INDUSTRIAL ROBOTICS
(MECH 4127)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) The robot designed with Cartesian 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.

(ii) A robot is a
(a) programmable (b) multi-functional manipulator
(c) both (a) and (b) (d) none of the above.

(iii) Drives are also known as
(a) Sensors (b) Controller (c) Actuators (d) Manipulator.

(iv) 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.

(v) Match the following:

a. Manipulator arm	1. For holding a piece or tool
b. Controllers	2. Move the manipulator arm and end effector
c. Drives	3. Number of degrees of freedom of movement
d. Gripper	4. Delivers commands to the actuators

(a) a-1, b-4, c-2, d-3 (b) a-3, b-4, c-2, d-1
(c) a-3, b-2, c-4, d-1 (d) a-4, b-3, c-2, d-1

(vi) A sensor is a device that converts
(a) Physical quantity into measurable signals
(b) Physical quantity into mechanical signal
(c) Electrical signal into physical quantity
(d) Physical quantity into electric signal only.

(vii) Which factor affects the least while selection of sensor?
(a) Size (b) Accuracy (c) Colour (d) Durability.

(viii) Which of the following interpolation schemes is suitable for lead through programming?
(a) Joint interpolation (b) Straight line interpolation
(c) Circular interpolation (d) Irregular smooth motion.

(ix) The main objective(s) of Industrial robot is to
(a) to minimize the labour requirement
(b) to increase productivity
(c) to enhance the life of production machines
(d) all of the above.

(x) Which sensor one should prefer for detecting black objects?
(a) Ultrasonic sensor (b) Infrared sensor
(c) Inductive sensors (d) Photoresistor sensor.

Fill in the blanks with the correct word

(xi) The capacity of a robot to carry a load is known as _____.

(xii) Full form of AML is _____.

(xiii) _____ is the difference between the maximum and minimum values of the input of a sensor.

(xiv) Work volume of a polar coordinate robot is_____.

(xv) _____ is situated at the end of the manipulator's wrist.

Group - B

2. (a) Mention the laws of robotics. *[(CO1)(Remember /LOCQ)]*

(b) It is desired to determine the values to which the angles θ_1 and θ_2 must be set in order to achieve a certain point in space for the manipulator shown in Fig. 1. The length of joint 1, L_1 =10 cm, the length of joint 2, L_2 = 8 cm. The point P_w which the robot must achieve is defined by the coordinates x = 10.73 cm and y = 12.73 cm.

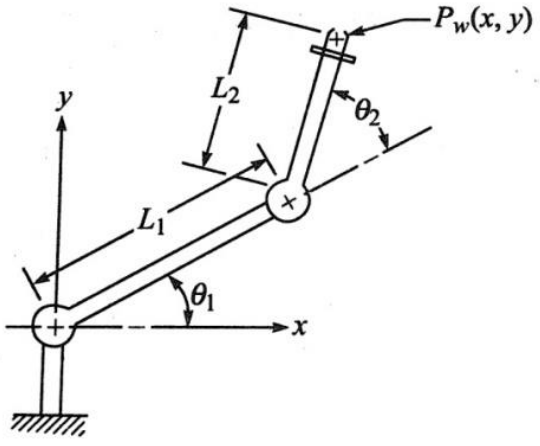

Fig. 1

[(CO2)(Evaluate/HOCQ)]

5 + 7 = 12

3. (a) Briefly explain in the following terms which are related to industrial robots:
(i) Payload,
(ii) Accuracy,
(iii) Repeatability. *[(CO1)(Understand/LOCQ)]*

(b) Determine a composite rotation matrix for the following sequence of rotations:
(i) Rotation of angle α about X-axis,
(ii) Rotation of angle β about Y-axis and
(iii) Rotation of angle γ about Z-axis. *[(CO2)(Evaluate/HOCQ)]*

6 + 6 = 12

Group - C

4. (a) What is a double-acting pneumatic cylinder? State the advantages and limitations of pneumatic actuators. *[(CO3)(Analyse/IOCQ)]*

(b) How magnetostrictive grippers work? Write its applications. *[(CO4)(Understand/LOCQ)]*

6 + 6 = 12

5. (a) Explain the working principle of a stepper motor with sketches. *[(CO3)(Understand/LOCQ)]*

(b) State the advantages, limitations and use of adhesive gripper. *[(CO4)(Analyse/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) What are the advantages, limitations and use of capacitive proximity sensor? *[(CO3)(Analyse/IOCQ)]*

(b) Explain how strain gauge works with a suitable diagram and write down the use of strain gauge. *[(CO3)(Remember/LOCQ)]*

6 + (4 + 2) = 12

7. (a) Explain the working principle of an absolute rotary encoder with a suitable diagram. What are the advantages of this type of encoder? *[(CO3)(Analyse/IOCQ)]*

(b) How to select suitable sensors for a robot? *[(CO3)(Analyse /IOCQ)]*

(4 + 2) + 6 = 12

Group - E

8. (a) What are the basic elements of second generation robotic programming languages? *[(CO5)(Understand/LOCQ)]*

(b) Explain in brief how robots can be used in a continuous arc welding process. Also, discuss its limitations. *[(CO6)(Understand/LOCQ)]*

6 + (4 + 2) = 12

9. (a) Discuss briefly about the different material handling operations performed by industrial robots. *[(CO6)(Understand/LOCQ)]*

(b) Discuss how a robot can be employed in spot welding. What are the advantages and disadvantages of using robots in spot welding? *[(CO6)(Analyse/IOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42.7	31.25	13.5