



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

(An Autonomous Institution affiliated to VTU, Belagavi)

**Second Semester, M.Tech. - Mechanical Engineering (MCIM)**

**Semester End Examination; May/ June - 2019**

**Advanced Industrial Robotics**

*Time: 3 hrs*

*Max. Marks: 100*

*Note: Answer FIVE full questions, selecting ONE full question from each unit.*

### UNIT - I

- 1 a. Define robot and explain the geometrical configuration of robots with its work volume. 10
- b. Explain: 6
- i) Spatial resolution      ii) Accuracy      iii) Repeatability
- c. A robot has a rotary joint with a full axis of  $128^\circ$ . If its control memory has an 8 bit storage capacity, find the control resolution of the axis. What is the representation of  $100^\circ$  angular position? 4
- 2 a. Define grippers and explain types of grippers with neat sketches. 10
- b. Explain the classification of fixed robots and mobile robots. 10

### UNIT - II

- 3 a. Explain direct kinematics problems in robotics. 10
- b. Explain transformation of matrix composed of orientation matrix and translation vectors. 10
- 4 a. With a neat sketch, explain D-H method for link coordinate systems and joint parameters. 10
- b. Explain types of joints and wrist motion with neat sketches. 10

### UNIT - III

- 5 a. Explain programming methods : 10
- i) Powered lead through method      ii) Manual lead through method
- b. Explain; i) Joint interpolation      ii) Straight line interpolation      iii) Circular interpolation 6
- c. Explain wait, signal and delay commands for a robot. 4
- 6 a. Explain the following : 10
- i) Motion commands      ii) Speed control statement      iii) Definition of point in workspace
- iv) Path and frames      v) Gripper commands
- b. Explain the concepts of branching for robot programme to perform a palletizing operation. 10

### UNIT - IV

- 7 a. Write a note on : 10
- i) Key issues of locomotion
- ii) Leg configuration and stability
- b. With the aid of neat sketches, explain various types of wheels used for wheeled mobile robots. 10

- 8 a. Explain wheel kinematics constraints for;
  - i) Steered standard wheel 10
  - ii) Control wheel
- b. With a neat sketch, explain robot kinematics constraints for an omnidirectional robot. 10

**UNIT - V**

- 9 a. Explain the following :
    - i) Degree of mobility for standard wheel 10
    - ii) Degree of steerability
  - b. With a neat sketch, explain path and trajectory considerations for omnidirectional robot. 10
- 10 a. Explain;
    - i) Bubble band technique 10
    - ii) Curvature velocity technique.
  - b. Explain general tiered mobile robot navigation architecture based on temporal decomposition. 10

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