

Code No: 117HA

**R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year I Semester Examinations, November/December - 2017

**ROBOTICS**  
(Common to AME, ME)

Time: 3 Hours

Max. Marks: 75

Note: This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A.

Part B consists of 5 Units. Answer any one full question from each unit.

Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

(25 Marks)

- 1.a) Define the term robotics [2]
- b) Describe the relation between automation and robotics [3]
- c) What is manipulator kinematics? [2]
- d) What is homogenous transformations? [3]
- e) What is robot arm dynamics? [2]
- f) Write about Euler angles. [3]
- g) What is a hydraulic actuator? [2]
- h) Draw the block diagram of trajectory planning. [3]
- i) Define robot applications in manufacturing. [2]
- j) Describe material transfer applications. [3]

**PART - B**

(50 Marks)

- 2.a) Distinguish an automation and a robot.
  - b) Classification the robot by any two coordinate systems. [5+5]
- OR**
- 3.a) Explain the working principle of proximity sensors used in robots.
  - b) Discuss some of the important considerations in the design of grippers. [5+5]
- 4.a) Derive rotation in the y-z plane using the geometric approach.
  - b) For the point  $a_{uvw} = (6, 2, 4)^T$  rotate  $30^\circ$  about the y-axis followed by translation of 6 units along X-axis. [5+5]
- OR**
- 5.a) For the point  $a_{uvw} = (6, 2, 4)^T$  Translate 6 units along y-axis, followed by rotation of  $30^\circ$  about x-axis.
  - b) Write the forward kinematics for any manipulator based on D-H convention. [5+5]
- 6.a) Differentiate clearly with reference to 2-jointed manipulator of LL type.
  - b) Find the joint space singularities of the cylindrical coordinate robot. [5+5]
- OR**
- 7.a) Find the manipulator Jacobain matrix  $J(q)$  of the five-axis spherical coordinate robot.
  - b) Describe newton-Euler formulation in dynamic modeling of robotics control. [5+5]

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8.a) A manipulator with a single link is to rotate from  $30^{\circ}$  to  $100^{\circ}$  in 2 seconds. The joint velocity and acceleration are both zero at the initial and final positions. Determine the coefficient of a quadratic polynomial that accomplishes the motion.

b) Differences between open-loop and closed-loop control systems. [5+5]

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9.a) Explain any one method of splitting a joint trajectory.

b) List the types of manipulators employed for travelling from point-to-point motion types. [5+5]

10.a) Describe the material handling operations.

b) Explain simple pick-and-place operation of the robot. [5+5]

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11.a) Describe the pelletizing operation of material transfer application of a robot.

b) Explain loading and unloading of material handling in die casting process. [5+5]

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