B. PRODUCTION ENGINEERING 4TH YEAR 2ND SEMESTER EXAMINATION – 2018

ROBOTIC ENGINEERING
(ELECTIVE – II)

Time: Three hours **Full Marks: 100**

Use separate Answer-Script for each part

PART - I (60 marks)
Answer any **six** questions

1. 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

2. What is the working envelope of a robot? Draw the working envelope of cylindrical and Cartesian robot configurations. 2+4+4

3. 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

4. Why are additional 3 degrees of freedom required at the robot wrist? Show a robot wrist using a neat sketch. 2+8

5. A cylindrical work-piece of weight 8 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 co-efficient of friction, u = 0.2. 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. 10

6. 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

7. 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

8. 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

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Ref. No. EX/PROD/T/424C/2018

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PART - II (40 marks)

Answer any **two** questions

9.a) Explain the world coordinate system and joint coordinate system for defining a location variable in a robot language. 4

b) Distinguish between the following :

i) MOVE and MOVES instructions in VAL-II

ii) CLOSEI and CLOSE instructions in VAL-II

(i) range and proximity robot sensors 6

c) Write a robot program in VAL-II language for a de-palletizing operation. The robot has to pick up 24 objects from a pallet, and to place them in a fixed location. The objects, to be picked up, are arranged in an array of 4 rows and 6 columns, where the rows and columns are parallel to x and y axes respectively, and are 150 mm & 100 mm apart respectively. 10

10.a) Explain briefly the working principle of an inductive proximity sensor. 6

b) How would you obtain a composite homogeneous transformation matrix from the basic homogeneous transformation matrices for a sequence of rotations and translations of a coordinate frame with respect to a fixed coordinate frame? 4

c) Discuss Denavit-Hartenberg (D-H) method for establishing a coordinate frame to each link of a robot arm, and to obtain a transformation matrix relating two successive coordinate frames. Hence, discuss its use in direct kinematics in robotics. 10

11.a) What is binary image and how is it obtained from gray image? Discuss edge detection technique. 3+5

b) Discuss some techniques of 'object recognition' in robot vision system. What are the major applications of vision system in robotics? 6+6