

CBCS SCHEME

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15MA82

Eighth Semester B.E. Degree Examination, November 2020 Industrial Robotics

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions irrespective of modules.

Module-1

- 1 a. What are the objectives of industrial robots? List them. (08 Marks)
- b. Give the classification of robots based on mechanical configuration. Sketch the configurations indicating degree of freedom associated. (08 Marks)
- 2 a. Give a comparison between hydraulic and electric drives used in robots. (08 Marks)
- b. List the tools which act as the end effector, when attached to the robot wrist. (08 Marks)

Module-2

- 3 a. Sketch the response of second order system subjected to step input and explain the terms:
 - (i) Raise time
 - (ii) Peak time
 - (iii) Peak overshoot
 - (iv) Setting time
 - (v) Steady state error(08 Marks)
- b. Derive an expression for the response of proportional integral controller to a step input. Sketch the response versus time. (08 Marks)
- 4 a. Explain the lead through programming used in robot programming. In what modes lead through procedure operate? (08 Marks)
- b. Give the syntax of following commands:

(i) aggregate	(ii) move	(iii) speed
(iv) signal	(v) wait	(vi) open
(vii) path	(viii) close for servoed gripper	(ix) react

(08 Marks)

Module-3

- 5 a. A gripper has yaw of $\frac{\pi}{2}$, pitch of $\frac{\pi}{2}$ followed by roll of $\frac{\pi}{2}$. Obtain the composition matrix. (08 Marks)
- b. A point P is expressed with respect to frame F denoted as P_1 . P_2 denotes the location of P_1 after 30° of rotation about z-axis, followed by translation of 2 units along x-axis and -1 unit along z-axis. Obtain the transformation matrix 1T_2 . (08 Marks)
- 6 a. Obtain the orientation matrix for XYZ Euler angle (moving frame) of rotation through ϕ , θ , Ψ respectively. Sketch the rotation frames. (08 Marks)
- b. Indicate D-H parameters and the associated transformation matrix for link parameters in terms of link frames. (08 Marks)

Module-4

- 7 A R-P manipulator is shown in Fig.Q7. Obtain the torque required at the joints to apply a force f at the tip.

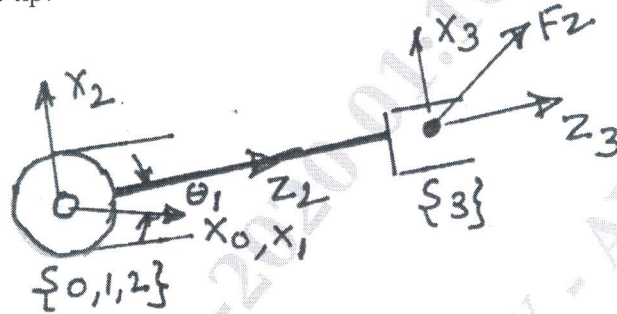
Angle is θ_1

Fig.Q7

(16 Marks)

- 8 A single link robot with rotary joint is motionless at $\theta = 15^\circ$. It is desired to move the joint in a smooth manner to $\theta = 75^\circ$ in 3 seconds. Find the coefficients of the cubic polynomial which accomplishes this motion and brings the manipulator to rest at goal point. Sketch the plot of displacement, velocity and acceleration versus time. (16 Marks)

Module-5

- 9 a. What are the desirable features of sensors used in robots? (08 Marks)
 b. A video signal is converted into a discrete signal. The range of signal after amplification is 0 to 5V. The A/D converter has 8 bit capacity. Determine:
 (i) The number of quantization levels
 (ii) The quantization level spacing
 (iii) The quantization error (08 Marks)
- 10 a. Write down the equation for static equilibrium in matrix form of a force-torque sensor measuring three forces and three moments. (08 Marks)
 b. Using a block diagram, represent a general machine vision system used in robot. (08 Marks)
