

B.E. PRODUCTION ENGINEERING 4TH YEAR 2ND SEMESTER EXAMINATION 2022

**ROBOTIC ENGINEERING
(ELECTIVE – II)**

Time: 4 hours

Full Marks: 70

Answer any seven questions

1. What is the basic difference between Polar & SCARA Configurations of Robot where both are R-R-P (Revolute-Revolute-Prismatic) configurations? Discuss with suitable figures. 10
2. 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
3. Show two different types of mechanism of two fingered parallel jaw type robot grippers (with revolute & prismatic joints) and compare the advantages & limitations of using these two types of robot gripper? 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. 8+2
4. Explain the working principle of the vacuum gripper. State the applications of vacuum grippers in industry. 9+1
5. A cylindrical work-piece of mass 10 kg with its axis vertical is to be gripped by a robot gripper with three fingers, using friction between the object and the fingers. The co-efficient of friction, $\mu = 0.1$. The gripper is attached to a SCARA type robot. Calculate the minimum gripping force, to be exerted by each finger when the work piece is being picked up vertically upwards with an acceleration, $g/5$. (g =acceleration due to gravity) 10
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.a) Explain the joint coordinate system and world coordinate system for defining a location variable in a robot language. 5
- b) Distinguish between the following :
 - i) MOVE and MOVES instructions in VAL-II
 - ii) range and proximity robot sensors 5

[Turn over

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8. Write a robot program in VAL-II for a palletizing operation, in which a robot has to pick up 35 objects from a fixed location, and to place them in a pallet in the form of an array of 5 rows and 7 columns. The rows and columns are parallel to x-axis and y-axis respectively, and are 140 mm & 100 mm apart respectively. 10
9. Explain the working principles of the following : 6+4
- (i) an inductive proximity sensor
 - (ii) an optical proximity sensor
10. 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