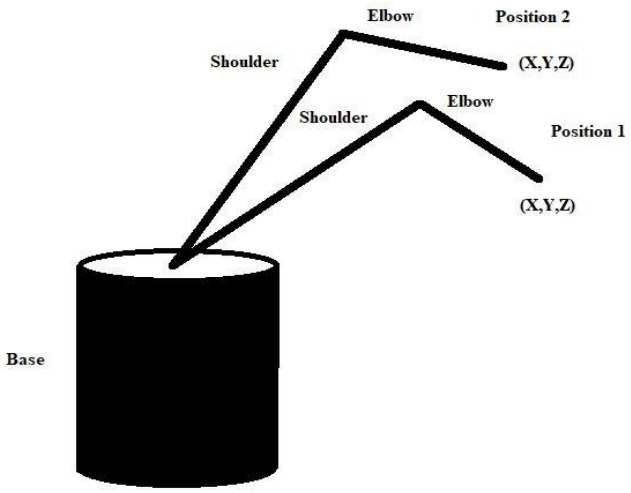
Name: ID: Section:

Set-A

The present world is the age of science and technology. Although people are developing newer and newer things day by day, we are facing various unfortunate and unwanted situations. Recently a massive fire at a container depot near a port city in southeastern Bangladesh killed at least 49 people, including nine firefighters, and injured more than 100 others, officials and local media reported Sunday, as efforts to extinguish the blaze continued into a second night. A Robotic team from Bangladesh has decided to make a rescue robot to support this kind of sorrowful situation.

After lots of research, the team has decided on some characteristics of their robot. As such the Robot should be able to survive at a certain heat level. It should be able to sense the fire and smoke and act accordingly by making an alarm. The robot should be able to detect the distance of any object and it would move in any direction. It should also recognize this current location. It should have an arm to collect small objects according to this capacity. Also, the team is planning to give the robot, object detection capability through image processing.

1.	**CO1**	a. **Which** robotic paradigm will the team use to build such a robot and why? [2 Marks] b. **What** kind of motor the team should use, and why? [2 Marks] c. **What** kind of actuator would be better to use for the manipulator, and why? [2 Marks] d. **What** types of sensors could be used, and why? [2 Marks] e. **What** kind of processing device is better to use in this Robot? [2 Marks]	**10**
2.	**CO1**	(Answer **Any 5 Marks** out of the following questions) a. Day by day the number of human labor is decreasing and consumption is increasing. In these circumstances, the RMG sector is looking for robots to work in their garments. Do you think we should use robots in the garment sector? Why or why not, justify your answer. [2 Marks]	**5**

		b. Write an application where a humanoid robot can be used. [1 Mark] c. If we increase the degree of freedom of a manipulator, what kind of advantages can be achieved? [1 Mark] d. What are the limitations of DC Motor? How can it be resolved? [2 Marks] e. Write an application where Sonar would be the better choice than a LIDAR. Why? [1 Mark]	
3.	**CO2**	 a. Suppose a manipulator is used in an automation factory that mainly moves an object from Position 01 (See Image) to Position 02. The manipulator has a base height of 32", shoulder length of 48", and elbow length of 23". Answer the following questions: 1. To go to Position 01, if the base rotates 20.4°, the shoulder moves 38°, and the elbow moves 102.1° then find the final coordinate (X, Y, Z) of the end-point of the manipulator. [5 marks] 2. For position 02, the (X, Y, Z) coordinates are (44, 26, 74). Find the angle of base rotation, angle of shoulder movement, and angle of elbow movement. [5 marks]	**10**

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CSE 461: Introduction to Robotics

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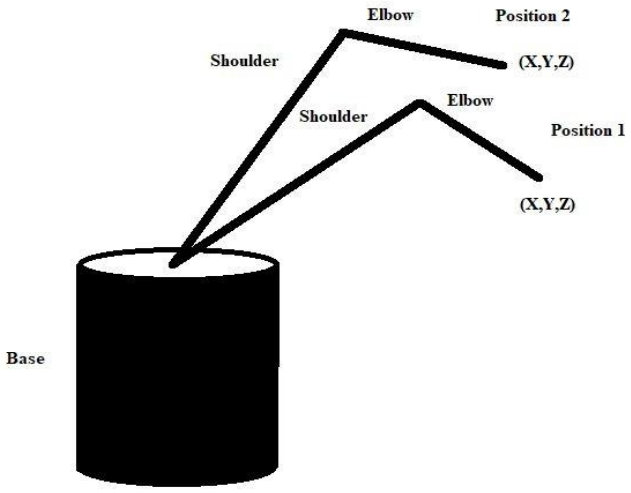
Set-B

As human civilization prospered in technology, they started thinking about sophisticated robot surgeons. ROBU (Robotics Club of BRAC University) wants to design a robot that can remove small calcified stones from human bodies. First, the robot will be given x-ray & MRI images. The stones can be determined through image processing which requires heavy computational resources. After detection, the robotic arm needs to move to the exact location. Finally, the end effector, which works like a small hand that may grasp small objects, collects the stones.

