PHYSICS EXAMINATION PROBLEMS
SOLUTIONS AND HINTS FOR STUDENT SELF-STUDY

Module Code and Lecturer	PHY1106: AU and PV
Name of module	Oscillations section (PV)
Date of examination	June 2002

1. Use the standard equation: $F = -kx$ to give: $k = 160$ N/m.

   Standard relation between KE and PE in an undamped system.
   Draw standard graph for this (notework / lectures).

   For this system without damping, PE = KE when $x = \pm A/\sqrt{2}$ (use lectures derivation for this).

   Show usual derivation of equation of motion from balancing of forces and describe the nature of each of the individual forces.

   Calculate ω' (= 3.15 rads/s) and then use standard equation $T' = 2\pi / \omega$ to give $T' = 2.0$ s.
   Then use equation for logarithmic decrement (δ) to give $\delta = 39.5$.

   Standard technique for max. value of *b* for oscillatory motion gives b = 16 kg/s.

2. Notework / lectures for complex impedances of components.

   Standard derivation (from notes) of total impedance of LCR circuit.

   Circuit resonates when Z is a minimum and this occurs when Z = R (i.e. giving $\omega = 1/\sqrt{(LC)}$.

   Desribe significance of ϕ as the phase term and use the argand diagram (from lectures / notes) to show that; $\cos\phi = \dfrac{R}{|Z|}$

   Use equation provided for av. power to calculate av. power absorbed in all three cases:

   i) for 1/8 F: $P_{av} = 7.4$ W ii) for 1/18 F: $P_{av} = 12.5$ W iii) for 1/32 F: $P_{av} = 5.3$ W

   At C = 1/18 F, the resonant freq. matches the driving frequency (i.e. the system is at resonance) and therefore the max. power is absorbed / transferred.

   Use standard equation for Q-factor. i.e. $Q = \dfrac{\omega_0 L}{R}$ to give Q = 1.5.

3. i) a) Notework / lectures for Z_m expression.

b) For velocity, differentiate the expression at the top of the page; then simplify to sin and cosine and take real component only.

c) Standard notework for graph of velocity vs. freq.