

M.E. PRODUCTION ENGG. 1ST YEAR 1ST SEMESTER EXAMINATION - 2025
Subject : ROBOTICS

Time: 3 hours

Full Marks: 100

Answer any 10 questions

1. Show the various robot configurations using neat sketches, stating their co-ordinate systems. 10
2. Show the basic components of a robot using a neat sketch of an industrial robot, indicating the locations of actuators and internal sensors for the various joints and the electrical interface between them & the robot controller. 10
3. What do you mean by the working envelope of a robot? Draw the working envelopes & also the configurations for cartesian type & cylindrical type robot configurations. 2+4+4
4. Classify end effectors. Show the mechanisms of two fingered parallel jaw type robot grippers with revolute joint & prismatic joint. State the relative advantages and disadvantages of these two types of robot grippers. 2+8
5. How many degrees of freedom (minimum) are required to position the end-effector at any point within the working envelope of a robot? How many additional degrees of freedom are required at the robot wrist & for what purpose? Show how this can be achieved, using a neat sketch of a robot wrist. 1+3+6
6. Explain the working principle of the vacuum gripper. State the applications of vacuum grippers in industry. 9+1
7. A cube of weight 8 kg is to be gripped by a SCARA type robot, using friction between the object and the two parallel opposing fingers. The co-efficient of friction, $\mu = 0.2$. The gripper is attached to a SCARA type robot. Calculate the minimum gripping force, to be exerted by each finger when
 - i) the cube is held up stationary
 - ii) the cube is being picked up vertically upwards with an acceleration, $g/10$
(g = acceleration due to gravity)10
8. Can a revolute joint of a robot be actuated using a piston & cylinder type prismatic actuator? If answer is 'yes' show a figure for that. Compare the advantages & disadvantages of different drive systems used for robots. 4+6

9. Discuss with a neat sketch, about the function and the working principle of a RCC device, that can be employed at the robot wrist for rectification of misalignment in peg and hole assembly. 10
10. Which specifications are important when buying an industrial robot? Explain any three of them. 4+6
11. Write a robot program in VAL-II for a palletizing operation, in which a robot has to pick up 20 objects from a fixed location, and to place them in a pallet in the form of an array of 4 rows and 5 columns. The rows and columns are parallel to x-axis and y-axis respectively, and are 200 mm & 150 mm apart respectively. 10
12. A robot has to pick up three different types of parts in a repeated fashion from a fixed location whenever any part is present there, and to place them in three different locations depending on the types of the parts. The presence of a particular type of part is indicated to the robot controller by a vision system that recognizes the parts, and sends a binary value 1 (= ON) to any one of three binary input channels (numbered 1, 2 & 3). Write a robot program in VAL-II for performing the operation. 10
- 13.a) Distinguish between internal and external robot sensors. 4
- b) Explain the working principle of an inductive proximity sensor. 6
14. Explain briefly the working principle of an optical absolute encoder used for the feedback of joint positions in robots. 10
- 15.a) What is 'segmentation' in vision processing? Discuss edge detection technique. 2+5
- b) What do you mean by direct and inverse kinematics in robotics? 3