Total No. of Questions : 8]

SEAT No. :

P7736

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[6180]-265

T.E. (Robotics and Automation)

ROBOT KINEMATICS AND DYNAMICS

(2019 Pattern) (Semester-I) (311503A)

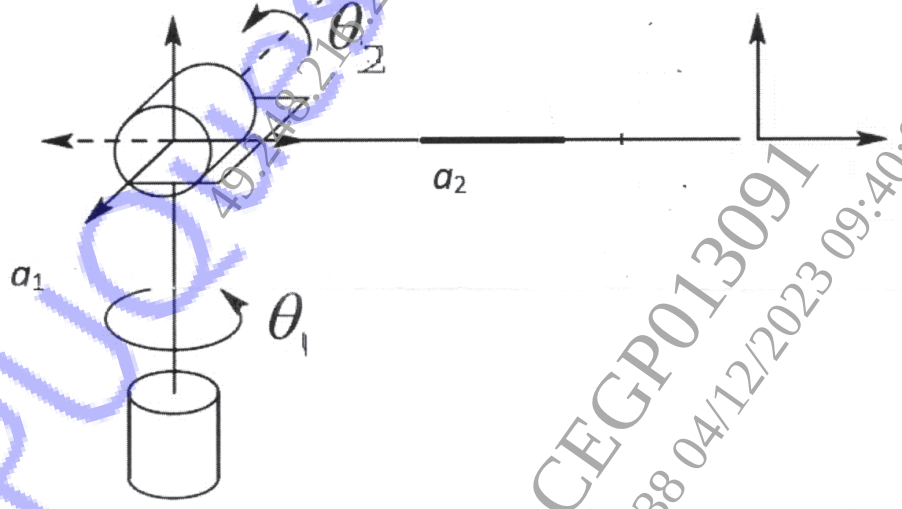
Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***
5) ***Assume Suitable data if necessary.***

Q1) a) Draw the flowchart and explain any one numerical method used to solve inverse kinematics problems. **[6]**

b) For the robot shown in Figure, use inverse kinematics to obtain the joint parameters θ_1 and θ_2 to bring the robot end effector to the position (32, 25, 10). Consider a_1 = 45 cm, and a_2 = 50cm. **[12]**



OR

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Q2) a) Determine the gradient of a function $5.x_1.x_2 - x_2^2 + 20$ at x_1=3 and x_2 = 2 **[8]**

b) Explain following terms related to genetic algorithm: **[10]**

i) Population size

ii) Crossover probability

iii) Mutatin probability

iv) Reproduction operator

v) Fitness function

Q3) a) Discuss various considerations in gripper selection and design. **[8]**

b) Determine the gripper force required for a mechanical gripper having two fingers used to hold the part weighing 10kg Assume that the coefficient of friction between the fingers and the part surface is 0.30 and the 'g' factor of 3. **[6]**

c) What are the limitations of vacuum grippers? **[4]**

OR

Q4) a) Explain the design aspects of mechanical grippers. **[6]**

b) Write short note on: Selection criteria for grippers. **[6]**

c) Explain the principal of working of accoustic sensor to measure the distance of the object from the gripper. **[6]**

Q5) a) Determine the angular position, angular velocity, and angular acceleration of a robot arm with revolute joint at t=10 seconds if it rotates from 10º to 70° in 25 second. **[9]**

b) Explain Newton-Euler formulation for manipulator dynamics. **[8]**

OR

Q6) a) What is robot forward dynamics? What are input and output parameters in forward dynamics. Explain the applicatins of forward dynamics in robot design. **[5]**

b) For a single rotary manipulato link, the gripper force is =[0, –30 N, 0], mass of the link =30 Kg, Angular velocity of link (ω)=6rad/s, Angular acceleration of link = –18 rad/s^2, Length of link=2m with CG located at 0.8 m from joint. Determine the resultant joint reaction force in base co-ordinatesystem for angular position of 40º. **[12]**

Q7) a) Discuss the balancing of V-engines. **[7]**

b) Define the following terms: **[10]**

i) Swaying Couple

ii) Hammer blow

iii) Tractive force

iv) Primary balancing

v) Secondary balancing

OR

Q8) a) What is balancing? What are types of balancing? **[8]**

b) A circular disc mounted on a shaft crries three atached masses of 4 kg, 3kg, and 2.5 kg at radial distances of 75 mm, 85 mm and 50 mm and at the angular positions of 45º, 135º and 240º respectively. The angular positions are measured counter-clockwise from the reference line along the x-axis. Determine the amount of the counter mass at a radial distance of 75 mm required for the static balance. **[9]**

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