Uva Wellassa University, Sri Lanka
End Semester Examination –March/April 2013
SCT 461-2 Robotics

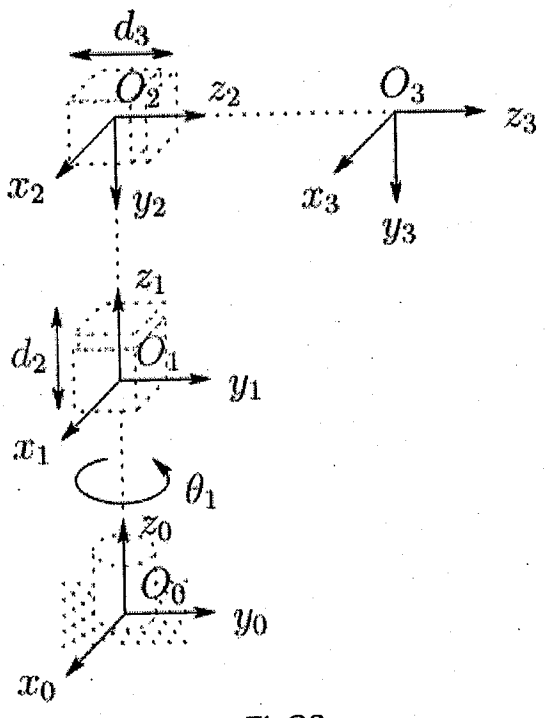
Time: Two (02) Hours

Total **04** Questions
Answer **all** questions

1. Define the following terms briefly in terms of robotics where possible with examples.
   I. Revolute joint
   II. Prismatic joint
   III. Degrees of freedom (DOF) of a manipulator
   IV. Planar manipulator
   V. Workspace or the work-envelop.

(10 marks)

2. FigQ2 shows joint space coordinate system for a three link cylindrical manipulator. θ_1 denotes the angular displacement of the revolute joint 1. d_2 and d_3 denote the displacements at prismatic joints 2 and 3.

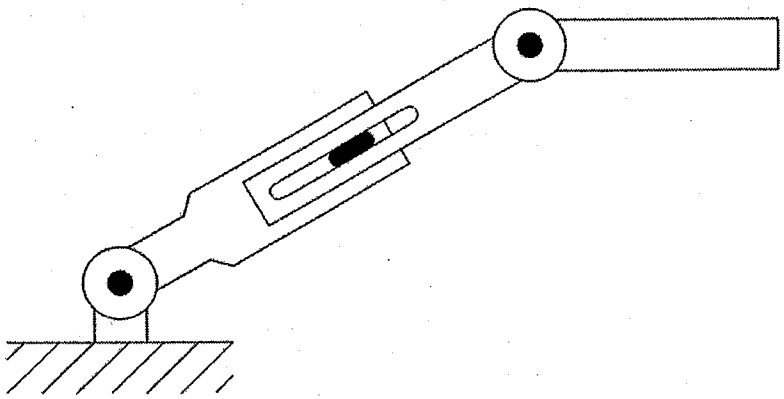


FigQ2

   I. Construct the link parameter table for the above manipulator.
   II. Write down T matrices for each joint.
   III. Derive the overall transformation matrix for the manipulator.

(30 marks)

3. FigQ3 shows a planar manipulator with 2 revolute joints and one prismatic joint. Derive the inverse kinematic model for the manipulator. You may use your own variables for joints and links where necessary.



FigQ3

(30 marks)

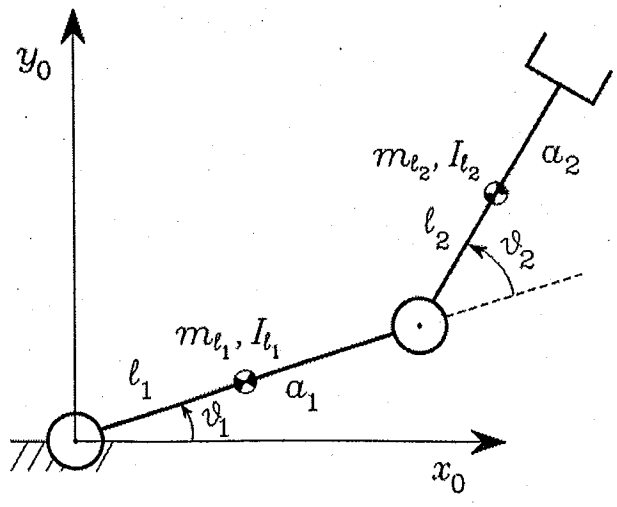
4. In robotics Lagrangian L is defined as the difference between the kinetic energy K and the potential energy P of the system

$$L = K - P$$

The dynamic equations, in terms of the coordinates used to express the kinetic and potential energy, are obtained as

$$F_i = \frac{d}{dt}\frac{\partial L}{\partial \dot{q}_i} - \frac{\partial L}{\partial q_i}$$

A two link planar arm is shown in FigQ4 below. The masses of the links m_1 and m_2, is considered as point masses at the center of each link. The links are of lengths ℓ_1 and ℓ_2, respectively. The generalized coordinates are chosen as θ_1 and θ_2, as shown in the figure. Obtain the expression for Lagrangian and derive expressions for torques T_1 and T_2, for joints 1 and 2 respectively.



FigQ4

(30 marks)