

Code No: RT32034

R13

SET - 1

III B. Tech II Semester Regular Examinations, April - 2016

ROBOTICS

(Mechanical Engineering)

Time: 3 hours

Maximum Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)

2. Answering the question in **Part-A** is compulsory

3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) What are the future applications of Robot? [4M]
- b) How many degrees of freedom does a wrist have? What is the purpose of these degrees of freedom? [4M]
- c) Differentiate joint coordinates and world coordinates. [3M]
- d) Differentiate between Lagrange Euler and Newton Euler Formulation. [4M]
- e) Differentiate joint space trajectory and Cartesian trajectory planning. [4M]
- f) List the advantages and disadvantages of pneumatic actuator. [3M]

PART -B

- 2 a) Sketch and explain the four basic robot configurations classified according to the coordinate system. [12M]
- b) Differentiate CAD/CAM and robotics. [4M]
- 3 a) Discuss in detail the architecture of robot system. [8M]
- b) Discuss about Vacuum Grippers along with their advantages and disadvantages. [8M]
- 4 a) Determine the transformation matrix T that represents a translation of 'a' units along x-axis, followed by a rotation of β about x-axis and followed by a rotation of Θ about z-axis. [8M]
- b) What is homogenous transformation matrix? Explain four sub matrices. [8M]
- 5 Determine the manipulator jacobian matrix and singularities for the 3-DOF articulated arm. [16M]
- 6 What are the common types of motion that a robot manipulator can make in travelling from point to point? [16M]
- 7 a) Explain the various drive system used with an industrial robot and compare their features, merits and demerits. [8M]
- b) Describe the various considerations taken into account for material handling. [8M]

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PART -A

- | | | | |
|---|----|---|------|
| 1 | a) | Differentiate flexible automation and fixed automation. | [4M] |
| | b) | What are the types of End effectors? | [3M] |
| | c) | Differentiate forward and inverse kinematics. | [4M] |
| | d) | What do you mean by Torque sensor? | [3M] |
| | e) | List out different robot programming languages. | [4M] |
| | f) | What features are required for robot in spray painting? | [4M] |

PART -B

- | | | | |
|---|----|--|-------|
| 2 | a) | What is the importance of Automation in industry? Explain. | [8M] |
| | b) | Describe the classification of robots by control system. | [8M] |
| 3 | a) | Discuss in detail about Magnetic gripper with neat sketch. | [8M] |
| | b) | What do you understand by degree of freedom (DOF)? How many DOFs are required to position an end effector at any point in 3-D space? | [8M] |
| 4 | | For the point [3 7 5] perform the following operations: | [16M] |
| | a) | Rotate 30^0 about X-axis | |
| | b) | Translate 8 units along y-axis | |
| | c) | Rotate 30^0 about x then translate 6 units along Y- axis. | |
| | d) | Rotate 90^0 about z-axis. | |
| 5 | a) | What are the singularities of a manipulator? How are they classified? | [8M] |
| | b) | How will you compute Jacobian for a rotary Joint? | [8M] |
| 6 | a) | Write down the capabilities and limitations of Lead through methods. | [8M] |
| | b) | A single cubic trajectory given by $q(t)= 30+t^2-6t^3$ is used for a period of 3 seconds. Determine starting and final position, velocity and acceleration of endeffector. | [8M] |
| 7 | a) | Briefly explain the working principle of any two types of position sensors with neat sketch. | [8M] |
| | b) | Explain use of robot in assembly operation. | [8M] |

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SET - 3

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2. Answering the question in **Part-A** is compulsory

3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) Give the classification of robot by control system. [3M]
- b) What do you mean by magnetic gripper? [4M]
- c) Define DH parameters. [4M]
- d) What do you mean by Jacobian matrix? [3M]
- e) What are the software packages available for robot programming? [4M]
- f) What features are required for robot in spot welding? [4M]

PART -B

- 2 a) Explain how robotics is a technology for future. [8M]
- b) What are types of automation? Explain them with examples. [8M]
- 3 a) Discuss in detail factors considered while selection and design of grippers. [10M]
- b) What are the different components of industrial robotics? [6M]
- 4 a) What is the role of D-H notation? Explain their importance in solving Forward Kinematics. [8M]
- b) Write homogenous transformation matrices for rotation in 3D. [8M]
- 5 a) Make a comparison of Newton-Euler and Lagrange-Euler formulations and state the situation when you will prefer Newton-Euler and when you will prefer Lagrange-Euler formulation. [8M]
- b) For a given manipulator, the velocity Jacobian and the static force jacobian different? Explain your answer. [8M]
- 6 a) Explain the steps involved in Trajectory planning. [8M]
- b) Discuss the SPEED control commands of Robot languages. [8M]
- 7 a) Describe the Spray coating operation with robot system. [8M]
- b) Explain the working of a stepper motor. [8M]

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3. Answer any **THREE** Questions from **Part-B**

PART -A

- | | | | |
|---|----|--|------|
| 1 | a) | Differentiate servo controlled robot and non-servo controlled robot? | [3M] |
| | b) | What are the limitations of Adhesive gripper? | [4M] |
| | c) | What do you mean by homogeneous transformation? | [3M] |
| | d) | What do you mean by manipulator jacobian? | [4M] |
| | e) | What are the methods of teaching a robot? | [4M] |
| | f) | What are the limitations of potentiometer? | [4M] |

PART -B

- | | | | |
|---|-----|---|-------|
| 2 | a) | What is the work envelope of a robot sketch and explain two views to indicate the work envelope of a cylindrical robot. | [8M] |
| | b) | Differentiate Hard automation and Flexible automation using robot. | [8M] |
| 3 | | Explain mechanical grippers and their linkage mechanisms with neat sketches. | [16M] |
| 4 | a) | Explain the implementation of DH notation for a links coordinate system and joint parameters. | [10M] |
| | b) | What are fundamental rotation matrices? | [6M] |
| 5 | | Determine the equations of motion for 2DOF RR- planar manipulator arm using Lagrange-Euler Formulation. | [16M] |
| 6 | | A jointed - arm robot of configuration RRR is to move all three axes so that the first joint is rotated through 50^0 , the second joint is rotated through 90^0 and the third joint is rotated through 25^0 . Maximum speed of any of these rotational joints is 100 mm/s. Ignore effects of acceleration and deceleration. | [16M] |
| | 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 velocity of each joint, if joint - interpolation motion is used. | |
| 7 | a) | Explain application of robot in robot continuous arc welding. | [8M] |
| | b) | Explain the importance of Robot in Spot Welding. | [8M] |
