Total No. of Questions : 12]

SEAT No. :

P1533

[Total No. of Pages :4

[4759] - 45
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]**

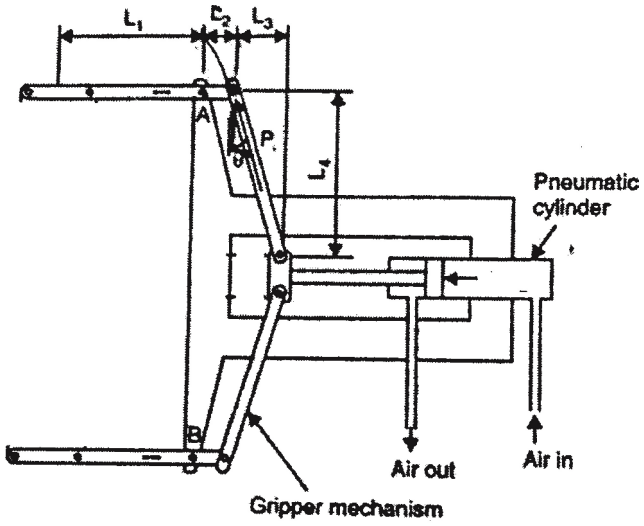
c) Explain cost effectiveness of using robots in industries with an illustration. **[6]**

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 $9.81 m/s^2$. 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.

P.T.O.



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]**

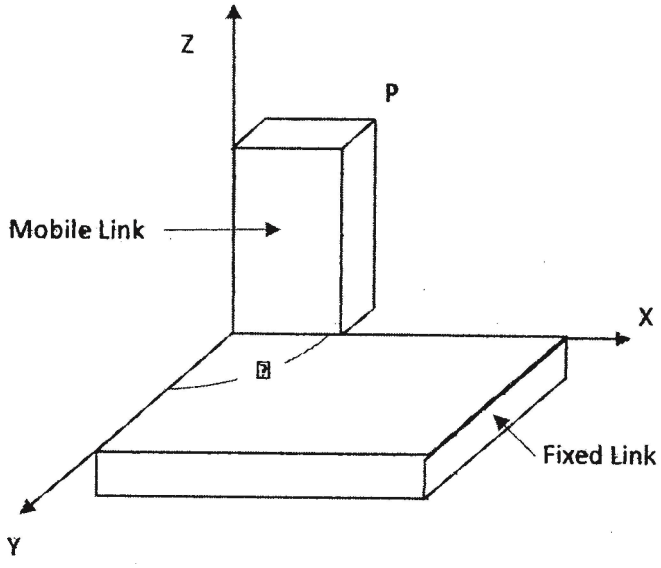
SECTION - II

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 Pm given by (2, 2, 8)T. Find the coordinates of the point Pf with respect to base frame when $\theta_1 = 180^\circ$ and $\theta_2 = 0^\circ$. **[8]**



OR

Q8) a) The coordinate of a point Pabc = (5, 4, 3)T in the body coordinate frame OABC is rotated 300 about OZ-axis. Determine the coordinates of the vector Pxyz 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]**

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]**