Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CSE)/SEM-8/CS-801A/2010

2010

ROBOTIC CONTROL

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) In the relation between OXYZ coordinate system and OUVW coordinate system

$$p_{xyz} = R_{x,\alpha} \cdot p_{uvw}$$

what is the value of $(i_x . i_u)$ within $R_{x,\alpha}$?

a) 0 b) cos α

c) sin αd) 1.

ii) What is called 'roll' ?

a) A rotation of ψ about the *OX* axis $(R_{x,\psi})$

b) A rotation of θ about the *OY* axis $(R_{y,\theta})$

c) A rotation of ϕ about the *OZ* axis $(R_{z,\phi})$

d) None of these.

iii) In robotics application, the scale factor within the homogeneous transformation matrix is equal to

a) 0 b) 1

c) $\cos\theta$ d) none of these.

iv) In Denavit-Hartenberg representation, which axis lies along the axis of motion of a joint ?

a) Z-axis b) X-axis

c) Y-axis d) U-axis.

v) In $T = \begin{bmatrix} n & s & a & p \\ 0 & 0 & 0 & 1 \end{bmatrix}$

p means

a) sliding vector of the hand

b) position vector of the hand

c) normal vector of the hand

d) none of these.

vi) External state sensors deal with the detection of variable such as

a) range, proximity and touch

b) range and arm joint position

c) only arm joint position

d) none of these.

vii) Inductive sensors detect

a) all solid materials

b) all liquid materials

c) all ferromagnetic materials

d) none of these.

viii) Which sensor is the best among the following for sensing all tyes of materials ?

a) Half-effect sensors b) Inductive sensors

c) Ultra-sonic sensors d) None of these.

ix) The diffuse lightning approach is a type of

a) sensing b) illumination technique

c) flow of control d) none of these.

x) RMFC is

a) Robotic Motion Force Control

b) Random Motion Force Control

c) Resolved Motion Force Control

d) Relative Motion Force Control.

xi) How many DOFs are possible in a rigid mechanical body in 3D space ?

a) 3 b) 4

c) 5 d) 6.

xii) The term 'Robot' was first indroduced by

a) Karel Capek b) Alan MacWorth

c) Robert Fu d) H.G. Wells.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is the advantage of Newton-Euler formulation over Lagrange-Euler formulation ?

3. Define degree of freedom (DOF). What are Roll, Pitch & Yaw ?

4. Explain internal state sensing and external state sensing.

5. Derive the translation matrix of imaging geometry.

6. Considering the robot arm control as a path trajectory tracking problem, classify the motion control.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Show and describe the architecture of a computer-based intelligent robotic manipulator.

   b) Describe an intelligent application of vision-controlled Robotic system. 8 + 7

8. a) Derive the basic form of Transformation matrix (R) & thus explain orthogonal transformation.

   b) Explain Langrange-Euler formulation of Robot Arm Dynamics. 7 + 8

9. a) What is Trajectory Planning ? How does it function ?

   b) What is Rotation matrix used in Robot Arm Kinematics ? Note down the rotation matrices when

      i) OUVW coordinate system is rotated an angle α about the OX axis

      ii) OUVW coordinate system is rotated an angle ϕ about the OY axis

      iii) OUVW coordinate system is rotated an angle θ about the OZ axis. 7 + 8

10. a) Describe the basic algorithm for generating joint trajectory set points.

    How is it modified for Cartesian path control ?

    b) Classify Robotic Arms according to mechanical structures. 8 + 7

11. Write short notes on any *three* of the following : 3 × 5

    a) Degree of freedom

    b) Binary sensors

    c) Expert system & knowledge engineering

    d) Robot learning

    e) Proximity sensing.