Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

## Continuous Assessment Test (CAT) – I - AUGUST 2024

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| Programme | : | B.Tech ECE | Semester | : | Fall Sem. 2024-25 |
| Course Code & Course Title | : | BECE312L & Robotics and Automation | Class Number | : | CH2024250101238 CH2024250101240 CH2024250101235 |
| Faculty | : | Dr. R. Priyadarshini / 52200 Dr. S. Abinaya / 52232 Dr. Suguna M / 52215 | Slot | : | B2+TB2 |
| Duration | : | 1½ Hours | Max. Mark | | 50 |

**General Instructions:**

Write only your registration number on the question paper in the box provided and do not write other information.

Only non-programmable calculator without storage is permitted

**Answer all questions**

| Q. No | Sub Sec. | Description | Marks |
|---|---|---|---|
| 1. | | 1. Carving wooden doors with designs<br>2. Spot welding<br>3. Engraving applications with high precision and accuracy<br>4. To employ in polar coordinate system<br>5. Packaging and material handling<br>Identify a suitable kinematic configuration robot for the above scenario with suitable formula. | 10 |
| 2 | | Consider a scenario, in which you are asked to identify the industrial robots for the degree of freedom from 1 to 5. Justify your answer, how you calculated the degree of freedom. | 10 |
| 3 | | A mobile robot has to travel on the given path. The path is drawn in black colour. During the journey, it may encounter obstacles. In the case of obstacles, it has to wait till the obstacle is cleared. It is to drive straight ahead (move forward) until it sees a traffic light which is either Yellow or Red. The mobile robot has to be idle as long as the traffic light is Red. When the light is Green it has to move straight ahead (forward) again. At every stoppage, it has to drop a packet. Once it reaches the destination, it has to display the total number of packets it dropped during the journey on the LED. | 10 |
| | a) | For the above given scenario, identify the suitable sensors and draw an architecture diagram. [5 marks] | |
| | b) | Explain the working mechanism and communication mechanism of the components. [5 marks] | |

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| 4 | | You are designing a robotic arm with three equal-length links L1, L2 and L3 each of 1 meter long and weighing 10 kg. The arm needs to pick up a 5 kg box from a conveyor belt and place it 2 meters away. The arm operates in a horizontal plane. | 10 |
| | a) | Calculate the torque required at each joint when the arm is fully extended and holding the 5 kg box. Assume gravitational acceleration is 9.81 $m/s^2$ [6 Marks] | |
| | b) | Calculate the additional torque needed at each joint, if the arm moves the box with an angular acceleration of 1.5 $rad/s^2$. [4 Marks] | |
| 5 | | As the lead engineer, your task is to design the electric drive systems for robotic arms for a high-precision industrial assembly line. The robotic arms are required to perform tasks that demand both accurate positioning, smooth and continuous movement. | 10 |
| | a) | Draw the schematic diagram of a DC motor with a commutator. [4 Marks] | |
| | b) | Illustrate a circuit diagram of a stepping motor control system, explaining how each component contributes to the precise control of the robotic arm's movements [6 Marks] | |