CBCS SCHEME

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15MA82

Eighth Semester B.E. Degree Examination, Aug./Sept.2020
Industrial Robotics

Time: 3 hrs. Max. Marks: 80

Note: i) For Regular Students: Answer any FIVE full questions irrespective of modules.
ii) For Arrear Students : Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain, why Robotics coincides most closely with programmable automation? Enlist the chronology of developments related to Robotics Technology. **(05 Marks)**

b. Discuss the advantages of using Robots in Industries. **(03 Marks)**

c. Sketch and explain the following configurations of Robots. Show their work volume:
(i) Cylindrical Robot
(ii) Articulated Robot **(08 Marks)**

2 a. Sketch and explain the three degrees of freedom degrees of freedom of a Robot Wrist. **(03 Marks)**

b. Briefly explain the following:
(i) End effectors
(ii) Types of Joints with sketches. **(08 Marks)**

c. Explain the three attributes of Precision of Movement in Industrial Robots. **(05 Marks)**

Module-2

3 a. Describe the control system components for a One Joint of a Robot Manipulator with the help of a block diagram. **(05 Marks)**

b. List the six controllers used in a Robot Control System, and describe the P-I controller with its Transfer function. **(06 Marks)**

c. What are the various transient response parameters? Indicate them on the response curve. **(05 Marks)**

4 a. Differentiate between Powered Lead through and Manual Lead through programming techniques. What are the limitations of lead through method? **(05 Marks)**

b. Briefly explain the features and capabilities provided by second generation programming languages for Robots. **(05 Marks)**

c. Briefly explain the following robot language commands with examples:
(i) Motion and related commands
(ii) End effector and sensor commands **(06 Marks)**

Module-3

5 a. Explain the following:
(i) Inverse kinematic analysis
(ii) Homogeneous Rotation Matrices **(10 Marks)**

b. A Point $P(8, 4, 3)^T$ is subjected to transformations described as:
(i) Rotation of 90° about Z-axis
(ii) Rotation of 45° about Y-axis
(iii) Rotation of 60° about X-axis
Find the coordinates of the point relative to the reference frame. **(06 Marks)**

6 a. Briefly explain the Link and Joint parameters for a Joint-Link pair with the help of figure. (08 Marks)

b. Explain the Denavit-Hartenberb (DH) method for obtaining the transformation matrix for a Robot Manipulator. (08 Marks)

Module-4

7 a. Explain the following briefly as applied to Robot Arm dynamics:
(i) Joint Velocities
(ii) Potential Energy
(iii) Kinetic Energy (08 Marks)

b. What is Lagrangian? Explain the steps involved in arriving at a dynamic equation for a robot manipulator by Lagrange-Euler formulation. (08 Marks)

8 a. What are the general considerations for Trajectory Planning? (06 Marks)
b. Briefly explain what is 4-3-4 Trajectory. (05 Marks)
c. Explain the problem for planning a trajectory planning. (05 Marks)

Module-5

9 a. Differentiate between Internal State and External State Sensors with examples. (04 Marks)
b. Explain what is proximity sensing. Sketch and explain the Reflected light with sensor array used for proximity sensing. (06 Marks)
c. Explain the types of Tactile Sensors. (06 Marks)

10 a. Briefly explain the three functions included for operation of Machine Vision System. (06 Marks)

b. Briefly discuss the three phases included for Analog to Digital Signal Conversion. (05 Marks)
c. Briefly explain about Image data reduction methods used for image processing and analysis. (05 Marks)

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