MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DEPARTMENT OF OCEAN ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

13.013J/1.053J Dynamics and Vibration

Fall 2001

Problem Set 11

Assigned: Nov 14, 2001

Due: Nov 21, 11am , 2001

1. Find the natural frequency of a marble of radius R1 rolling inside of a stationary spherical shell with radius R2. Assume small motions. Gravity acts.

2. Read section 8.4 in the text
   a). Find the EOM of the system in 4-59
   b). Express the EOM in matrix form.
   c). Let k1=k, k2=3k, m1=2m, m2=3m, Find expressions for the natural frequencies and mode shapes. At the very end let k/m = 64.

3. You have done 5-25 previously.
   a). Write down the linearized EOM.
   b). Find the natural frequency for k1=k2=50 N/m, h=0.5m, l=1.0m; try three values of m= 1, 2.5 and 2.548 kg.
   c). Explain physically what happens in the last case.

4. Do problem 6-110 and find an expression for the natural frequency.
5. Estimate the heave natural period for the TLP described in the handout.

6. Estimate the surge and sway natural periods for the TLP.