

D-180343**B. Tech. EXAMINATION, 2018**

Semester VII (CBS)

INDUSTRIAL AUTOMATION AND ROBOTICS

ME-701

Time : 3 Hours

Maximum 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 questions in all, selecting one question from each Sections A, B, C and D. Section E is compulsory.

Section I

- (a) Define the term 'Automation'. Discuss the different Elements and Aims of Automation with suitable examples. 5
- (b) How 'Fixed Automation' is different than 'Flexible Automation' ? What strategies should be adopted for 'Automation' ? 5

2. (a) Explain all the elements of robot anatomy with neat sketch. 4
- (b) Explain briefly the following end effectors and drive methods : 6
- (i) Active end-effector
- (ii) Passive end-effector
- (iii) Pneumatic Drive.

Section B

3. Classify and discuss the robots manipulators on the basis of mechanical configuration and control method. 10
4. Explain briefly any five robot specifications with neat sketch. 10

Section C

5. (a) A frame {B} is located initially coincident with a frame {A}. Rotate {B} about \hat{Z}_B by 45 degrees, and then we rotate the resulting frame about \hat{X}_B by 30 degrees. Find the rotation matrix that will change the descriptions of vectors from B_P to A_P . 4
- (b) Compute the arm matrix $T_{tool}^{base}(q)$ for the four-axis SCARA Robot. 6

6. (a) Explain Denavit Hartenberg (DII) convention briefly to write down general homogeneous transformation matrix. 6
- (b) Show that the rotation matrices about the Y and Z axes are unitary. 4

Section D

7. (a) Derive the inverse kinematic equation of the six-axis articulated Robot. 6
- (b) Enlist the various advantages and benefits or Robot Arc Welding. 4
8. (a) Explain the payback method for the economic analysis. 4
- (b) A robot installation has an investment cost of INR 75,000 and the expected annual cost for operation and maintenance are estimated to be INR 30,000. The project is expected to generate revenues INR 45,000 per year for three years, at which time the project will be retired. The estimated salvage value of the robot at the end of the three years is INR 28,000. Determine the payback period for this project. 6

Section E

9. Write short notes on the following :
- (a) Asynchronous Transfer System
- (b) Joint Reference Frame
- (c) Singularity of a Mechanism
- (d) Reach and Stroke
- (e) Denavit-Hartenberg (DH) Representation
- (f) Screw Transformation
- (g) Translation is commutative
- (h) Three axis planer articulated Robot
- (i) Tool orientation
- (j) Degree of freedom. 2×10=20

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