Fayoum University – Faculty of Engineering
1st Year Dept. of Electrical Engineering
Physics (2a) – PHYS118a
First Semester Final Exam 2015/2016
Date: January, 16th 2016
Allowed Time: 3 hours Total Score : 75 Points

Part (1): Oscillations & Waves

(1) A 5.00-kg object on a frictionless horizontal surface is attached to one end of a horizontal spring that has a force constant k = 700 N/m. The spring is stretched 8.00 cm from equilibrium and released. What are (a) the frequency of the motion, (b) the period, (c) the amplitude, (d) the maximum speed, and (e) the maximum acceleration? (f) When does the object first reach its equilibrium position? What is its acceleration at this time?.....**[12 points]**

(2) A mass of 5 kg is suspended on a spring of stiffness 4000 N/m. The system is fitted with a damper with a damping ratio of 0.2. The mass is pulled down 50 mm and released. (a) Write down the differential equation that describes this motion, (b) Identify the type of damping, (c) Find the general solution x(t), (d) Find the displacement after 0.3 seconds.....**[8 points]**

(3) The following differential equation represents an equation of motion;

$$\ddot{x} + 4\dot{x} + 5x = 130\sin(2t)$$

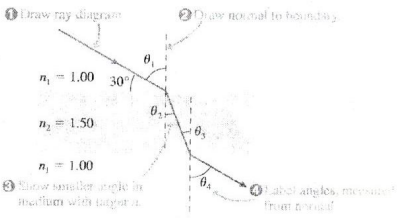
(a) Write down the general solution x(t), including both the transient and the steady state parts, (b) Show, in few words, what is meant by transient and steady state?., (c) Find the steady state solution $x_{s.s.}(t)$. .....**[8 points]**

(4) A standing wave (mode) on a string for which the wave speed is v has the equation, $y(x; t) = 2A\sin(kx)\cos(\omega t)$,

If the string has fixed ends (nodes) at x = 0 and x = L, then (a) Sketch the first three modes (standing waves), (b) derive the allowed wavelengths λ_n and frequencies f_n of the normal modes. Express these in terms of v and L. (c) a piano string is 1.10 m long and has a mass of 9.00 g. How much tension must the string be under if it is to vibrate at a fundamental frequency of 131 Hz?.....**[12 points]**

Part (2) : Geometrical and Physical Optics

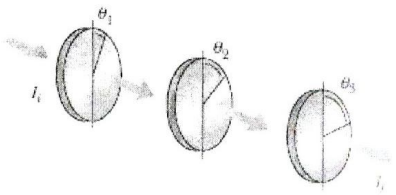
(5) A laser beam is aimed at a 1.0-cm-thick sheet of glass at an angle 30^0 above the glass. (a) What is the laser beam's direction of travel in glass?. (b) What is its direction in the air on the other side?. ..... **[8 points]**



(6) *Two narrow parallel slits each of width a= 0.4mm separated by distance d=0.850 mm are illuminated by 600-nm light, and the viewing screen is 2.80 m away from the slits. (a) Which pattern would you expect to appear on the screen? Justify your answer.(b) What is the phase difference between the two interfering waves on a screen at a point "P" 2.50 mm from the central bright fringe? (c) What is the relative intensity (I/I_0) at this point?.(d) If the values of slit width "a" and the slits-separation "d" are changed to a= 60 μm, and d=240μm. Would you expect the pattern to be changed? Justify your answer. Then (e) find the relative intensity (I/I_0) at the same point "P". .....* ***[16 points]***

(7) *A diffraction pattern is formed on a screen 120 cm away from a 0.400-mm-wide slit. Monochromatic 546.1-nm light is used. Calculate the fractional intensity I/Imax at a point on the screen 4.10 mm from the center of the principal maximum. .....* ***[8 points]***

(8) *Three polarizing disks whose planes are parallel are centered on a common axis. The direction of the transmission axis in each case is shown in figure relative to the common vertical direction. A plane-polarized beam of light with E_0 parallel to the vertical reference direction is incident from the left on the first disk with intensity I_i =10.0 units (arbitrary). Calculate the transmitted intensity I_f when (a) $\vartheta_1 = 20.0°$, $\vartheta_2 = 40.0°$, and $\vartheta_3 = 60.0°$; (b) $\vartheta_1 = 0.0°$, $\vartheta_2 = 30.0°$, and $\vartheta_3 = 60.0°$;*



..... [8 points]

Good Luck

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