



**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 - 2016**

**Industrial Robotics**

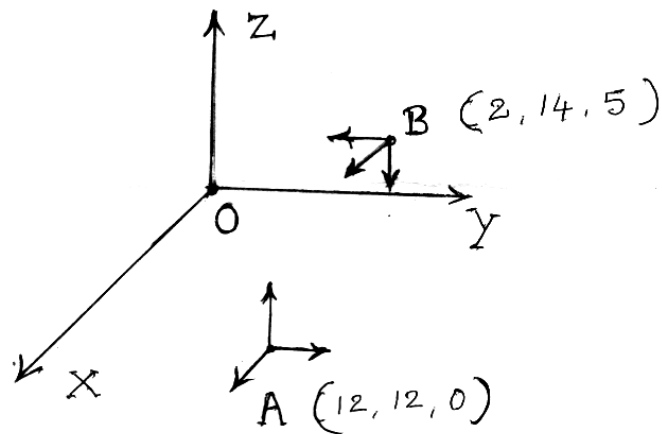
*Time: 3 hrs*

*Max. Marks: 100*

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

**PART - A**

- 1 a. With the help of a block diagram explain the basic components of robot system. 10
- b. Explain different types of costs involved in an industrial robot. 10
- 2 a. Sketch and explain following joints used in robots : 8
  - i) Linear                      ii) Rotational
  - iii) Twisting                iv) Revolving
- b. Differentiate between hydraulic drive and electric drive used in robots. 8
- c. A cylindrical robot has a horizontal reach of 300 mm and stroke of 200 mm, its vertical reach is 480 mm and stroke is 360 mm. The radial axis of the robot is driven by 8-bit memory controller determine; 4
  - i) Work Volume                ii) Radial Resolution
- 3 a. Describe closed loop control system of an industrial robot with the help of block diagram. 8
- b. Explain the functions of various control levels of robot controllers. 12
- 4 a. Sketch and show the resultant rotation matrix for Eulerian angle system-I and Eulerian angle system - II. 10
- b. Write homogeneous transformation matrices for the coordinate frames at points 'A' and 'B' with respect to base co-ordinate frame 'O'. Determine position and orientation of 'A' with respect to frame 'B' shown in Fig. 4.b.1



10

Q.NO. 4.b-Fig:-4.b.1

**PART - B**

- 5 a. Derive an expression for kinetic energy of robot manipulator. 8
- b. Explain Lagrange-Euler equation for robotic manipulator and obtain general form of  ${}^{2'-1}A_i$  when joint is revolute. 12
- 6 a. What is the critical information required for task programming of robot? 5
- b. Explain powered lead through teaching of robots. 5
- c. Write robot task program in VAL-II to perform following tasks :
- i) Robot picks apart from Conveyor 'μ' its approach point is 60 mm and departure point is 75 mm from conveyor. 10
- ii) Robot places the part in a box 'B' its approach point is 30 mm and departure point is 50 mm from Box.
- Write end effect or path diagram.
- 7 a. Explain the desirable features of sensors. 5
- b. Sketch and explain the following sensors :
- i) Tactile sensor 15
- ii) Inductive sensor
- iii) Range sensor
- 8 a. Discuss about material handling robot features and advantages. 10
- b. Distinguish between spot welding and arc welding robots. 10

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