ME 115(b): Homework #3
(Due Wednesday, April 26, 2006)

Problem 1: Problem 21(a,b,c,d,e), Chapter 3 of MLS.

Problem 2: (Special Configurations of a linkage). Consider the linkage shown Figure 1. This problem considers the stationary configurations of this mechanism.

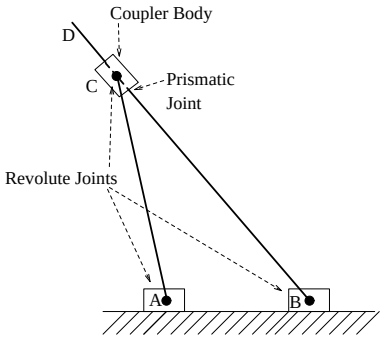

Figure 1: Mechanism

In this mechanism, let $|\overline{AB}| = 1$. The dimension $|\overline{AC}| = l_1$ is a parameter, and you will consider its value below.

(a) What is the mobility of this mechanism?

(b) derive the twist coordinates for the joint axis screws (this is equivalent to determining the velocity structure equations.

(c) It was shown in class that the special (or stationary) configurations for the j^{th} joint occur when the determinant of the cofactor of the jj element of the grammian matrix:

$$\begin{bmatrix} \xi_1 \cdot \xi_1 & \xi_1 \cdot \xi_2 & \xi_1 \cdot \xi_3 & \xi_1 \cdot \xi_4 \\ \xi_2 \cdot \xi_1 & \xi_2 \cdot \xi_2 & \xi_2 \cdot \xi_3 & \xi_2 \cdot \xi_4 \\ \xi_3 \cdot \xi_1 & \xi_3 \cdot \xi_2 & \xi_3 \cdot \xi_3 & \xi_3 \cdot \xi_4 \\ \xi_4 \cdot \xi_1 & \xi_4 \cdot \xi_2 & \xi_4 \cdot \xi_3 & \xi_4 \cdot \xi_4 \end{bmatrix}$$

becomes zero (where ξ_j denotes the twist for joint axis j).

Develop an expression for the stationary configurations of joint B. What are the necessary conditions (in terms of link lengths, etc.) for joint B to have a stationary configuration?

(d) Do any other joints have stationary configurations?

Problem 3: Problem 1(a) Chapter 5 of MLS.