PHYS 301
HOMEWORK #4

Due : 15 Feb. 2016

You may use *Mathematica* to verify your integrals on this assignment, but you must do all integrals by hand (or use symmetry arguments) and include all work with your assignment.

1. This problem will help you think through the meaning of the terms in the acceleration equation. For this problem, refer to the solutions for Homework #2 for the correct expresssion for acceleration in spherical polar coordinates. Refer also to the webpage :
 http : // en.wikipedia.org/wiki/File : Gimbal_ 3 _axes _rotation.gif

Assume the {pink, blue, green} rings have radii {P, B, G} respectively.Consider a point fixed on either the green or blue ring.Use the expression for acceleration in spherical polar coordinates to determine an expression for the acceleration of this point.(10) Now determine an expression for the acceleration of a particle fixed to the pink ring.(10) Assume all angular velocities are constant.Explain clearly (but briefly) which terms you set equal to zero and why you can do so.What is the acceleration of a point on the North Pole of the pink ring?(5)

2. Each of the functions below is defined on [-π, π] and extends beyond this interval with a period of 2 π. For each function, state whether it is even, odd or neither; compute the Fourier coefficients (you may use symmetry arguments, but if you do, write them explicitly; write out the Fourier series in closed form (e.g., for the example in class, the closed form is:
$\frac{1}{2} + \frac{2}{\pi} \sum_{n=odd}^{\infty} \frac{\sin(n x)}{n}$) (10 pts for each series)

a) $f(x) = x$

b) $f(x) = \text{Abs}[x]$

c) $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ \sin x, & 0 < x < \pi \end{cases}$

d) $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ -1, & 0 < x < \pi/2 \\ 1, & \pi/2 < x < \pi \end{cases}$

3. Problem 9 - 27, text, all parts.

4. At t = 0, you have a bank account with $1000. Since you have forgotten about this account, you neither add nor withdraw funds. Each month, the bank assess a penalty equal to 1 % of the remain-

ing total. Write a short Mathematica program, using recursion relations and loop controls as necessary, to determine how much money will remain after 3 years. Submit your Mathematica code and output with this assignment.