2013

ROBOTICS AND CONTROL ENGINEERING

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) A SCARA is a

a) Selective Compliant Assembly Robot Arm

b) Selective Compliant Articulated Robot Arm

c) Both (a) and (b)

d) None of these.

ii) What type of joint are normally used in manipulator ?

a) Hinge joint b) Ball Joint

c) Sliding Joint d) all of these.

iii) An inverse transducer converts

a) Electrical energy to any other form of energy

b) Electrical energy to light energy

c) Mechanical displacement into electrical signal

d) Electrical energy to Mechanical energy.

iv) Position and orientation angles are converted into Joint angle of end effectors

a) This if Forward kinematics

b) This in Inverse kinematics

c) This is Reverse kinematics

d) none of these.

v) A reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through various programmed motions for the performance of a variety of tasks

a) Robot b) Rigid body

c) End-effector d) None of these.

vi) For the case of ball joint degrees of freedom is

a) 1 b) 2

c) 3 d) 4.

vii) How accurately the same position can be reached if the motion is to be repeated many times ?

a) Accuracy b) Repeatability

c) Resolution d) All of these.

viii) CZECH word 'Robota' means

a) forced labour b) worker

c) Both (a) and (b) d) none of these.

ix) In an CLOSED-LOOP control system

a) the input has control over output

b) input has no control over output

c) both of these.

d) none of these.

x) All the points from origin to the perimeter is called

a) Reachable Workspace

b) Envelope Workspace

c) both of these

d) none of these.

xi) The function of absorption screen of a optical pyrometer

is

a) to eliminate colour difference between the filament

and the hot body to facilitate matching

b) that reduces the intensity of the radiation from the

object reading the filament

c) both (a) and (b)

d) none of these.

xii) ..... is minimum volume swept by the robot when

all possible motion are perform.

a) Workspace b) Payload

c) End effector d) All of these.

GROUP – B

(Short Answer Type Questions)

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

2. Compare between Forward Kinematics and Inverse

Kinematics.

3. Write down the basic elements of Robots.

4. Explain the principle of Controller.

5. What is the rotation matrix for a rotation of ϕ angle about the

OX axis, followed by a rotation of ψ angle about the OW axis,

followed by a rotation of θ angle about the OY axis ?

6. What is Manipulator ? Write its application on robots. 1 + 4

7. What is Adaptive Control ? Explain Briefly.

GROUP – C

(Long Answer Type Questions)

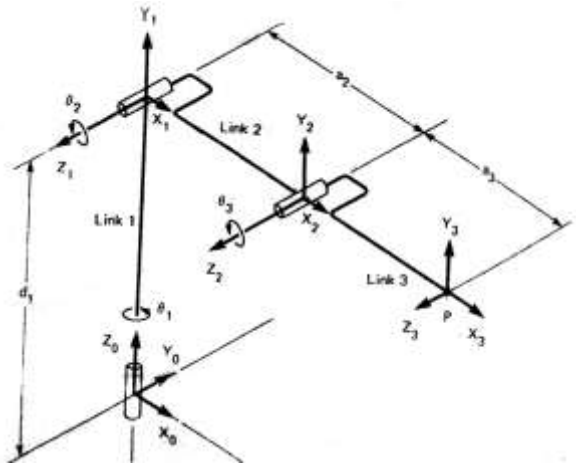
Answer any *three* of the following. $3 \times 15 = 45$

8. Find out the $3_* 3$ rotational matrices on the reference

coordinate system OXYZ.

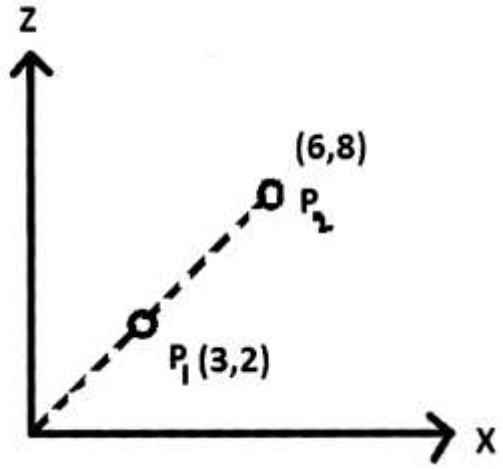
Give two points $a_{uvw} = (4, 3, 2)^T$ and $b_{uvw} = (6, 2, 4)^T$ with respect to the rotated OUVW coordinate system, determine the corresponding points a_{uvw} b_{uvw} with respect to the reference coordinate system if it has been rotated 60° about the OZ axis. 10 + 5

9. According to the Denavit-Hartenberg representation find out the joint angle, distance from the origin, offset distance from the intersection and offset angle of the following figure.



What is Workspace ? Define Reachable Workspace and Dextrous Workspace. 7 + 8

10. Find the resultant rotation matrix that represents a rotation of angle about the *OY* axis followed by a rotation of θ angle about the *OW* axis followed by a rotation of α angle about the *OU* axis.



From the following figure Mass of the ball m = 10. What will be the work done ? 7 + 8

11. What is Robot ? Discuss the working principle of Manipulator ? Write the three laws of Robot. Write down the characteristics of Robot. What are the basic elements of Robot ? What types of joint are normally used in manipulator ? 1 + 2 + 3 + 3 + 3 + 3

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

a) Trajectory Planning

b) Robot Workspace

c) Embedded System

d) Robot Intelligence

e) Lagrangian formulation for Robot arm dynamics.