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

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Mechanical Engineering

Semester End Examination; June - 2017

Industrial Robotics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Define industrial robots. With a neat sketch, briefly explain three degrees of freedom associated with robot wrist. 10

b. With a neat sketch, briefly describe the polar and jointed arm configurations of a typical robot. 10

2 a. Define work volume of a robot and briefly explain the four major types of joints used in robot with sketches. 10

b. Discuss repeatability, accuracy and resolution. Also mention any five typical industrial applications of robots. 10

UNIT - II

3 a. Define a robot drive systems and briefly explain them with examples. 10

b. Mention the four basic categories of sensors which are used in robotics and list any five advantages and disadvantages of an electrical drive system of an industrial robot. 10

4 a. Briefly describe different types of tactile sensors. 10

b. Explain range and proximity sensors with a sketch. 10

UNIT - III

5 a. Define robot arm kinematics with an example and briefly explain direct and inverse kinematics with neat block diagrams. 10

b. Discuss rotation matrix about an arbitrary axis with neat diagram. 10

6 a. A robot work station has been setup with TV camera. The camera can see the origin of the base co-ordinate system where 6 joint robots are attached. It can also see the centre of the object (assumed to cube) to be manipulated by robot. If a local coordinate system has been established at the center of the cube, this object as seen by the camera can be represented by a homogenous transformation matrix T_1. If the origin of the base coordinate system as seen by the camera can also be expressed by homogenous transformation matrix T_2, and

$$T1 = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 10 \\ 0 & 0 & -1 & 9 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad T2 = \begin{bmatrix} 1 & 0 & 0 & -10 \\ 0 & -1 & 0 & 20 \\ 0 & 0 & -1 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

10

Contd....2

i) What is the position of the center of the cube with respect to the base coordinate system?

ii) Assume that the cube is within arm's reach. What is the orientation matrix [*n*, *s*, *a*], if you want the gripper (or finger) of the hand to be aligned with the *Y*-axis of the object and at the same time pick up the object from the top.

b. Give Euler's angle representation for System I and System II and derive the rotation matrix for System III. 10

UNIT - IV

7 a. Briefly discuss Powered-Lead through and manual lead through programming and mention any two important applications for each. 10

b. With a neat sketch, explain robot language elements and its functions. 10

8 a. Explain VAL and briefly illustrate the two important motion commands. 10

b. Write a VAL program for palletizing operation, the robot must pick up parts from an incoming chute and deposit them onto a pallet as shown in the below figure. The objects to be picked up are about 25 mm tall (approximately). Use constants and variables in program. 10

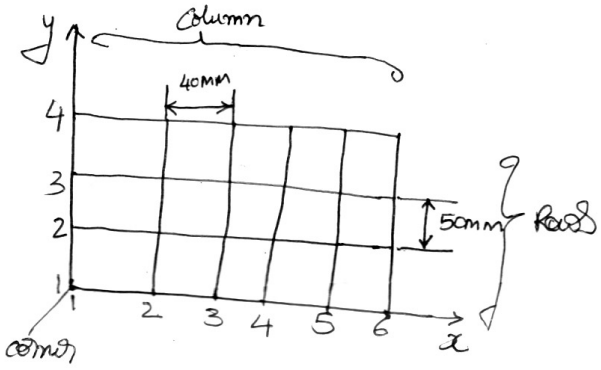

Fig. Pallet configuration for examples

UNIT - V

9 a. Briefly discuss the general considerations for materials handling in a typical work cell design. 10

b. Illustrate briefly the pick and place operation of an industrial robot with a neat sketch. 10

10 a. Write short notes on the following robotics applications in industry : 12

i) Die casting ii) Plastic moulding.

b. Describe the features of Arc welding robot. 8

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