Register Number: ……..

B.E., DEGREE EXAMINATIONS: MAY/ JUNE 2013

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE119 **:** Robotics and Automation

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The end effectors used to grasp and hold object is
   a) Gripper b) Stripper
   c) Controller d) Actuator
2. The sensor used in smoke detector is
   a) Range sensor b) Sniff sensor
   c) Proximity sensor d) Tactile sensor
3. The technique used for representing and modeling the robot motion is
   a) Triangulation b) Unimation
   c) D-H Matrix d) Digitizing
4. The following configuration belongs to inverse kinematics for orientation
   a) Gantry coordinates b) Anthropomorphic coordinates
   c) Cartesian coordinates d) RPY angles
5. The energy based approach used in dynamic equation of robot
   a) Lagrangian formulation b) Newtonian approach
   c) Milacron approach d) George approach
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 sequence of robot movement specified with time is called
   a) Path b) Transformation
   c) Trajectory d) Space description
8. In which trajectory planning, the joint values are repeatedly calculated by inverse kinematic equations
   a) Joint space b) Parabolic trajectory
   c) Polynomial d) Cartesian Space

9. 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

10. A differential equation that describes the evolution of errors relative to desired trajectory is to be written in

a) Joint space b) Error space

c) Cartesian space d) Trajectory planning

PART B (10 x 2 = 20 Marks)

11. Mention any four robot programming languages.
12. List the classification of robot.
13. How do you represent both position and orientation in the same matrix?
14. Identify the joint variables, if the origin of hand frame of cylindrical robot is placed at $[3, 4, 7]^T$.
15. Mention the significance of Jacobian related to differential motion of robot.
16. State Lagrangian mechanics.
17. Write down the schemes available in joint space trajectory planning.
18. List out any four boundary and blending condition in higher order trajectory.
19. Classify the classes of response in second order system.
20. Mention the factors to be considered in choosing fast servo rate.

PART C (5 x 14 = 70 Marks)

21. a) (i) Explain briefly, the schematic of hydraulic actuating system with sketch. (10)

(ii) Write down the characteristics of sensors. (4)

(OR)

b) How do you classify grippers? Explain in detail, vacuum cup with neat sketch.

22. a) (i) Write down homogeneous transformation matrix for pure translation and pure rotation. (6)

(ii) Find the coordinates of point relative to reference frame, if a point P $(7, 3, 2)^T$ is attached to a frame (n, o, a) and is subjected to transformation as (8)

a) Rotation of 90^0 about z – axis

b) Followed by rotation of 90^0 about the y – axis

c) Followed by translation of [4, -3, 7].

(OR)

b) Explain in detail, Denavit – Hartenberg representation of forward kinematic equations of robot.

23. a) Discuss in detail, the Jacobian of a robot.

(OR)

b) Using Lagrangian method, derive the equation of motion for the two degree- of-freedom robot arm as shown in Figure-1. The centre of mass for each link is at centre of the link and the moments of inertia are I_1 and I_2.

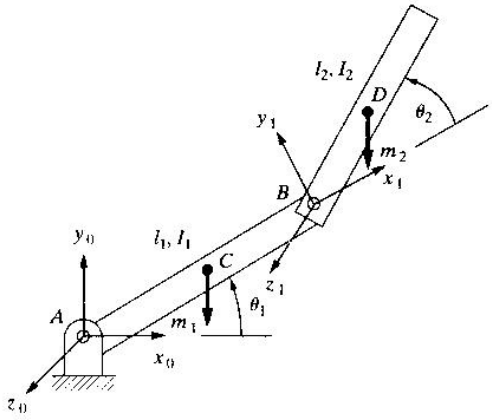

Figure-1

24. a) (i) Differentiate between Path and Trajectory. (4)

(ii) Describe with neat sketch Cartesian-space trajectory planning. (10)

(OR)

b) Discuss the schemes used in joint-space trajectory planning.

(i) Third order polynomial trajectory planning (7)

(ii) Linear segment with parabolic blends (7)

25. a) (i) Explain trajectory planning control with neat sketch. (8)

(ii) Explain briefly, the high level block diagram of robot control system. (6)

(OR)

b) (i) Discuss in detail, architecture of an industrial robot controller with necessary block diagram.

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