PHY 4938 HOME AND CLASS WORK – SET 8

(November 21, 2011)

(32) Assume $R = 1$ meter in the previous problem and plot the velocity versus the angle θ over two periods (for both cases A. and B.). Due November 28 before class (4 points).

(33) The angular velocity of a symmetric top can be written as

$$\vec{\Omega} = \vec{\Omega}_{\mathrm{pr}} + \vec{\Omega}_3^* = \Omega_{\mathrm{pr}}\,\hat{M} + \Omega_3^*\,\hat{x}_3$$

where $\hat{M}$ is the unit vector in direction of the angular momentum $\vec{M}$ and $\hat{x}_3$ the unit vector of the x_3 axis, $\Omega_{\mathrm{pr}} = M/I_1$. Compare figure 46, p.107 of Landau-Lifshitz. Express Ω_3^* in terms of M, I_1, I_3 and θ, all defined in the book. Due in class (4 points).

(34) Inertia tensor of a homogeneous cube of density ρ, mass M, and side length b.

   1. Let one corner be at the origin and let the three adjacent edges lie along the coordinate axes. Calculate the inertia tensor with respect to these axes. Due November 30 before class (4 points).

   2. Use the parallel axis theorem to find the inertia tensor for axes through the center of mass, which are parallel to the axes used in part 1. Due November 30 before class (4 points).

   3. Is the cube a spherical top? Due November 30 before class (2 points).

(35) Express the angular velocity components in Euler angles with respect to the axis of the fixed (lab) frame, i.e., Ω_X, Ω_Y, Ω_Z. Due December 2 before class (6 points).