22383

24225

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answer with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define a Robot.

b) Define actuator. Name its types.

c) State the difference between active and passive grippers.

d) Define angular velocity and angular acceleration.

e) List out any four Robot programming languages.

f) Define –

i) Path

ii) Trajectory.

g) State the difference between forward dynamics and inverse dynamics.

P.T.O.

Marks

2. Attempt any THREE of the following: **12**

a) Define work envelope. Draw work envelope for cylindrical coordinates.

b) Explain Pneumatic actuator with diagram.

c) Define Homogeneous Transformation Matrix (HTM). Find out the HTM for translation by 4, 2, 7 units along the axes of Universal Coordinate System.

d) Explain any four switches of teach pendent.

3. Attempt any THREE of the following: **12**

a) State any four safety measures while working with robots.

b) Describe Lagrange - Euler method and state its equation of motion in dynamics.

c) Find out T(composite) Matrix for cylindrical coordinate system.

d) Differentiate between Joint space trajectory and Cartesian trajectory planning.

4. Attempt any THREE of the following: **12**

a) Compare Lead through and Walk - through programming. (Any four points)

b) Compare hydraulic actuator with electric actuator. (Any four points)

c) Explain the principle of vacuum gripper and adhesive gripper.

d) Define Jacobian Matrix equation in robotics with description of each term.

e) Mention the types of joint with diagram.

Marks

5. Attempt any TWO of the following: **12**

a) Derive rotational operator matrix for ROT (Z, θ)

b) Describe On-line and offline programming of Robot.

c) A 2 DOF serial manipulator with the links having lengths of L_1 and L_2 has joint angles θ_1 and θ^2. The end effector's co-ordinates are (X, Y) where

$X = L_1 \cos \theta_1 + L_2 \cos (\theta_1 + \theta_2)$

$Y = L_1 \sin \theta_1 + L_2 \sin (\theta_1 + \theta_2)$

Find out the Jacobian matrix for the given configuration.

6. Attempt any TWO of the following: **12**

a) State DH Rules. Define DH parameters.

b) Define –

i) Linear Velocity

ii) Linear acceleration

iii) Centripetal acceleration

iv) Tangential acceleration.

c) Derive the Homogeneous Transformation Matrix for 2R planar robot arm.
