

Code No: R32032

**R10****Set No: 1**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

**ROBOTICS**

(Mechanical Engineering)

**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions  
All Questions carry equal marks

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1. a) Explain the three classes of Automation.  
b) Why robots are to be applied in industries?
2. a) What is work envelope? Show the work envelope of  
i) SCARA robot ii) Cartesian robot iii) articulated robot iv) Cylindrical robot  
b) What is the difference between standard servo and feed forward servo?
3. For the point  $P_{xyz} = (8, 3, 6)^T$  perform following operations  
a). Rotate  $60^\circ$  about the Y-axis followed by translation of 4 units along x-axis?  
b). Rotate  $30^\circ$  about the Z-axis followed by rotation of  $60^\circ$  about X-axis?  
c). Translate 10 units along Z-axis followed by rotation of  $45^\circ$  along Z-axis?
4. Write the steps involved in deriving forward kinematics for any manipulator based on D-H convention?
5. What are singular configurations? Determine Jacobin, singularities and joint velocities for a 3-DOF spherical wrist?
6. Write briefly about Robot programming, languages and software packages?
7. a) Differentiate stepper motor and D.C motor drives of a robot?  
b) Explain the position sensors used in robotics?
8. a). What are the requirements of the robot for spray-coating applications?  
b). Discuss the robotic Inspection system.

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**R10****Set No: 2**

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**ROBOTICS**

(Mechanical Engineering)

**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions  
All Questions carry equal marks

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1. a) Write the present and future applications of robots used in industries.  
b) Write the main characteristics of robot application in industry.
2. a) Explain the architecture of the following robots  
i) jointed arm robot ii) Cartesian robot iii) cylindrical robot iv) spherical robot  
b) With the help of line diagram show basic components of a robot connected to a system?
3. a) Obtain the homogeneous transformation matrix that represents a rotation of ' $\alpha$ ' degrees about the current X-axis followed by a translation of ' $b$ ' units along the current X-axis, followed by a translation ' $d$ ' units along the current Z-axis, followed by a rotation of ' $\theta$ ' degrees about the current Z-axis?  
b) Explain about equivalent axis & angle representation?
4. Derive the forward kinematics matrix for a SCARA robot arm without wrist?
5. Derive the jacobian matrix and find the linear and angular velocities of the end effector for a planar RR manipulator?
6. a) What is path planning? Explain the need for path planning?  
b) A single cubic trajectory is given by  $\theta(t) = 8 + 10t + 45t^2 + 35t^3$  and is used over the time interval from  $t = 1$  to  $t = 2$ . What are the initial and final velocities and accelerations?
7. a) Explain the encoders used in robots.  
b) Explain about stepper motors.
8. a) What are the general considerations in selecting a robot for material handling?  
b) Explain the use of robots in inspection of parts.

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**R10****Set No: 3**

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**ROBOTICS**

(Mechanical Engineering)

**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions  
All Questions carry equal marks

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1. a) What are the Laws of Robotics? What are the Thumb Rules on the decision of a robot usage?  
b) Discuss about various special purpose robots?
2. a) Explain the terms resolution, payload, repeatability, degrees of freedom and accuracy of a manipulator.  
b) Explain various types of joints used in robots. What are the design considerations of gripper selection?
3. a) Explain the homogeneous transformation as applicable to rotation?  
b) If a point  $(8i+5j+6k)$  is translated 4 units along Y-axis and then rotated  $30^\circ$  about X-axis, obtain the co-ordinates after transformation?
4. Derive the forward kinematics matrix for an articulated robot arm (3-axis) using D-H convention?
5. What is Jacobian? Find the jacobian matrix for 2-link planar RP manipulator and also find its singularities?
6. Derive the expression for the joint torques of a two link planar revolute jointed robotic manipulator using Lagrange-Euler formulation?
7. a) Explain the working principle of pneumatic and hydraulic actuators?  
b) Write a brief notes on feed back components?
8. Describe the applications of robots for the following cases.
  - a). Material handling
  - b). Continuous arc welding
  - c). Loading and unloading

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**R10****Set No: 4**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

**ROBOTICS**

(Mechanical Engineering)

**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions  
All Questions carry equal marks

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1. a) Give comparison of CAD/CAM and robotics.  
b) Classify robots based on the co-ordinate system and control system with neat diagram.
2. a) Sketch and explain general linkage mechanisms for mechanical grippers.  
b) Give comparison of electric, hydraulic and pneumatic types of locomotion devices.
3. a) Explain Roll-Pitch-Yaw (RPY) transformation with an example?  
b) For the point  $P_{xyz} = (0, 5, 2)^T$  perform following operations i) Rotate  $30^\circ$  about the Y-axis followed by translation of 4 units along z-axis? ii) Translate 6 units along Z-axis followed by rotation of  $60^\circ$  along y-axis?
4. Derive the forward kinematics equation using the D-H convention for the three link planar revolute jointed manipulator (RRR)?
5. What is dynamic modeling? Distinguish the advantages and disadvantages between Euler-Lagrange and Newton-Euler formulation?
6. a) An articulated robot (RRR) is to move all three axes so that the first joint is rotated through  $45^\circ$ , the second joint is rotated through  $60^\circ$  and the third joint is rotated through  $45^\circ$ . Maximum speed of any rotational joints is  $15^\circ/\text{s}$ . Ignore effects of acceleration and deceleration.  
i) Determine the time required to move each joint if skew motion is used?  
ii) Determine the time required to move the arm to the desired position and the rotational velocities of each joint, if joint interpolation motion is used?  
b) Differentiate between path planning and trajectory planning?
7. Explain about robot actuators and feedback components.
8. a) What are the different types of robotic programming techniques? Explain.  
b) Describe material handling operations.

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