1.	**CO1**	a. **Which** robotic paradigm will the team use to build such a robot and why? [2 Marks] b. **What** kind of motor the team should use, and why? [2 Marks] c. **What** kind of actuator would be better to use for the manipulator, and why? [2 Marks] d. **What** types of sensors could be used, and why? [2 Marks] e. **What** kind of processing device is better to use in this Robot? [2 Marks]	**10**
2.	**CO1**	(Answer **Any 5 Marks** out of the following questions) a. Suppose Dr. Bongobahadur built an AI robot named Bongobot and he is using it for his household purpose. There was a fire in his house and Bongobahadur ordered Bongobot to save his dog from the fire. As the robot was programmed to protect itself from harm it did not help him. Was it fair? Why or why not? [2 Marks] b. Write an application where a miniature UAV robot can be used. [1 Mark] c. If you want to reduce the huge amount of motor rotation speed and hold strongly, what type of gear can be used?[1 Mark] d. What are the limitations of the Stepper Motor? How can it be resolved? [2 Marks]	**5**

		e. Write an application where Terrestrial LIDAR would be the better choice than a Camera. Why? [1 Mark]	
3.	**CO2**	 a. Suppose a manipulator is used in an automation factory that mainly moves an object from Position 01 (See Image) to Position 02. The manipulator has a base height of 20.84”, shoulder length of 28.97”, and elbow length of 13.48”. Answer the following questions: 1. To go to Position 01, if the base rotates 58.77°, the shoulder moves 25.41°, and the elbow moves 70.5° then find the final coordinate (X, Y, Z) of the end-point of the manipulator. [5 marks] 2. For position 02, the (X, Y, Z) coordinates are (10.52, 28.99, 29.44). Find the angle of base rotation, angle of shoulder movement, and angle of elbow movement. [5 marks]	**10**

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CSE 461: Introduction to Robotics

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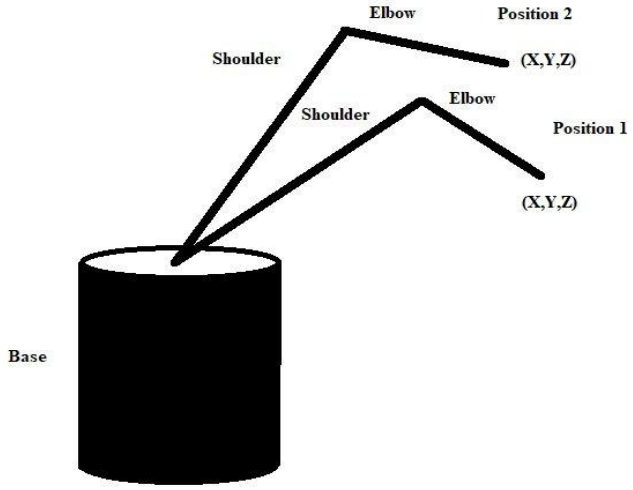
Set-C

Japan is organizing a Robot combat tournament named "Megalo Boxing". Robotics engineers from all over the world will participate in the tournament with highly developed combat robots. From Bangladesh, you and your team will participate in that tournament with a robot named "Xtreme-007". Your team is already working on making a powerful and intelligent robot. Your robot will process the opponent robot's combat skills and Offensive/Defensive mode will be turned on accordingly. It will give an overall measurement and data about the opponent robot to the team so that your team can think of a strategy. Your robot should be able to generate a very powerful punch to make a destructive blow. Even if the opponent makes a sudden attack from behind, your robot will be able to precisely position or rotate itself to block the attack. Its hardware structure should be strong enough to process all these complex actions. Now your job is to help your team to make a robot that can fulfill all the requirements.

1.	**CO1**	a. **Which** robotic paradigm will the team use to build such a robot and why? [2 Marks] b. **What** kind of motor the team should use, and why? [2 Marks] c. **What** kind of actuator would be better to use for the manipulator, and why? [2 Marks] d. **What** types of sensors could be used, and why? [2 Marks] e. **What** kind of processing device is better to use in this Robot? [2 Marks]	**10**
2.	**CO1**	(Answer **Any 5 Marks** out of the following questions) a. Suppose after 20 years AI robots have become very advanced. Robots can be used in every task we want (from toilet cleaning to cooking). At that time, suddenly Ms. Bongonari came to Mr. Bongobahadur for a job where Bongobahadur was looking for an efficient robot for that job. What should Bongobahadur do in these circumstances? Why? [2 Marks]	**5**

		b. Write an application where a Remotely operated underwater vehicle robot can be used. [1 Mark] c. If we want to change a mechanical movement from one direction to another (90 degrees) what type of gear can be used?[1 Mark] d. What are the limitations of Servo Motors? In what application can it be used? [2 Marks] e. Write an application where Terrestrial LIDAR would be the best choice over a Camera. Why? [1 Mark]	
3.	**CO2**	 a. Suppose a manipulator is used in an automation factory that mainly moves an object from Position 01 (See Image) to Position 02. The manipulator has a base height of 26.23", shoulder length of 34.44", and elbow length of 18.13". Answer the following questions: 1. To go to Position 01, if the base rotates 40°, the shoulder moves 32.3°, and the elbow moves 120.45° then find the final coordinate (X, Y, Z) of the end-point of the manipulator. [5 marks] 2. For position 02, the (X, Y, Z) coordinates are (25.46, 35.68, 43.11). Find the angle of base rotation, angle of shoulder movement, and angle of elbow movement. [5 marks]	**10**