2nd Semester Back Examination 2016-17
ROBOTICS
SPECIALIZATIONS: DESIGN AND DYNAMICS, MACHINE DESIGN, MECH. SYSTEM DESIGN, PRODUCTION ENGG, PRODUCTION ENGG AND OPERATIONAL MGT
### Time: 3 Hours
Max Marks: 100
Q.CODE: Z1088
**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:** *Short answer type* **(2 x 10)**
- **a)** Explain about the historical background of Robot manipulators and State the laws of robotics.
- **b)** Define the terms: Work envelope, Payload with respect to robot.
- **c)** With the aid of sketches briefly describe Pitch-Roll-Yaw motions of a robot wrist.
- **d)** What do you mean by teach pandant?
- **e)** The coordinates of point P with respect to a moving coordinate frame are given as P = $[0.5\ \ 0.8\ \ 1.3]^T$. What are the coordinates of P with respect to fixed coordinate frame, if the moving frame rotated by 40^0 about X-axis of the fixed frame.
- **f)** Explain why homogeneous coordinates are required in modeling of robotic manipulators.
- **g)** Write the possible walking robot applications in manufacturing industries.
- **h)** What do you mean by robot vision system?
- **i)** Compare different types of actuating systems i.e., hydraulic and pneumatic systems with respect to robotic systems.
- **j)** What are the advantages and disadvantages of stepper motors over D.C. servo motors?

Q2 **a)** What are the basic components of a robotic system? State the main function of each of the components. **(5)**
b) What do you mean by inverse kinematic? Differentiate between direct and inverse kinematics. **(5)**

Q3 **a)** With the help of neat diagram, illustrate the scheme of robot sensors. State and explain five types of sensors used in robotics. **(5)**
b) What are the different types of hydraulic actuators used in robotics? Compare different types of actuating systems i.e., hydraulic, electric and pneumatic systems with respect to robotic systems. **(5)**

Q4 How is a robot end-effector specified? State and explain various drives methods used for robot gripper systems. Explain with neat sketch of mechanical, vacuum and adhesive gripper. **(10)**

Q5 **(10)**

For the object shown in figure 5.1, find the homogeneous transformation matrices ^0A_i for

i = 1, 2 also find $^1A_2$.

Figure 5.1

Q6 **(10)**
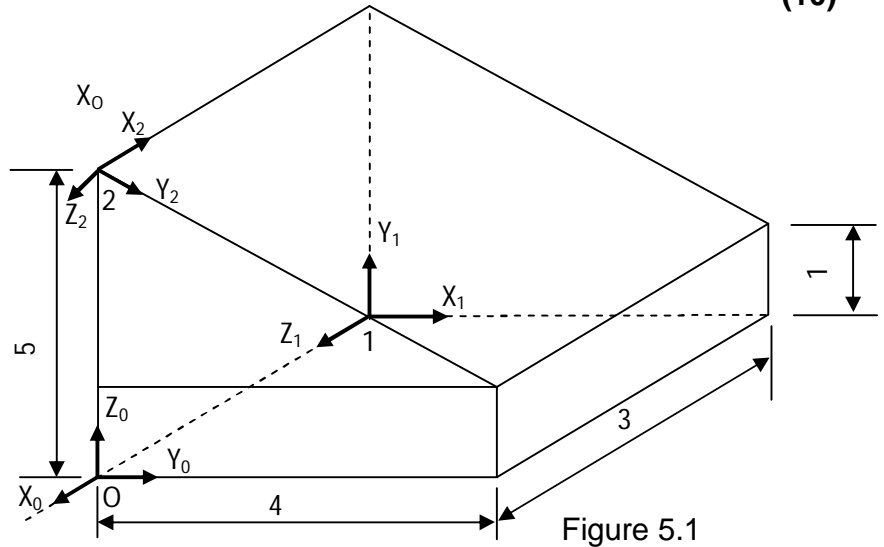
Two plates of 10 mm thickness are to be welded with square butt joint as shown in figure-6.1. The welding is straight weld. The welding torch should start from position A, move to B, continue with continuous arc welding along BC in a straight line and then move to position D. Write a VAL programe in global-coordinates.
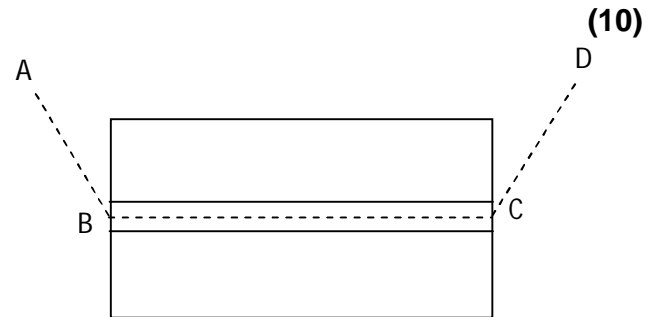

Figure – 6.1

Q7 What are the benefits of using flexibility in manufacturing systems? How do you classify robots from the view points of application of FMS? Distinguish between hard automation and flexible automation. **(10)**

Q8 a) A single axis robot with a fixed base and a mobile link as shown figure 8.1. The mobile frame has a point pm given by $[2 \quad 5 \quad 9]^T$. Find the co-ordinates of the point P with respect to base fame when $\varphi_1 = 145^0$ and $\varphi_2 = 35^0$. **(4)**

Figure – 8.1
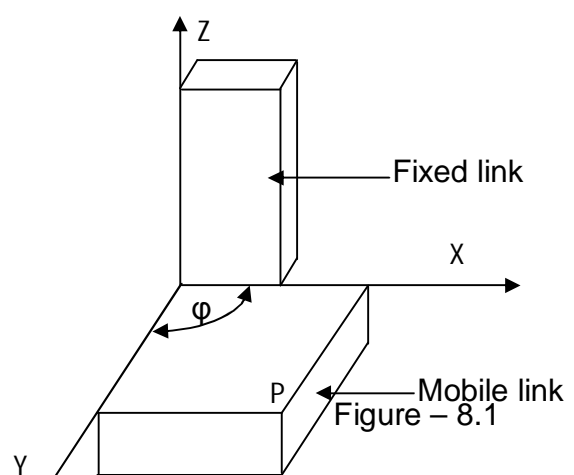
b) Cylindrical workpieces are to be picked up and inserted in the lathe chuck. Suggest type of robot and end-effector to grip and insert the workpieces. **(3)**

c) What are the functions of a robot vision system? What are the types of vision sensor used to take the image of an object? **(3)**