***PHYS 214***

**Problem 1**

A bowling ball of mass M is attached to the end of a nylon cord with a cross-sectional area A. The other end of the cord is fixed to the ceiling. When the bowling ball is pulled to one side and released from rest, it swings downward in a circular arc. At the instant it reaches its lowest point, the bowling ball is at an altitude y lower than the point it was released from, and the cord is stretched by an amount Δy from its unstrained length. Write an expression for the unstrained length of the cord y0 assuming that Y is Young’s modulus of the material from which the cord is made (you may ignore the increase in the length of the rod when calculating any quantity other than the strain).

**Problem 2**

A cylinder of diameter d floats with l of its length submerged. The total Height is L. assume no damping. At time t=0 the cylinder is pushed down a distance B and released. Develop an expression for the frequency of oscillation and draw a graph of velocity versus time from t=0 to t=T, where T is the oscillation period. The correct amplitude and phase should be included.

**Problem 3**

Use the complex exponential method to analyze the forced oscillation with damping. Then, use the result to explain the role of the resistance R, the capacitor C, and the inductor L, in an RLC circuit. Note that when an alternating voltage of frequency ω and amplitude V0 is applied to the RLC circuit, the differential equation governing the charge variation with respect to time *t* is given by

$\frac{d^{2}q}{dt^{2}}+\frac{R}{L}\frac{dq}{dt}+\frac{1}{LC}q=\frac{V\_{0}}{L}\cos(ωt)$

**Problem 4**

The free oscillations of a mechanical system are observed to have a certain angular frequency ω1. The same system, when driven by a force $F\_{0}\cos(ωt )$(where $F\_{0}$ is a constant force and ω is a variable frequency), has a power resonance curve whose angular frequency width, at half-maximum power, is ω1/5.

1. At what angular frequency does the maximum power input occur?
2. What is the quality factor Q of the system
3. If the system consists of a mass m on a spring of spring constant k, what is the value of the constant b in the resistive term –bv

**Problem 5**

How you define the normal modes of oscillations?