

Code No: D1508

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH II - SEMESTER EXAMINATIONS, APRIL/MAY 2012

ROBOTICS
(MACHINE DESIGN)

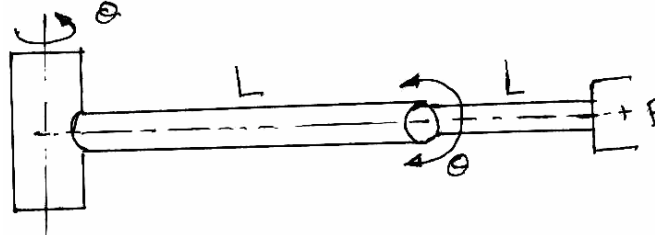
Time: 3 hours

Max. Marks: 60

Answer any five questions
All questions carry equal marks

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- 1.a) Define work volume for various types of robot configurations.
- b) Determine the transformation matrix T that represents a transformation of a unit along x-axis, followed by a rotation of angle α about x-axis followed by a rotation of θ about rotated z-axis.
- 2.a) Explain why homogeneous transformations are required in modeling of robotic manipulator
- b) The end effector (gripper) of a manipulator relocated from initial point $[2 \ 0 \ 4 \ 1]^T$ to $[4 \ 0 \ 0 \ 1]^T$. Determine the direction of axis k and the angle of rotation about this k-axis.
- 3.a) Using Denavit Hartenberg notation for frame assignment it is possible to have a link with zero link length whereas physical link on the manipulator will have a finite link length. Explain.
- b) Solutions to inverse kinematics problem are generally difficult. Explain why.
- 4.a) Why it is important to choose a frame assignment for an n-DOF manipulator that gives a maximum number of zero joint – link parameters.
- b) Why closed form solutions are preferred over numerical, iterative or other forms of solutions to the inverse kinematics problems.
5. For the robotic arm shown, obtain the Jacobian to express the Cartesian velocities in terms of joint velocities.



Two degree of freedom RR manipulator

- 6.a) For a given manipulator, are the velocity and the static force Jacobian different. Explain with an example.
- b) What is a skew symmetric matrix? How this matrix is related to the angular velocity of a link of an n-DOF manipulator.
7. Find the trajectory for a Cartesian space straight line path from $[1.0 \ 1.0 \ 1.0]^T$ to $[-1.0 \ 0.0 \ 1.0]^T$.
8. a) An object has to be picked from location A and placed in location B by a robot. Write a relevant program in VAL.
- b) Discuss requirements of robot programming language.
