

III B. Tech II Semester Regular Examinations, April/May - 2019

INDUSTRIAL ROBOTICS

(Common to Mechanical Engineering, Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

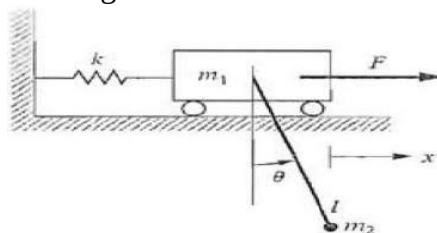
- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **FOUR** Questions from **Part-B**

PART -A

1. a) What is Automation in robotics? [2M]
- b) What are the types of End effectors? [2M]
- c) What do you mean by homogeneous transformation? [2M]
- d) What is meant by Jacobian? [3M]
- e) Illustrate and explain Skew motion. [3M]
- f) What is potentiometer? [2M]

PART -B

2. a) Differentiate CAD/CAM and robotics. [7M]
- b) What are the future applications of robots? Explain. [7M]
3. a) What are the different components of industrial robotics? Explain. [7M]
- b) Discuss in detail factors considered while selection and design of end effectors. [7M]
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. [7M]
- b) Derive the forward kinematics matrix for an articulated robot arm (3-axis) using DH convention. [7M]
5. Using Lagrangian mechanics derive the equations of motion for the two degree of freedom system shown in figure 1: [14M]

**Figure: 1**

6. a) Differentiate between path planning and trajectory planning. [7M]
- b) Explain different methods of Robot programming. [7M]
7. a) Compare stepper motor and D.C. motor drives for a robot. [7M]
- b) Describe the various considerations taken into account for material handling. [7M]

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**PART -A**

1. a) Differentiate flexible automation and fixed automation. [2M]
- b) What are degrees of freedom in Industrial robot? [2M]
- c) Define DH parameters. [2M]
- d) What is the purpose of Differential transformation? [3M]
- e) What are the methods of teaching a robot? [3M]
- f) List the advantages and disadvantages of pneumatic actuator. [2M]

**PART -B**

2. a) Explain the four basic robot configurations classified according to the coordinate system. [7M]
- b) Explain how robotics is a technology for future? [7M]
3. a) Discuss in detail the architecture of robot system. [7M]
- b) How many DOFs are required to position an end effector at any point in 3-D space? Explain. [7M]
4. a) Derive the fundamental rotation matrices. [7M]
- b) What is the role of D-H notation? Explain their importance in solving Forward Kinematics. [7M]
5. a) How will you compute Jacobian for a rotary Joint? Explain. [7M]
- b) Explain the steps involved in the formulation of Lagrange-Euler dynamic model. [7M]
6. a) What are the common motion types that a robot manipulator can make in travelling from point to point? Explain. [7M]
- b) Discuss the relative merits and demerits of different textual robot languages. Explain different program instructions. [7M]
7. a) Briefly explain the working principle of any two types of position sensors with a neat sketch. [7M]
- b) Explain about welding operations of robot with neat sketch. [7M]

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**PART –A**

1. a) How do you classify robots by coordinate system? [2M]
- b) What are the requirements of end effectors? [2M]
- c) Differentiate joint coordinates and world coordinates. [2M]
- d) Write short note on Lagrange Euler formulation. [3M]
- e) List out different robot programming languages. [3M]
- f) What are the applications of encoders? [2M]

**PART –B**

2. a) What are the types of automation? Explain them with examples. [7M]
- b) What is the work envelope of a robot? Sketch and explain the work envelope of a cylindrical robot. [7M]
3. a) What do you understand by degree of freedom (DOF)? Explain. [7M]
- b) Explain mechanical grippers and their linkage mechanisms with neat sketches. [7M]
4. a) Explain about homogeneous transformations in Robotics kinematics. [7M]
- b) For the point [5 7 3] perform the following operations: [7M]
  - (i) Rotate  $30^\circ$  about X-axis
  - (ii) Translate 8 units along y-axis.
5. a) State the situation when you will prefer Newton-Euler and when you will prefer Lagrange- Euler formulation? [7M]
- b) Explain the classification of singularities of a manipulator. [7M]
6. a) 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? [7M]
- b) Discuss the different teaching methods of robot. [7M]
7. a) Explain in detail about safety sensors and safety Monitoring. [7M]
- b) Explain the use of a robot in assembly operation. [7M]

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**PART -A**

1. a) What are the future applications of Robot? [2M]
- b) What are the applications of magnetic grippers? [2M]
- c) What is Forward Kinematics? [2M]
- d) What do you mean by manipulator Jacobian? [3M]
- e) Explain joint integrated motion. [3M]
- f) List the advantages of pneumatic actuator. [2M]

**PART -B**

2. a) Explain the importance of Robotics in Automation. [7M]
- b) Describe the classification of robots by control system. [7M]
3. a) What are the requirements and challenges of end effectors? Explain. [7M]
- b) Discuss about magnetic grippers along with their advantages and disadvantages. [7M]
4. a) Derive the homogenous transformation matrix as applicable to rotation about x, y and z axes. [7M]
- b) Perform the following operations for the point [3 7 5]: [7M]  
 (i) Rotate  $30^\circ$  about Y -axis (ii) Translate 6 units along X- axis.
5. Determine the equations of motion for two-degree of freedom RR planar manipulator arm using Lagrange-Euler Formulation. [14M]
6. a) Explain the following: [7M]  
 (i) Skew motion (ii) Straight line motion
- b) Explain Lead through programming methods. [7M]
7. a) Explain the working of a stepper motor used for a robot. [7M]
- b) Describe the Spray coating operation with robot system. [7M]

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