

INDUSTRIAL ROBOTICS
(MECH 4127)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) In which of the following operations, continuous path system is used?
 - (a) Pick and place
 - (b) Loading and unloading
 - (c) Continuous welding
 - (d) All of the above.
 - (ii) The robot designed with cylindrical coordinate systems has
 - (a) three linear movements
 - (b) three rotational movements
 - (c) two linear and one rotational movement
 - (d) two rotational and one linear movement.
 - (iii) Internal state sensors are used for measuring _____ of the end effector.
 - (a) position
 - (b) position & velocity
 - (c) velocity & acceleration
 - (d) position, velocity & acceleration.
 - (iv) Computer vision plays vital role in the domains of _____.
 - (a) safety
 - (b) security
 - (c) health
 - (d) all of the above.
 - (v) Which of the following is not advantage of robotics?
 - (a) Greater flexibility and re-programmability
 - (b) Greater response time to inputs than human
 - (c) Greater unemployment
 - (d) Improved product quality.
 - (vi) Which of the following term refers to the use of compressed gasses to drive (power) the robot device?
 - (a) Pneumatic
 - (b) Piezoelectric
 - (c) Hydraulic
 - (d) Photosensitive.
 - (vii) In which of the following operation, dual gripper is must?
 - (a) Unloading in die casting
 - (b) Unloading in injection moulding
 - (c) Machine tool loading and unloading
 - (d) Pick and place.

- (viii) VAL II is a robotic language of
 (a) first generation (b) second generation
 (c) future generation (d) none of the above.
- (ix) The objective of using robot in industry is to
 (a) minimize labour requirement (b) increase productivity
 (c) enhance safety (d) all of the above.
- (x) What is the predominant factor for selecting robot over human in industry?
 (a) Labour cost (b) Accuracy
 (c) Very unsafe environment (d) Time.

Group - B

2. (a) Describe the specifications of an industrial robot. [(CO1)(Remember/LOCQ)]
 (b) Find out the DH parameters of the SCARA robot shown in Fig.1.

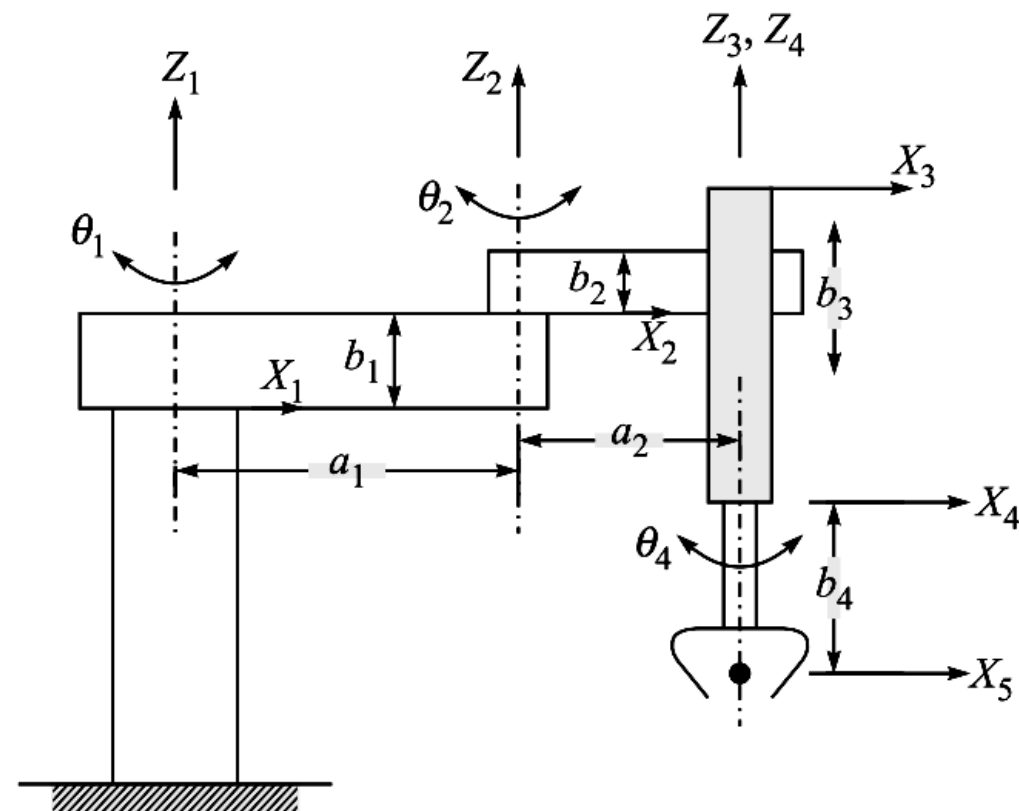


Fig.1

[(CO2)(Evaluate/HOCQ)]
4 + 8 = 12

3. (a) Explain and draw various types of the robot joints (at least three). [(CO1)(Understand/LOCQ)]
 (b) Frame $\{B\}$ was initially coincident with $\{A\}$. Then frame $\{B\}$ was rotated about X_A -axis by 45° . Then it was rotated it about Y_A -axis by 30° , and then was rotated it about Z_A -axis by 60° . Note that X_A , Y_A , and Z_A axes are the original axes of frame $\{A\}$. Calculate the resultant rotation matrix ${}^A_B R$. [(CO2)(Evaluate/HOCQ)]
6 + 6 = 12

Group - C

4. (a) Discuss the working of elastomeric actuators. Also write the advantages over conventional actuators. [(CO3)(Remember/LOCQ)]
 (b) What is end effector? Give some examples of tool as robot end effector. [(CO4)(Remember/LOCQ)]

- (c) What are the difference between internal grippers and external grippers?
[[CO4](Analyze/IOCQ)]
6 + (2 + 1) + 3 = 12
5. (a) Explain the working principle of servo motor with sketches.
[[CO3](Understand/LOCQ)]
(b) Discuss about any three special actuators used in robots.
[[CO3](Understand/LOCQ)]
6 + 6 = 12

Group - D

6. (a) Explain the working principle of inductive type proximity sensor?
[[CO3](Remember/LOCQ)]
(b) What are the different types of force sensors used in a robot? Explain any one.
[[CO3](Remember/LOCQ)]
6 + (2 + 4) = 12
7. (a) What is vision system of a robot? What are the advantages and application of robot vision system?
[[CO3](Apply/IOCQ)]
(b) Describe the working principle of position sensors with neat sketch.
[[CO3](Understand/LOCQ)]
6 + 6 = 12

Group - E

8. (a) Discuss the capabilities and limitations of lead through programming.
[[CO5](Understand/LOCQ)]
(b) Describe the methods of defining positions in space.
[[CO5](Understand/LOCQ)]
6 + 6 = 12
9. (a) What are the basic elements of second generation robotic programming languages?
[[CO5](Understand/LOCQ)]
(b) Explain in brief how robot can be used in continuous arc welding process. Also discuss its limitations.
[[CO6](Understand/LOCQ)]
6 + (4 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	76.04	9.37	14.58

Course Outcome (CO):

After the completion of the course students will be able to

- CO1 Identify different components of industrial robots and classify based on different criterion
- CO2 Implement the knowledge of forward kinematics, inverse kinematics to analyze manipulator motions
- CO3 Use sensors, actuators, drives for various industrial applications
- CO4 Select suitable end effectors for specific industrial applications
- CO5 Develop program for controlling robot for a given application
- CO6 Describe the various applications of robots in industry.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question;
HOCQ: Higher Order Cognitive Question