PHY820 Homework Set 11

1. [10 pts] Goldstein, Problem 5-9. Hint: Start out by considering the components of the torque along the principal axes of the inertia tensor.

2. [5 pts] Goldstein, Problem 5-11. Hint: Consider the magnitude of angular momentum in the body frame. What does the precession imply for the magnitude of angular momentum?

3. [10 pts] Goldstein, Problem 6-4.

4. [10 pts] A thin hoop of radius R and mass M oscillates in its own plane hanging from a single fixed point on its circumference. Moving along the hoop, without friction, is a small bead also of mass M. Consider only small oscillations around equilibrium and determine the normal frequencies and normal modes of oscillations for the system. Describe those normal modes in words and how the initial conditions have to be set to make the system oscillate in each of those modes.

5. [10 pts] From a CM Final Exam: Three beads are mounted on a ring and connected by three identical springs, as shown. Two beads are of mass m and one of mass $2m$. The ring radius is R. The spring constant is k and the spring mass may be neglected. The masses and springs are free to move around the ring. (a) Find a Lagrangian for the system of beads and springs, in terms of suitably chosen coordinates. (b) Find frequencies of normal vibrations for the system. (c) Find normal coordinates for the system. (Can you find any shortcuts, bypassing standard procedures, relying on physical or symmetry considerations?)