

**B. PRODUCTION ENGINEERING 4TH YEAR 2ND SEMESTER EXAMINATION – 2017  
(Old)**

**ROBOTIC TECHNOLOGY  
(ELECTIVE – I)**

**Time: Three hours**

**Full Marks: 100**

**Use separate Answer-Script for each part**

**PART - I (60 marks)**

Answer any **six** questions

1. What is the working envelope of a robot? Draw the working envelope of cylindrical and Cartesian robot configuration. 2+4+4
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 various components of the robot controller. 10
3. Why are additional 3 degrees of freedom required at the robot wrist? Show a root wrist using a neat sketch. 2+8
4. A cylindrical workpiece of weight 10 kgf with its axis vertical is to be gripped by a robot gripper with three fingers, using friction between the object and the fingers. The coefficient 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 the workpiece is being picked up vertically upwards with an acceleration,  $g/4$ . 10
5. Show two different types of mechanism of two fingered parallel jaw type robot grippers (with revolute & prismatic joints). What are the advantages & limitations of using these two types of robot gripper? 7+3
6. 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
7. Show the various robot configurations using neat sketches, stating their co-ordinate systems. What is the advantage of SCARA configuration in industrial applications 8+2
8. Why is the use of robots economically justified in batch production where there is frequent changes of product? Why is it necessary to use at least one internal sensor at each joint of a robot? 4+6

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**PART - II (40 marks)**

Answer any **two** questions

- 9.a) What parameters are stored for the location variables defined in world coordinate system and joint coordinate system in VAL-II? 4
- b) Distinguish between the following instructions in VAL-II : 6
- i) APPRO and DEPART
  - ii) CLOSEI and CLOSE
  - iii) CIRCLE and PCIRCLE
- c) Write a robot program in VAL-II for a robot to pick up 24 objects from a fixed location, and to place them in a pallet in an array of 4 rows and 6 columns. The rows and columns are parallel to x-axis and y-axis respectively, and are 150 mm and 120 mm apart respectively. 10
- 10.a) What do you mean by internal and external sensors in robots? Explain with suitable examples. 4
- b) What is meant by proximity sensor? Explain briefly the working principle of an inductive proximity sensor. 2+6
- c) 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 turning a signal 'on' at one of three binary input channels (numbered 1,2,3) of the robot controller by a vision system that recognizes the parts. Write a robot program in VAL-II for performing the operation. 8
- 11.a) What do you mean by direct and inverse kinematics in robotics? 4
- b) What is 'segmentation' in vision processing? Discuss edge detection technique. 1+5
- c) Discuss some techniques of 'object recognition' in vision processing. What are the major applications of vision system in robotics? 5+5