

[6403]-244

T.E. (Robotics and Automation)
ROBOT KINEMATICS AND DYNAMICS
(2019 Pattern) (Semester - V) (311503 A)

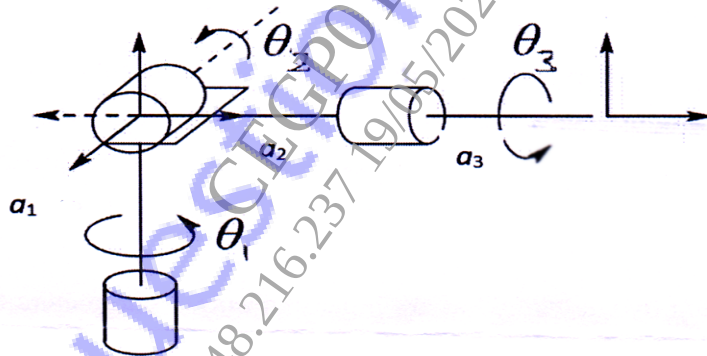
Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

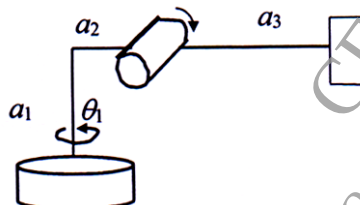
- 1) Neat diagrams must be drawn wherever necessary.
- 2) Figures to the right side indicate full marks.
- 3) Use of Calculator is allowed.
- 4) Assume Suitable data if necessary.

- Q1) a)** Explain the following terms related to genetic algorithm: (a) Crossover probability (b) Mutation probability [8]
- b)** For the robot shown in Figure, use inverse kinematics to obtain the joint parameters θ_1 , θ_2 and θ_3 to bring the robot end effector to the position (-25.8, -30.75, -7.34). Consider $a_1 = 50$ cm, $a_2 = 40$ cm, $a_3 = 30$ cm. [10]



OR

- Q2) a)** What is inverse kinematics problem? Explain various approaches to solve inverse kinematics problem. [8]
- b)** For the robot shown in Figure, use inverse kinematics to obtain the joint parameters θ_1 and θ_2 to bring robot end effector to position (39.5, 22.8, 55.7). Consider $a_1 = 30$ cm, $a_2 = 15$ cm and $a_3 = 40$ cm. [10]

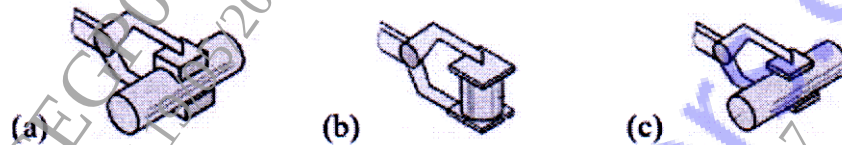


P.T.O.

- Q3) a)** Write short note on: (1) Vacuum Grippers (2) Mechanical grippers. [8]
b) A vacuum gripper is to be designed to hold a plate having weight 200 N with 2 suction cups each having diameter 100 mm. Determine the negative pressure required to lift the plate. [6]
c) Write short note on: Magnetic grippers. [4]

OR

- Q4) a)** Following gripper mechanisms are used to hold the objects. Determine the degrees of freedom of the objects. [6]



- b)** A magnet with 1,500 turns and a cross-sectional area of 0.4 m^2 is operated with 12 amperes of current, 0.8 meters from a piece of metal. Determine the electromagnetic force. [6]
c) What are different types of gripper's based on method of actuation? [6]
- Q5) a)** A planner robot has both prismatic joints. The masses of the link 1 and link 1 are 1.2 Kg and 1 Kg respectively. Linear positions of the joints are given by equations: $q_1 = -0.2t^3 + 3t^2 + 5$ and $q_2 = -0.1t^3 + 5t^2 + 4$. Determine the joint force acting on each link at $t = 3 \text{ sec}$. [9]
b) What is inverse robot dynamics? What are input and output parameters for inverse dynamics of articulated robot? [8]

OR

- Q6) a)** Following data operates for a 2 DOF planer robot : [12]
 • Length of link 1 = 0.3 m
 • Length of link 2 = 0.2m
 • Angular position of link 1 = 40°
 • Angular position of link 1 = 35°

Determine the Jacobian of link 1 and link 2.

- b)** Explain Lagrangian formulation for manipulator dynamics. [5]
- Q7) a)** Explain clearly the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them. [7]
b) Write a short note on primary balancing and secondary balancing. [10]

OR

- Q8) a)** Write notes on: (a) Free vibration (b) Damped vibration. **[8]**
- b)** A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. **[9]**

