

Total No. of Questions : 12]

SEAT No. : **P1533****[4759] - 45**

[Total No. of Pages : 4]

B.E. (Mechanical)
ROBOTICS

(2008 Course) (402049C) (Part - II) (Elective - III) (Semester - II)

Time : 3 Hours]

[Max. Marks : 100]

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) Answer any three questions from each section.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right side indicate full marks.
- 5) Use of Calculator is allowed.
- 6) Assume Suitable data if necessary.

SECTION - I

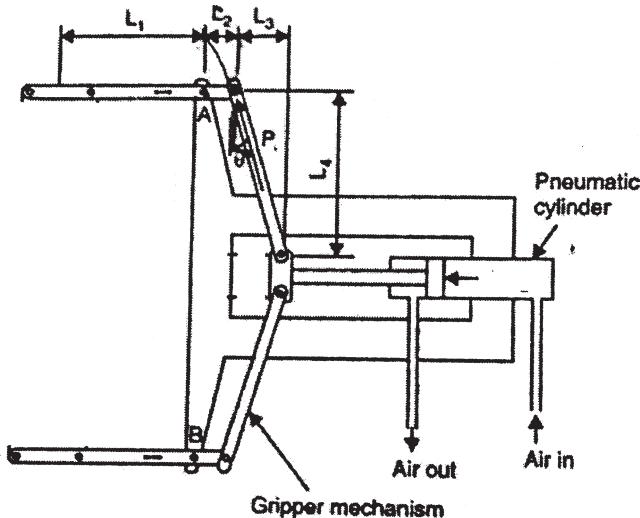
- Q1)** a) What are various types of reference frames attached to a robotic structure? Explain with example. [4]
- b) Define a robot and with a neat sketch explain anatomy of robot. [6]
- c) Define repeatability, resolution and accuracy. [6]

OR

- Q2)** a) Enumerate the factors that contribute to the limitation of spatial resolution. [4]
- b) A Cartesian robot has a slide with a total range of 1.2m and it is desired that it will have a control resolution of 0.46 cm on this axis. Determine the bit storage capacity which the control memory must possess to accommodate this level of precision. [6]
- c) Explain cost effectiveness of using robots in industries with an illustration. [6]

- Q3)** a) The mechanical gripper uses friction to grasp a part weighing 25N. The co-efficient of friction between the part and the gripper pad is 0.3. The gripper is accelerating down with a acceleration of 9.81m/s^2 . The diameter of piston of pneumatic cylinder is 65 mm. Assume factor of safety as 1.5 and lengths L_1 , L_2 , L_3 and L_4 as 60mm, 40mm, 15mm and 45mm respectively. Calculate: [8]
- i) The gripping force to retain the part,
 - ii) Actuation force required to achieve this gripping force.

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- b) Discuss desirable engineering features of sensors and transducers. [4]
- c) What are various important parameters considered for selecting a sensor? [6]

OR

- Q4)**
- a) Discuss in detail comparison between absolute and incremental coding. [6]
 - b) Derive with usual notations, the expression for force exerted by the mechanical grippers in robotics. [6]
 - c) Explain characteristics and uses of vacuum grippers. [6]

- Q5)**
- a) Compare three basic types of drives enlisting their merits and demerits. [6]
 - b) Explain with schematic diagram operating principle of a stepper motor used in robotics. [6]
 - c) What are the assumptions made in designing control of a single joint in robots? [4]

OR

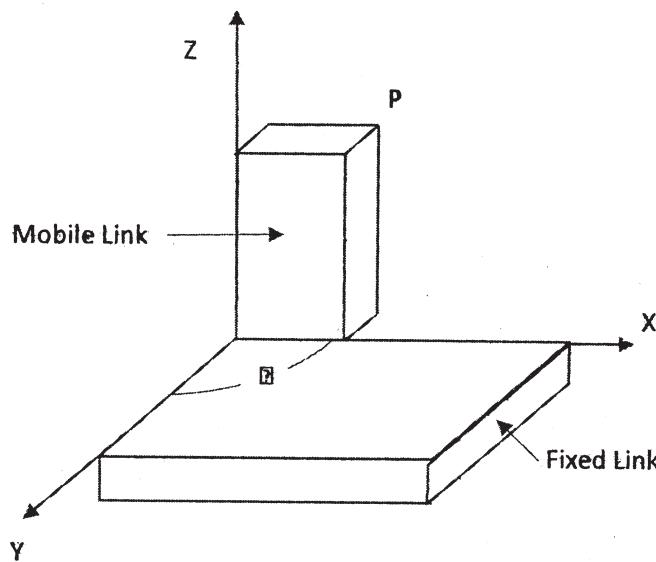
- Q6)**
- a) Write and explain general block diagram of robot control system. [4]
 - b) Write short note on: Control law of partitioning. [6]
 - c) What are general considerations in trajectory planning? [6]

SECTION - II

Q7) a) Write a short note on: [10]

- i) Direct and inverse kinematics.
- ii) D-H Convention.

b) A single axis robot with a fixed base and a mobile link is as shown in fig. Suppose the mobile frame has a point P_m given by $(2, 2, 8)^T$. Find the coordinates of the point P_f with respect to base frame when $\theta_1 = 180^\circ$ and $\theta_2 = 0^\circ$. [8]



OR

Q8) a) The coordinate of a point $P_{abc} = (5, 4, 3)^T$ in the body coordinate frame OABC is rotated 300° about OZ-axis. Determine the coordinates of the vector P_{xyz} with respect to base reference coordinate frame. [6]

- b) Discuss Lagrange-Euler formulations for a robotic manipulator. [6]
- c) Explain the use of inverse transformation matrix in robotic application. [6]

Q9) a) Write a note on: (Any two) [8]

- i) Object recognition technique
- ii) Image acquisition
- iii) Image processing techniques

- b) Discuss the programming methods used in robots mentioning their specific field of application. [4]
- c) What are the image devices used in robot lighting techniques? [4]

OR

- Q10)**a) What are key stages in image processing? Explain any one in brief. [4]
- b) Write a short notes on: [8]
 - i) Motion interpolation
 - ii) Branching capabilities
 - c) With the help of block diagram, explain the functions of a robotic vision system and devices used in the same. [4]

- Q11)**a) What is Artificial intelligence? What are the characteristics of AI systems? [6]
- b) What are the advantages of simulation? Explain in brief. [4]
 - c) Briefly discuss the practical application domains where robotic technology is most likely to be used in future? [6]

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OR

- Q12)**a) What are various components of Artificial intelligence? [6]
- b) Discuss in detail the main challenges for the future of intelligent robotics. [6]
 - c) What are the disadvantages of simulation? Explain in brief. [4]

