



Name :

Roll No. :

Invigilator's Signature :

CS/M.TECH(ME)/SEM-2/ME-1201/2010

2010

ROBOTICS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions.

5 × 14 = 70

1. a) Explain the laws of robotics from basic philosophy pertaining to the field.

b) What are basic components of a robot and how do they interact among themselves to meet the need ?

c) What is meant by work envelope ? With suitable sketch show the work envelope of a spherical and cylindrical robot. 2 + 4 + 8
2. a) With a block diagram differentiate forward kinematics to backward kinematics.

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- b) Using Denavit-Hartenberg (D-H) convention, write down transformation matrices for each link and represent the position and orientation of end-effector with respect to base for the robot shown in the following *Figure 1*. 4 + 10

Fig. 1

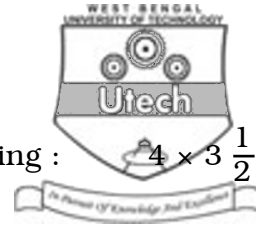
3. a) With proper illustrations, classify industrial robot grippers according to their functionality and purpose.
- b) What are the issues and aspects in designing autonomous anthropomorphic robot grippers under visual guidance ? Explain with hierarchical control strategies. 5 + 9
4. a) What does Remote Center Compliance (RCC) mean ? With proper illustration show its functions.
- b) Draw the block diagram of an intelligent robot. Discuss various types of sensors along with their applications that are used in industrial robots. 6 + 8



5. a) What are the general considerations in path description and generation for any robotic manipulator ?
- b) What are the techniques adopted in collision free path planning in a robotic cell ?
- c) In a Stanford arm manipulator, the second joint is to move from an initial position of 30° to a final position of 78° in 3 seconds. Assume the joint starts and finishes a zero velocity. Find the cubic polynomial that satisfies this motion. Calculate the position, velocity and acceleration of this joint at intervals of 1 second and show their plots against time. 2 + 4 + 8
6. a) What are the different textual robot languages ? Discuss their relative merits and demerits.
- b) In a pallet objects protruding 40 mm from the face of the pallet are located in a number of rows and columns. The pallet has 3 rows that are 30 mm apart and 4 columns that are 50 mm apart. The plane of the pallet is assumed to be parallel to the X-Y plane. The rows are parallel to X-axis and the columns are parallel to Y-axis. The objects are to be picked up one after another from the pallet and to be placed in a location chute. The pallet has been shown in *Figure 2*. Write the programme for depalletizing operation. 6 + 8

Fig. 2

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7. Write short notes on any *four* of the following :

$4 \times 3 \frac{1}{2}$

- a) ANN approach in prehension
- b) Force & Torque sensors
- c) Nano-robotics
- d) Tele-robotics
- e) Singularity in Robot Dynamics
- f) Robot application in medical science.

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