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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022

ROBOTICS AND AUTOMATION

(2021 Scheme)

Course Code: **21RA102**

Course Name: **Robotic System Configuration**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Classify the configurations of robots based on joint notation scheme.
2. Represent the fundamental rotation matrices about three axes of the Cartesian coordinate frame.
3. Classify the types of joint space trajectory planning techniques.
4. Explain the Euler Lagrange equation to represent the dynamic properties of a system.
5. Identify the limitations of linear control schemes in robot manipulators.
6. Examine the working of proportional derivative gravity control.
7. With the help of a block diagram, explain the robotic vision system.
8. List the limitations of using robots in industries.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Discuss the robot anatomy with the help of neat diagram. (6)

OR

10. a) A frame M point was rotated about the z-axis by 60 degrees; then it was translated about the x axis of mobile frame by 2 units before it was rotated about the z-axis of mobile frame by 90 degrees. Estimate the final location of a point $P = [2,1,1]^T$ in the mobile frame relative to the reference frame. (4)

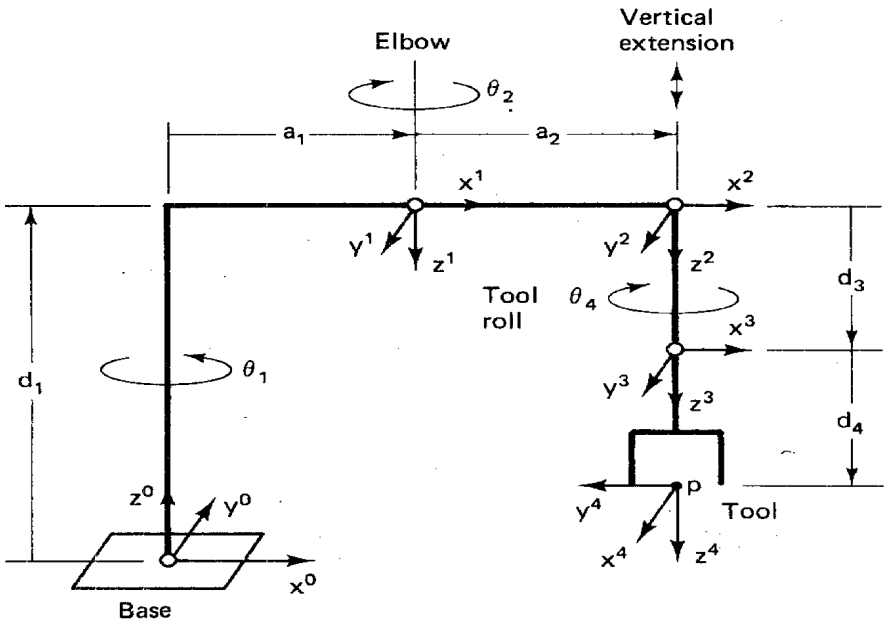
    b) List the four DH parameters represented in robot kinematic analysis. (2)

MODULE II

11. a) Evaluate the role of Jacobian matrices in robot kinematics. (2)

    b) Explain the singularity analysis of a 2-DOF robotic arm. (4)

OR

12. 

(6)

Represent the DH parameters of the given robotic arm. Evaluate the arm matrix.

MODULE III

13. It is desired to have the third joint of a 6-axis robot go from an initial angle of 20° to a final angle of 80° in 4 seconds. Calculate the coefficients for a third-order polynomial joint-space trajectory. The robot starts from rest but should have a final velocity of 5°/sec. (6)

OR

14. a) Examine the limitations of implementing a pure linear trajectory for robot joint motion. (2)

b) One of the joints of a robot moves from initial angle of 10 degrees to the final angle of 50 degrees in 5 seconds with a velocity of 10 degrees/sec. Calculate the necessary time for blending. (4)

MODULE IV

15. a) Differentiate between forward dynamics and inverse dynamics. (3)

b) Differentiate between Newtonian and Lagrangian methods for robot dynamic analysis. (3)

OR

16. Considering the moment of inertia of a uniform rod, evaluate the inverse dynamics of a single axis robot manipulator. (6)

MODULE V

17. a) With the help of a block diagram, illustrate the working of a single axis PID control. (4)

b) Identify the effect of gravity in implementing a single axis PID control. (2)

OR

18. Elaborate the computed torque control of a three axis SCARA robot. (6)

MODULE VI

19. a) Examine the role of robots in machining operations. (4)
b) Identify the use of mobile robots in industries. (2)

OR

20. Differentiate between perspective and inverse perspective transformation. Explain with the help of an example. (6)

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