

2012

ROBOTICS AND ROBOT APPLICATIONS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) For what type of robot is the precision uniform throughout the work envelope ?
 - a) Cartesian-coordinate robot
 - b) Cylindrical robot
 - c) Spherical robot
 - d) SCARA robot.
- ii) The maximum elevation about the work surface that the wrist mounting flange can reach is known as
 - a) horizontal reach b) horizontal stroke
 - c) vertical reach d) vertical stroke.
- iii) Which type of sensor is used as proximity switch and for determining the accuracy and repeatability of commercial robotic manipulators ?
 - a) Optical proximity sensor
 - b) Ultrasonic proximity sensor
 - c) Eddy current proximity sensor
 - d) Inductive proximity sensor.
- iv) Which type of grippers may be employed, when the objects to be handled are too large and ferromagnetic in nature ?

- a) Adhesial gripper
 - b) Electromagnetic gripper
 - c) Specialised gripper
 - d) None of these.
- v) The extracted geometric features of an image are known as
- a) object recognition b) object descriptors
 - c) edge detection d) image presentation.
- vi) In powered lead through programming method, a control box with buttons used to control joint motors is known as
- a) teach pendant b) lead pendant
 - c) controller d) stylus.
- vii) Which programming method suits well for robots used in arc welding and spray painting operations ?
- a) Manual programming
 - b) Walk through programming
 - c) Lead through programming
 - d) Offline programming.
- viii) Hydraulic systems are equipped with one or more accumulators that serve to perform which of the following functions ?
- a) To provide pressure for emergency operation of the system in the event of system failure
 - b) To act as a buffer and absorb surges and shock pressures that might damage pipes and other components of the system
 - c) To equalize and readjust for any pressure losses in the system due to small leaks and thermal reaction of the fluid
 - d) All of these.
- ix) Which component of the fluid power system converts

fluid power into mechanical force and motion ?

a) Pump b) Valve

c) Actuator d) Solenoid.

x) The process of stacking or storing the material, parts or cartons on a pallet in a specified manner is known as

a) deburring b) routing

c) pelletizing d) none of these.

xi) Selective Compliance Assembly Robot Arm has

a) one revolute joint and two prismatic joints

b) two revolute joints and one prismatic joint

c) all revolute joints

d) all prismatic joints.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Determine the transformation of matrix T that represents a translation of a unit along x -axis, followed by a rotation of angle α about x -axis followed by a rotation of θ about the rotated z -axis.

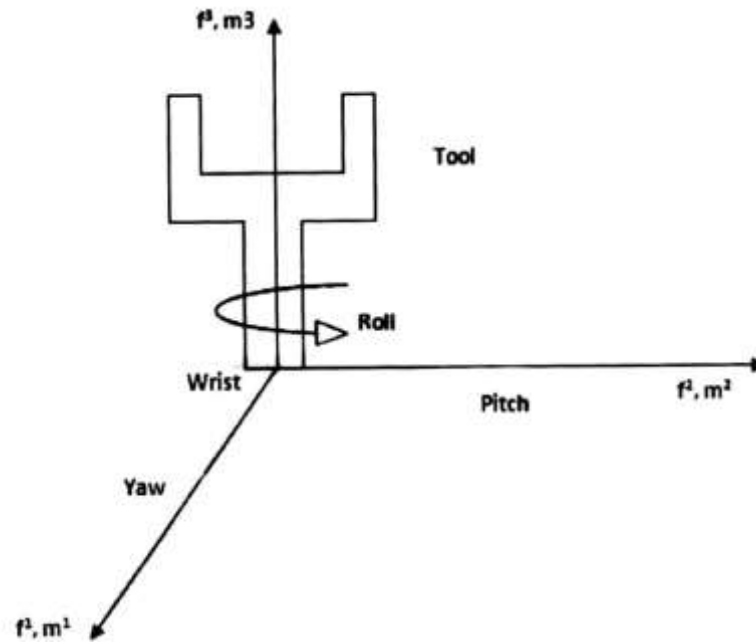
3. Explain why homogeneous transformations are required in modelling of robotic manipulators.

4. Consider the robotic tool shown in figure given below.

Suppose we yaw the tool by π about f^1 , then pitch the tool

By $-\pi/2$ about f^2 , and finally roll the tool by $\pi/2$

about f^3 .



- a) Sketch the sequence of tool positions after each of the yaw, pitch and roll movements.
- b) Find the transformation matrix T which maps tool coordinates M into wrist coordinates F following the sequence of rotations.
- c) Find $[P]^F$, the location of the tool tip p in wrist coordinates F following the sequence of rotations, assuming that the tool-tip coordinates in terms of the tool frame are $[P]^M = [0, 0, 0.8]^T$.

- 5. What are the factors which should be considered while installing a robot or robot system ?
- 6. Explain briefly the use of a robot in a pelletizing operation.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- 7. a) What do you mean by 'Touch sensing', 'Tactile sensing' and 'Slip' ? Name a few important tactile sensors.
- b) Explain briefly 'Lift and Try technique' for slip detection. Name some slip sensors developed in past. 8 + 7
- 8. a) What is the difference between a primitive and an

abstract behaviour ?

b) Define

i) behaviour table

ii) causal chain

iii) coordinated control program. 6 + 9

9. Explain briefly the following basic method of improving robot accuracy :

a) Joint calibration

b) Open-loop calibration

c) Closed-loop calibration. 5 + 5 + 5

10. a) Discuss the different economic performance for selection of a robot.

b) Briefly describe the procedural steps taken to safety measure in a robotic environment. 8 + 7

11. Explain briefly the following terms :

a) Robot vision

b) Vision Hardware

c) Automated visual inspection. 5 + 5 + 5

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