2nd Semester Regular Examination 2016-17
ROBOTICS AND AUTOMATION
Branch: DESIGN AND DYNAMICS, MECH. SYSTEMS DESIGN AND DYNAMICS
Time: 3 Hours
Max Marks: 100
Q.CODE: Z980
Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.

Q1   Answer the following questions: *Short answer type*   **(2 x 10)**
   a) Write about the historical development of Robot manipulators.
   b) Why homogeneous coordinates are required in modeling of robotic manipulators.
   c) State the important advantages and disadvantages of pneumatic actuators.
   d) The coordinates of point P with respect to a moving coordinate frame are given as P = $[0.6\ 0.7\ 1.5]^T$. What are the coordinates of P with respect to fixed coordinate frame, if the moving frame rotated by 60^0 about Y-axis of the fixed frame.
   e) State and explain Laws of Robotics. Define the terms: Work envelope, Payload with respect to robot.
   f) With aid of sketches briefly describe Pitch-Roll-Yaw motions of a robot wrist.
   g) Jacobian matrix is usually of size $m \times n$ where 'm' stands for _____ and 'n' stands for_____.

   h) Write short notes on the following terms with respect to material handling: i) Automation principle and ii) Ergonomic principle.
   i) Explain in detail about line balancing problems.
   j) What is mean by automation? Write the basic elements of an automated system.

Q2 **a)** What are the advantages and disadvantages of stepper motors over D.C. servo motors?   **(5)**
   b) State and explain five types of sensors used in robotics.   **(5)**
   c) Compare different types of actuating systems i.e., hydraulic, electric and pneumatic systems with respect to robotic systems.   **(5)**
   d) What are the different types of hydraulic actuators used in robotics? Explain the working principle of Pneumatic-actuator.   **(5)**

Q3 a) A single axis robot with a fixed base and a mobile link as shown figure 3.1. Suppose the mobile frame has a point p_m given by $[2 \quad 8 \quad 8]^T$. Find the co-ordinates of the point P_F with respect to base fame when $\theta_1 = 180^0$ and $\theta_2 = 0^0$ **(8)**
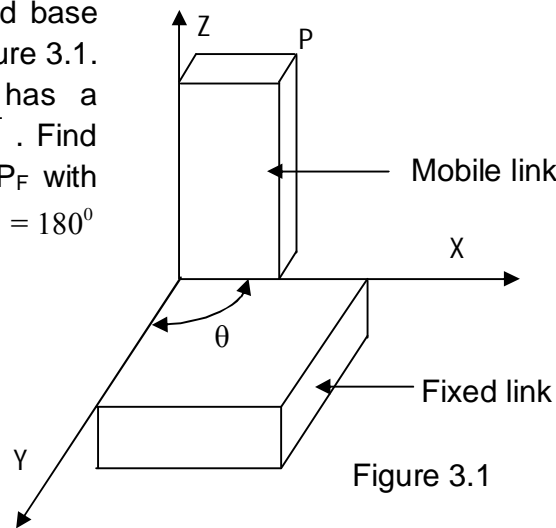

Figure 3.1

b) Write the homogeneous transformation matrices shown in the figure 3.2 for the co-ordinate frames attached to the corners A, B, C and D with respect to the base co-ordinate frame 'O'. Also write the transformation matrix for 'A' with respect to 'C' frame and verify the same by finding the inverse. **(12)**
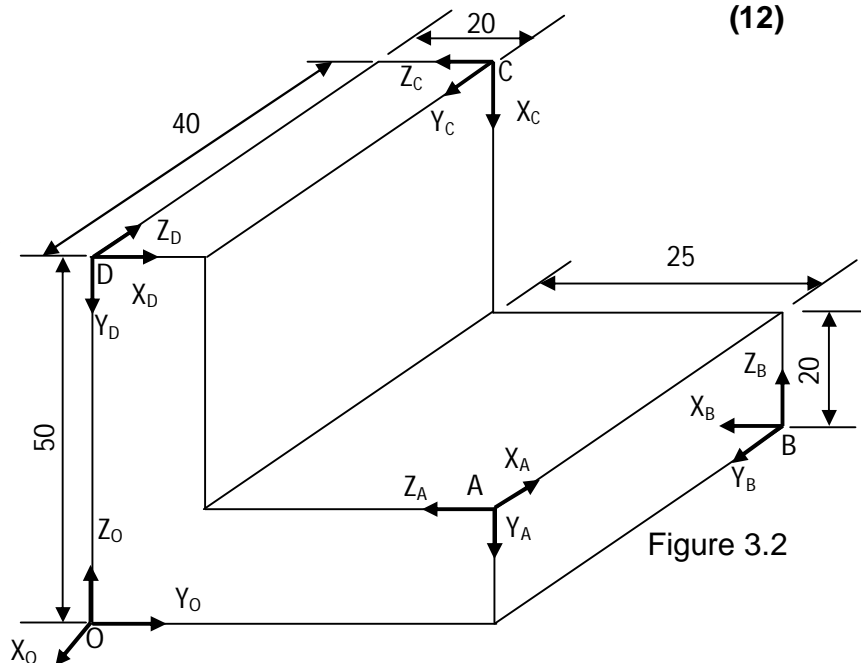

Figure 3.2

Q4 a) Derive the forward kinematic equations using Denavit-Hartenberg notation for a three link planner manipulator. **(10)**

b) Discuss the differences between path and trajectory and Cartesian trajectory and Joint space trajectory planning. **(10)**

Q5 a) Differences between Lagrange-Euler and Newton Euler equation of motion. **(10)**

b) The first joint of a 2R robot is to rotate from 100 to 600 following cubic trajectory. The initial and final angular velocities are +10 deg/sec and -30 deg/sec. The motion is to be completed in 2 sec. Derive approximating polynomial for the trajectory, its velocity and acceleration. **(10)**

Q6 **a)** State in details about the fundamentals of automated assembly systems. Also explain what do you mean by multi station automated assembly machines? **(10)**

b) Write ten principles of material handling. **(10)**

Q7 **a)** Explain briefly about automated material handling systems. What do mean by automated guided vehicle systems? State their types and applications also explain about vehicle guidance technology. **(10)**

b) With neat diagram explain in details about "automated storage systems" and "automated storage and retrieval systems (AS/RS)". Write differences Between an AS/RS and a Carousel Storage System. **(10)**