



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Eighth Semester, B.E. - Mechanical Engineering

Semester End Examination; June/July - 2015

Industrial Robotics

Time: 3 hrs

Max. Marks: 100

Note: Answer any FIVE full questions, selecting at least TWO full questions from each part.

PART - A

1. a. Explain the relationship of Robotics with industrial automation and discuss its role with a suitable example. 8
- b. State and explain the various aspects that justify the need for robots in industry. 6
- c. Bring out the detailed classification of robots. 6
2. a. With a neat sketch differentiate and highlight the common types of robot configuration. 8
- b. Describe with a neat sketch the degrees of freedom associated with a robot wrist motion. 6
- c. The base joint of a cylindrical robot is driven by a 12-bit memory converter and has a swing range of 360°. The radial arm is driven by a 8 bit memory convertor and has a horizontal reach of 300 mm and a stroke of 200mm. The vertical motion has a drive of 10 bit memory convertor with a vertical reach of 480 mm and stroke of 360 mm. Compute the following: 6
 - i) Volume of the work envelope
 - ii) Vertical resolution
 - iii) Minimum and Maximum angular resolution.
3. a. Describe any four controllers used in robotics system along with their transfer function. 8
- b. Explain the parameters associated with transient response of a second order system. 8
- c. Obtain the classification of actuators and state any two characteristic features of pneumatic actuators. 4
4. a. Differentiate between direct and inverse kinematics. 4
- b. Sketch and obtain the rotation matrix for Euler angle system. 6
- c. A Robot work cell has a camera within the setup. The origin of the six joint robot fixed to a base can be seen by a camera. A cube placed on the work cell table is also seen by the camera. The following homogeneous transformation matrix (T_1) maps the camera with a cube centre. The origin of the base co-ordinate system as seen by camera is represented by homogeneous transformation system (T_2) 10

$$T_1 = \begin{bmatrix} 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 8 \\ 0 & 0 & -1 & 7 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad T_2 = \begin{bmatrix} 1 & 0 & 0 & -8 \\ 0 & -1 & 0 & 15 \\ 0 & 0 & -1 & 6 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- (i) What is the position and orientation of the cube with respect to the base –coordinates system?
- (ii) After the system has been set up, someone rotates the camera by 90° about the Z-axis of the camera. What is the position and orientation of the camera with respect to robot's base co-ordinates?

PART – B

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| 5 | a. Discuss Lagrange - Euler formulation for 'n' degree general manipulator. | 14 |
| | b. Discuss the importance of Lagrangian Mechanics with respect to robot dynamics. | 6 |
| 6 | a. Discuss the programming methods used in robots mentioning their field of application. | 12 |
| | b. Discuss the following : | |
| | (i) Manual teaching | 8 |
| | (ii) PTP and continuous path programming. | |
| | (iii) Robot programming languages. | |
| 7 | a. Differentiate sensor and transducer using suitable example. Also give classification of sensors. | 10 |
| | b. Name the sensors used in controlling Robot. | 6 |
| | c. List any four characteristics of a tactile sensor. | 4 |
| 8 | a. With a simple sketch explain the applications of robots in welding. | 8 |
| | b. What is an FMS? Explain the role of robots in FMS. | 12 |

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