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B.E. Eighth Semester (Mechanical Engineering) (CGS)

10893 : Elective-III : Robotics : 8 ME 02

P. Pages : 2

Time : Three Hours

AU - 2986

Max. Marks : 80

Notes :
1. All question carry marks as indicated.
2. Answer **three** question from Section A and **three** question from Section B.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of calculator is permitted.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Explain various types of mechanical joints with the help of suitable sketches, used in robots. **7**

b) You are required to design a robot that can pick-up an object of arbitrary shape from a table and place it inside a box. **6**
i) What is the minimum number of degrees of freedom it should have ?
ii) List all the possible arm configurations.
iii) Draw their corresponding work volumes.

OR

2. a) For the following arm and body designations, describe the particular robot system with the help of neat sketch **7**
i) LRR ii) LVR iii) LLR

b) Explain the terms "accuracy", "repeatability" and "resolution" with reference to the robot. **6**

3. a) How grippers are classified ? Sketch and explain at least two different mechanical grippers. **7**

b) Calculate the vacuum cup area grasping a plate weighing 60 kgf, if the number of vacuum cups on the end effector is 3. The pressure difference is given as 0.7 kg/cm^2. **6**

OR

4. a) Sketch and explain the working of vacuum gripper for contoured surface. **7**

b) A 2 kg rectangular block is gripped in the middle and lifted vertically at a velocity 1m/sec. If it accelerates to this velocity at 22 m/sec and the coefficient of friction between the gripping pads and the block is 0.4, calculate the minimum gripping force that would prevent slippage. **6**

5. a) Explain the sections of general hydraulic circuit with the help of neat sketch. **7**

b) Explain the construction and working of stepper motor. Draw the sketch and state advantages and disadvantages over other electric motors. **7**

OR

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6. a) Describe the following : 7
   i) Walk through programming method.
   ii) Lead through programming method.

   b) What are the holding force and velocity of movement of piston of single acting hydraulic actuator, if the fluid pressure is 12 bars, diameter of the piston is 60 mm and flow rate is 0.4 m^3/min. 7

SECTION - B

7. a) What are optical encoders ? Explain the incremental and absolute types of encoders with the help of neat sketches. 7

   b) What are tactile sensors ? Give their types. Explain any one tactile sensor with the help of neat sketch. 6

OR

8. a) What are the various types of proximity sensors ? Explain the working of eddy current non-contact proximity sensor with the help of neat sketch. 7

   b) Explain the triangulation range sensing technique with the help of suitable diagram. 6

9. a) Explain the forward and reverse transformation of 3 DOF robot arm in 2D with neat sketch. 7

   b) For the vector V = 25 i + 10 j + 20 k, 6
   i) Perform a translation by a distance of 8 in the x-direction, 5 in the y-direction, and 0 in the z-direction.
   ii) Perform a rotation by 90° about the x-axis.

OR

10. a) Explain the concept of direct and inverse kinematics. 7

    b) A vector V = 3i + 2j + 7k is rotated by 60° about the z-axis of the reference frame. It is then rotated by 30° about the x-axis of the reference frame. Find the rotation transformation. 6

11. a) Discuss the management considerations for the economic justification of Robotics technology ? 7

    b) The total investment on robot including accessories is Rs. 5,00,000. There is one shift operation of 1800 hours and one man replaced. The annual maintenance cost is Rs. 32,000. The annual value of increased output is Rs. 1,20,000. The labour rate including direct overhead is Rs. 80 / hour. Calculate the annual rate of return in percentage. 7

OR

12. a) Describe various cost components of robot investments. 7

    b) Describe the basic methods of economic evaluation with reference to the robotic investments. 7

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