The Open University of Sri Lanka
B.Sc. Degree Programme – Level 3
Department of Physics
Waves in Physics - PYU 1162 / PYE 3162
Open Book Test – 2009/2010
Duration: 1½ hrs.

Date: 18-04-2010 **Time: 10.00 a.m. to 11.30 a.m.**

Answer all Questions

1. (a) Find the magnitude and direction of the vector $(4-\sqrt{5}\,\mathrm{j})^3$.

   (b) What is the real and imaginary part of $\dfrac{Ae^{j(\omega t+\pi/2)}}{4+5j}$, assuming A and ω are real.

   (c) Write the following complex vectors Z in terms of $a + jb$ (a and b are real). There may be more than one solution.
   (i) $Z_1 = (j)^j$ (ii) $Z_2 = (j)^{8.03}$

(30 marks)

2. (a) Any motion that repeats itself in regular interval is called periodic motion or harmonic motion.
   (i) For a particle executing a simple harmonic motion, write down an expression for the displacement, x, of the particle from its equilibrium position as a function of time t. Define the other physical quantities used in your equation.
   (ii) From the above equation, derive expressions for velocity, $v(t)$, and acceleration, $a(t)$, of the particle at any given time.
   (iii) Using Hooke's law and Newton's second law, derive expressions for the angular frequency, ω, and the period, T, of the said simple harmonic motion.

   (b) At $t = 0$, the displacement, x (0), of a particle executing a periodic motion is – 8.50 cm, its velocity, $v(0)$, is – 0.92 m s^{-1} and the acceleration, $a(0)$, is + 47.0 m s^{-2}.
   (i) Find the angular frequency, ω, and the frequency, f, of the system.
   (ii) What is the phase constant?
   (iii) What is the amplitude of the motion?

(40 marks)

3. An object of mass 0.2 kg is hung from a spring whose spring constant is 80 N m^{-1}. The object is subject to a resistive force given by $-bv$, where v is its velocity.

   (a) Establish the differential equation of motion for free oscillations of the system.

   (b) If the damped frequency is 0.995 of the undamped frequency, what is the value of the constant b?

   (c) What is the Q value of the system, and by what factor is the amplitude of the oscillation reduced after 4 complete cycles?

   (d) Which fraction of the original energy is left after 4 oscillations?

(30 marks)

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