

01011

**BACHELOR OF TECHNOLOGY IN
MECHANICAL ENGINEERING
(COMPUTER INTEGRATED
MANUFACTURING)**

Term-End Examination

December, 2013

BME-029 : ROBOTICS

Time : 3 hours

Maximum Marks : 70

Note : Attempt any five questions. All questions carry equal marks.

1. (a) What are the four D's of robotics ? Briefly explain. 7
- (b) What is the shape of the work space of SCARA robot ? Draw it. 7
2. (a) Give the requirements of an actuator for robotic applications. 7
- (b) Distinguish accuracy from repeatability. 7
3. (a) What is the meanings orthogonal property of a rotation matrix ? Find out inverse of following rotation matrix : 7

$$Q = \begin{bmatrix} \text{Cos}\alpha & -\text{Sin}\alpha & 0 \\ \text{Sin}\alpha & \text{Cos}\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

- (b) Define degree of freedom (DOF) of a mechanical system. With suitable notation give the formulae of DOF as Grubler - Kutzbach Criterion. 7
4. (a) Find the Jacobian for any three link planar manipulator with revolute joints. 9
- (b) Describe two important methodologies for robot dynamics. 5
5. Explain the order of trajectory that has to satisfy position , velocity and acceleration-constraints at the initial and final points - Derive the function. 14
6. Classify the type of robot control systems. With the help of suitable block diagram describe any one of the robot control systems. 14
7. (a) Differentiate on-line and off-line programming. 7
- (b) What is programming by simulation ? 7
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