Registration no:

1st Semester Examination – 2015-16
INDUSTRIAL AUTOMATION AND ROBOTICS
BRANCH(S): E & I / A E & I
Time: 3 Hours
Max marks: 70
Q.CODE-T1218
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1   Answer the following questions: (2 x 10)

a) Define "Automation". Write down the significance of a Robot in Industrial Automation.

b) Why 6 Degree of Freedom Robot is used in industry?

c) Sketch two views to indicate the work-envelope of a cylindrical and a polar Robot.

d) For an image digitized at 128 points per line and consisting of 128 lines, determine**:** the number of bits required to represent the gray level values if an 8 bit A/D converter is used to indicate various shades of gray.

e) What are the advantages and disadvantages of magnetic grippers?

f) Give some examples of Robot End Effector.

g) What is D-H representation? What is its significance?

h) What is Inverse Jacobian Representation?

i) How can you define a "Robot Program"? What are the methods of "Robot Programming"?

j) What is the difference between Path and Trajectory?

Q2 a) Give a brief idea about "Robot Reference Frames".   (5)

     b) Explain the concept of Accuracy and Repeatability of a Robot. Sketch   (5) the following Robots indicating the joints and the Degree of Freedom :
(i) SCARA Robot (ii) Gantry Robot

Q3 a) What are different types of sensors? How do you sense the positional   (5) accuracy of a Robot? Describe the suitable types of sensor used to measure the position.

     b) For the following frame, find the values of the missing elements, and   (5) complete the matrix representation of the frame:

$$\begin{bmatrix} ? & 0 & ? & 5 \\ 0.607 & ? & ? & 2 \\ ? & ? & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Q4 a) What is the function of a manipulator? Sketch and explain a robotic   (5) manipulator arm.

b) Discuss the functions of a gripper with the help of a sketch. Explain the working of "Magnetic Grippers" used for Robots. (5)

Q5 a) Define a Robot. With the help of sketches describe Pitch, Yaw and Roll motion of a Robot wrist. (5)

b) A Robot is installed in a work space and the location of the base is bolted. With the end effector (E) of it, the Robot need to reach the target (P). Find the forward and inverse kinematics transformation with respect to Universe (U). (5)
Note : Hand is denoted by H.

Q6 a) Discuss about differential motions of a Robot and its hand frame using Jacobian. (5)

b) The hand frame of a Robot with 5 Degree of Freedom, its numerical Jacobian for this instant and a set of differential motion are given. The Robot has a 2RP2R configuration. Find the new location of the hand after the differential motion. (5)

$$T_6 = \begin{bmatrix} 1 & 0 & 0.1 & 5 \\ 0 & 0 & -1 & 3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$J = \begin{bmatrix} 3 & 0 & 0 & 0 & 0 \\ -2 & 0 & 1 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} d\theta_1 \\ d\theta_2 \\ d\theta_3 \\ d\theta_4 \\ d\theta_5 \\ d\theta_6 \end{bmatrix} = \begin{bmatrix} 0.1 \\ -0.1 \\ 0.05 \\ 0.1 \\ 0 \end{bmatrix}$$

Q7 a) Define "Third order polynomial trajectory". It is desired to have the first joint of a 6-axis Robot to go from initial angle of 30° to a final angle of 75° in 5 seconds. Using a third-order polynomial, calculate the joint angle at 1, 2, 3 and 4 seconds. (5)

b) What is the first real Robot Programming method? Discuss the relative merits and demerits of different textual robot languages. (5)

Q8 Write short notes on the following **(Any Two)** (5 x 2)
a) Servomotor
b) Hill Climbing Technique
c) Advantages of Hydraulic Actuator Systems over Electrical motors
d) Robot Cell Design