Hall Ticket No | | | | | | | | | | | Question Paper Code: AME553

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - II

B.Tech VI Semester End Examinations (Regular), April– 2020

Regulations: R16

INTRODUCTION TO ROBOTICS

(**AERONAUTICAL ENGINEERING**)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. a) Classify sensors used in robots and explain each of them in detail. **[7M]**

   b) At time t the excitation voltage to a resolver is 24V and Vs_1 = 17V and Vs_2 = -17V. What is the angle?. **[7M]**

2. a) Describe magnetic gripper in detail with a neat sketch. **[7M]**

   b) Differentiate between polar configuration robot and jointed-arm configuration robot. **[7M]**

UNIT – II

3. a) Describe the forward kinematics transformation of a RR robot of 2 D.O.F with a neat sketch. **[7M]**

   b) Find the resultant rotation matrix that represents a rotation of Φ angle about the OY axis followed by a rotation of θ angle about the OZ axis followed by a rotation of α angle about the OX axis. **[7M]**

4. a) Explain the inverse kinematics transformation of a LL robot of 2 D.O.F with a neat sketch. **[7M]**

   b) The coordinates of point P in frame {1} are $[3.0\ 2.0\ 1.0]^T$. The position vector P is rotated about the Z – axis by 45^0 . Find the coordinates of point Q, the new position of point P. **[7M]**

UNIT – III

5. a) Derive Lagrange-Euler formulation for the joint force/torque. **[7M]**

b) Calculate the velocity of the tip of the two-link, planar, RR- manipulator arm shown in below fig. **[7M]**

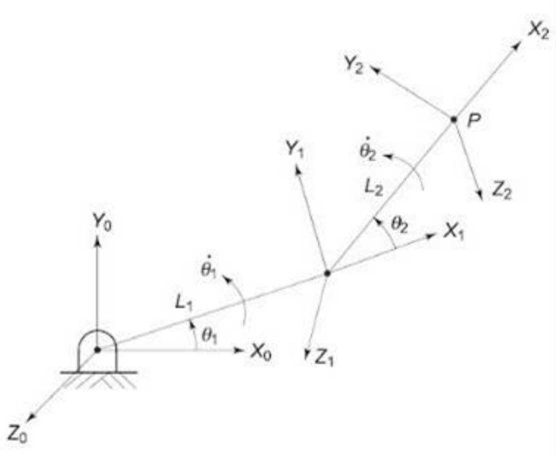

Fig: A two-link, RR planar manipulator.

6. a) Differentiate between Newton-Euler formulation and Lagrange-Euler formulation. **[7M]**

   b) A moving frame {1} is represented by the following rotation matrix R, where α is the angle of rotation of the frame {1} with respect to the base frame. If α is a function of time, find the angular velocity of frame {1}. **[7M]**

$$^{0}\boldsymbol{R}_1 = \begin{bmatrix} C\alpha & -S\alpha & 0 \\ S\alpha & C\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

UNIT – IV

7. a) Discuss the general considerations of joint interpolated trajectory. **[7M]**

   b) Determine the time required for each joint of a three-axis RRR manipulator to travel the following distances using slew motion; joint 1, 1000; joint 2, 300; and joint 3, 600. All joints travel at a rotation velocity of 150/s. **[7M]**

8. a) A single link rotary robot is required to move from $\Theta(0)=45^0$ to $\Theta(2)=90^0$ in two seconds. Joint velocity and acceleration are zero at initial and final positions. What is the highest degree polynomial that can be used to accomplish the motion? **[7M]**

   b) Briefly classify actuators used in robot manipulator. **[7M]**

UNIT – V

9. a) Explain the importance of robot safety in industrial applications. **[7M]**

   b) Explain arc welding robot requirements. **[7M]**

10. a) Explain vision based inspection. **[7M]**

    b) Discuss the importance of work cell design for industrial application. **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Develop the knowledge in various robot structures and their workspace.
II	Develop the skills in performing kinematics analysis of robot systems.
III	Provide the knowledge of the dynamics associated with the operation of robotic systems.
IV	Provide the knowledge and analysis skills associated with trajectory planning.
V	Understand material handling and robot applications in industries.

COURSE OUTCOMES (COs):

CO 1	Understand characteristic features of robots and usage of different grippers for industrial applications.
CO 2	Understand direct and inverse kinematics of robot structure.
CO 3	Illustrate Differential Kinematics of planar and spherical manipulators.
CO 4	Understand classification of robot actuators and trajectory planning.
CO 5	Remember material handling and applications in manufacturing.

COURSE LEARNING OUTCOMES (CLOs):

AME553.01	Differentiate between automation and robotics.
AME553.02	Classify robots and describe itsanatomy.
AME553.03	Specify various types of industrial sensors.
AME553.04	Classify various grippers.
AME553.05	Discuss about motion analysis of robot.
AME553.06	Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.
AME553.07	Describe D-H notations, joint coordinates and.world coordinates.
AME553.08	Discuss abouthomogeneous transformation.
AME553.09	Describe the differential kinematics of planarmanipulators.
AME553.10	Illustrate Lagrange-Euler formulation.
AME553.11	Discussjacobian and robot dynamics.
AME553.12	Illustrate Newton-Euler formulation.
AME553.13	Describe Joint space scheme.
AME553.14	Illustratecubic polynomial fit.
AME553.15	Classify types of motion.
AME553.16	Explain actuators and classify them.
AME553.17	Illustrate various robot applications in manufacturing.
AME553.18	Discuss the role of robots in material handling.
AME553.19	Explain work cell design.
AME553.20	Discuss the role of robots inassembly and inspection,

Mapping of Semester End Examinations to Course Outcomes:

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AME553.03	Specify various types of industrial sensors.	CO 1	Understand
	b	AME553.03	Specify various types of industrial sensors.	CO 1	Understand
2	a	AME553.04	Classify various grippers**.**	CO 1	Understand
	b	AME553.02	Classify robots and describe its anatomy.	CO 1	Understand
3	a	AME553.06	Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.	CO 2	Understand
	b	AME553.06	Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.	CO 2	Remember
4	a	AME553.06	Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.	CO 2	Remember
	b	AME553.06	Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.	CO 2	Remember
5	a	AME553.10	Illustrate Lagrange-Euler formulation.	CO 3	Understand
	b	AME553.09	Describe the differential kinematics of planar manipulators.	CO 3	Understand
6	a	AME553.12	Illustrate Newton-Euler formulation.	CO 3	Understand
	b	AME553.09	Describe the differential kinematics of planar manipulators.	CO 3	Understand
7	a	AME553.13	Describe Joint space scheme.	CO 4	Understand
	b	AME553.14	Illustrate cubic polynomial fit.	CO 4	Remember
8	a	AME553.14	Illustrate cubic polynomial fit.	CO 4	Remember
	b	AME553.14	Illustrate cubic polynomial fit.	CO 4	Remember
9	a	AME553.17	Illustrate various robot applications in manufacturing.	CO 5	Remember
	b	AME553.17	Illustrate various robot applications in manufacturing.	CO 5	Understand
1 0	a	AME553.20	Discuss the role of robots in assembly and inspection.	CO 5	Understand
	b	AME553.19	Explain work cell design.	CO 5	Remember

Signature of Course Coordinator **HOD, ME**