KUMARAGURU college of technology
character is life

Register Number: ……..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Sixth Semester

ELECTRONICS AND INSTRUMENTTION ENGINEERING

EIE119:Robotics and Automation

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which gripper is preferred for handling fabrics and other lightweight material?
   a) Vacuum cup b) Adhesive type
   c) Magnetic type d) Mechanical gripper
2. _____ is responsible for the physical action of the robot.
   a) Arm b) Actuator
   c) Sensor d) End Effector
3. Transformation and Kinematics are required to describe the _____ and _____of a manipulator for generating motions.
   a) Size and shape b) Position and size
   c) Position and orientation d) Type and shape
4. Computing individual DOF values that result in specified end effector's position is called as
   a) Inverse Kinematics b) Forward Kinematics
   c) Reverse Kinematics d) Backward Kinematics
5. In order to calculate the differential motions needed at the joints of the robot for a desired hand differential motion, we need to calculate
   a) Inverse Jacobian b) Jacobian
   c) Lagrangian d) Inverse Lagrangian
6. The technique used to calculate velocity of joint from end effector velocity is
   a) Forward kinematics b) Inverse kinematics
   c) Newton's formula d) Euler's formula
7. The path followed by the end effector is
   a) Linear b) Trajectory
   c) Straight line d) Curved

8. Path and trajectory planning requires the use of _____ of robot.

a) Dynamics b) Kinematics

c) Both a and b d) Inverse Kinematics

9. If the roots are real and unequal, the response is called _____.

a) Under damped b) Critically damped

c) Over damped d) Undamped

10. A control system that makes use of feed back is called

a) Closed loop system b) Open loop system

c) Trajectory control d) Path control

PART B (10 x 2 = 20 Marks)

11. State Asimov's Law of Robotics.
12. List any four actuators used in Robots.
13. Write the matrix representation of Cylindrical co ordinates.
14. Identify the joint variables, if the origin of hand frame of cylindrical robot is placed at $[3, 4, 7]^T$.
15. Name the three differential motions of a frame.
16. State Lagrangian mechanics.
17. Differentiate Path and Trajectory.
18. Write down the schemes available in joint space trajectory planning.
19. Draw the responses of system based on the location of roots.
20. Mention any four applications of Robots in manufacturing industries.

PART C (5 x 14 = 70 Marks)

21. a) (i) How are robot end effectors classified? (4)

(ii) Draw and explain any two types of end effectors. (10)

(OR)

b) What is the role of sensors in Robots? With suitable sketch and citing appropriate applications, explain any two sensors.

22. a) (i) What is Homogeneous transformation matrix? Write the transformation matrix for translational and rotational transformations. (7)

(ii) Determine the new position of a gripper which was initially located at $(10, 30, 20)^T$. Then following movements are carried out in sequence. (7)

(i) Rotation of $+90^0$ about X-axis

(ii) Rotation of -90^0 about Z-axis

(iii) Translational of 5 units in Y-axis

(OR)

b) Discuss the different inputs to an inverse kinematics algorithm. Explain the solution of a simple inverse kinematic algorithm.

23. a) A camera is attached to the hand frame TH of a robot as given. The corresponding inverse Jacobian of the robot at this location is also shown. The robot makes a differential motion described as D = $[0.05\ 0\ -0.1\ 0\ 0.1\ 0.03]^T$
a) Find which joints must make a differential motion, and by how much, in order to create the indicated differential motions.
b) Find the change in the hand frame
c) Find the new location of the camera after the differential motion

$$T_H = \begin{bmatrix} 0 & 1 & 0 & 3 \\ 1 & 0 & 0 & 2 \\ 0 & 0 & -1 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad J^{-1} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 2 & 0 & -1 & 0 & 0 & 0 \\ 0 & -0.2 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

(OR)

b) (i) Describe the three Eulerian angle representation of a rigid body rotation. (7)

(ii) Give the Lagrange-Euler equation. Describe the terms involved in the equation. (7)

24. a) (i) Discuss in detail about the Third order polynomial trajectory planning scheme. (8)

(ii) It is desired to have the first joint of a 6-axis robot go from initial angle of 30° to a final angle of 75° in 5 seconds. Using third order polynomial, calculate the joint angle at 1, 2, 3 and 4 seconds. (6)

(OR)

b) (i) Differentiate Cartesian space and Joint space descriptions. (6)

(ii) Explain the basics of Trajectory planning. (8)

25. a) (i) Derive an expression for the step response of an under damped second order system. (8)

(ii) How damping factor affects the response of a system? Explain. (6)

(OR)

b) (i) What are the advantages and disadvantages of robot? (4)

(ii) Write a note on the below stated robot application. (10)

1) Spray painting 2) Palletizing

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