

[Total No. of Questions - 9] [Total No. of Printed Pages - 3]

Dec.-23-0552

ME-701 (Industrial Automation and Robotics)

B.Tech, 7th (CBCS)

Time : 3 Hours

Max. Marks : 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five question in all, selecting one question each from section A, B, C & D and Question no. 9 is compulsory.

#### SECTION - A

- Write a short note for:
  - Robot specification
  - Tool Orientation
  - Degree of Freedom
  - Hard automation
  - Spatial Resolution (5×2=10)
- Explain the different type of geometrical arm configurations with 3-DOF, with work volume (With neat schematic diagrams). (10)

#### SECTION - B

- What are the fundamental rotation matrices? Obtain the three fundamental rotation matrices for rotations about axes x, y, and z from the rotation matrix for rotation about an arbitrary axis k. (10)
- Output link of a rotational joint at the end of an arm is connected to the wrist assembly. Considering the design of this joint only, it is given the length of output link as 600 mm and total range of rotation of the joint as 40°. The spatial resolution of this joint is expressed as a linear measure at the wrist and is specified

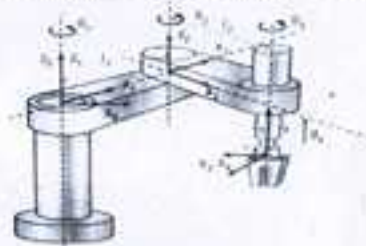
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to be  $\pm 0.5$  mm. Determine the minimum number of bits required in the robot's control memory. Take the mechanical inaccuracies in the joint results in an error of  $3\sigma \pm 0.018^\circ$  rotation. (10)

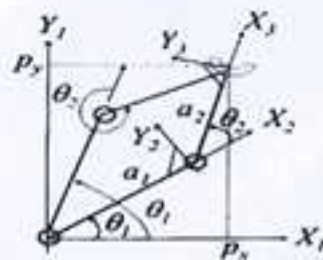
#### SECTION - C

- What is D-H representation? Write the composite Homogenous transformation matrix using D-H representation in 3D used for forward kinematic solutions. (10)
- Find Forward kinematic solution to given SCARA Robot. (10)



#### SECTION - D

- (a) Find the inverse kinematic solution of 2-Link Manipulator. (5)



[P.T.O.]

- (b) Explain, socio economic impacts of automation. (5)
8. (a) Name any two methods by which path is controlled by robot controller. Discuss various transfer mechanisms. (5)
- (b) Draw and explain the various types of joints used in robotic manipulators. (5)

**SECTION - E (Compulsory)**

9. Briefly Explain:

- (a) Singularity of mechanism.
- (b) Explain the need of pneumatic systems in robotics.
- (c) What is Coanda effect?
- (d) Sensors used in robots.
- (e) Explain speed of motion in an industrial robot.
- (f) Repeatability of manipulator.
- (g) Accuracy of the manipulator.
- (h) Grippers used in robots.
- (i) Wrist motion of robots.
- (j) Articulated manipulator. (10 \* 2= 20)