Kafr Elshiekh University
Faculty of Engineering
Department of
Physical and Mathematical Engineering
First Year

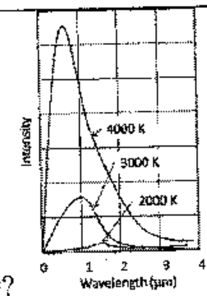
24- 06- 2021
3 hours
60 Marks
Final exam: 3 pages

Engineering physics (2)(PHM1107)

Answer the following questions:

(30Marks)

Question(1) : (ILOs: A1)

1.	 The radiation has a peak near the visible range (0.4-0.7um) at T=?							
	(A)	1000K	(B)	2000K	(C)	3000K	(D)	4000K
2.	Find the peak wavelength of the black body radiation which has a temperature 5800k							
	(A)	0.99um	(B)	0.299um	(C)	0.499um	(D)	9.9um
3.	Solar cells is one of the practical uses of the …?							
	(A)	Compton effect	(B)	Photoelectric effect	(C)	Work function	(D)	Wave function
4.	Light of λ=500nm is incident on sodium with Φ=2.28ev. what is the maximum kinetic energy of ejected photoelectrons? (hc=1240 ev.nm)							
	(A)	40ev	(B)	30ev	(C)	10ev	(D)	0.2 ev
5.	In Compton effect the kinetic energy of the recoiling electron is :							
	(A)	$E_e = \sqrt{E_o^2 + P_e^2C^2}$	(B)	$E_e = \sqrt{P_e^2C^2}$	(C)	$E_e = \sqrt{E_o^2 + C^2}$	(D)	$E_e = \sqrt{E_o^2 + P_e^2}$
6.	Electromagnetic radiation with a wavelength of $\lambda=5.7*10^{-12}$m is incident on stationary electrons. Radiation that has a wavelength of $6.57*10^{-12}$m is detected at a scattering angle of ….? $(\frac{h}{m_e c} = 2.34 * 10^{-3} nm)$							
	(A)	30°	(B)	50°	(C)	70°	(D)	90°
7.	A free electron has a momentum of $5*10^{-24}$kg.m/s. The wavelength of its wave function is : ($h=6.63*10^{-34}m^2kg/s$)							
	(A)	$1.3*10^{-10}$m	(B)	1.3m	(C)	$1.3*10^{-20}$m	(D)	$23*10^{-10}$m
8.	The energy of a photon of wavelength 700nm is:							
	(A)	5.75ev	(B)	3ev	(C)	1.75ev	(D)	0.9ev
9.	Ψ(x) is the wave function for a particle moving along x axis. The probability that the particle is in the interval from x=a to x=b is given by:							
	(A)	$\int_a^b \Psi(x)dx$	(B)	$\int_a^b \|\Psi(x)\|^2dx$	(C)	$\Psi(a) - \Psi(b)$	(D)	$\Psi(a) * \Psi(b)$

10.	If a wave function of ψ for a particle moving along x axis is normalized, then:							
	(A)	$\int_a^b \Psi(x)dx$	(B)	$\int \lvert\Psi^2\rvert dx = 0$	(C)	$\int \lvert\Psi^2\rvert dx = \infty$	(D)	$\int \lvert\Psi^2\rvert dx = 1$
11.	If $\int \lvert\Psi^2\rvert dx = A^2x - \frac{2A^2x^3}{3L^2} + \frac{A^2x^5}{5L^4}$ - (i) Determine the value of A that normalizes ψ(x)							
	(A)	$A = \left(\frac{5}{6L}\right)^2$	(B)	$A = \left(\frac{15}{16}\right)^2$	(C)	$A = \left(\frac{15}{16L}\right)^2$	(D)	$A = \left(\frac{16L}{15}\right)^2$
12.	- (ii) Determine the probability that the particle is located between x=-L/3 and x=+L/3							
	(A)	5	(B)	1	(C)	0.57	(D)	0
13.	E=hf = ...?							
	(A)	ωh^2	(B)	$\omega/\hbar$	(C)	$\hbar/\omega$	(D)	$\hbar\omega$
14.	An electron is incident on a square barrier what is the probability that the electron tunnels through the barrier if its width is 1nm? (constant C=16.18*10^9)							
	(A)	0	(B)	$3*10^{-31}$	(C)	$5*10^{-9}$	(D)	$8.8*10^{-15}$
15.	An electron is confined between two impenetrable walls. The energy level for state n=1 is E_1=9.42ev. Determine E_3							
	(A)	84.8ev	(B)	8ev	(C)	55ev	(D)	400ev

Question(2) : (ILOs: A2) ***(15Marks)***

(a) 1- An oscillator is subjected to a damping force that is proportional to its velocity. A sinusoidal force is applied to it. After a long time:
A. its amplitude is an increasing function of time B. its amplitude is a decreasing function of time
C. its amplitude is constant D. its amplitude is a decreasing function of time only if the damping constant is large

2- Sinusoidal water waves are generated in a large ripple tank. The waves travel at 20 cm/s and their adjacent crests are 5cm apart. The time required for each new whole cycle to be generated is:
A. 100 s B. 4 s C. 2 s D. 0.25 s

3-The tension in a string with a linear mass density of 0.0010 kg/m is 0.4 N. A sinusoidal wave with a wavelength of 20 cm on this string has a frequency of:
A. 0.0125 Hz B. 0.25 Hz C. 100Hz D. 630Hz

4- If the speed of sound is 340m/s a plane flying at 200m/s creates a conical shock wave with an apex half angle of:
A. 58° B. 32° C. 40° D.non of these

5- One of the different types of velocities in wave motion:
A. The particle velocity B. The phase velocity C. The group velocity D. All of the above

6-The following function might be a solution to the wave equation with phase velocity c.
A. $f(x,t) = (ct - x)^2$ B. $f(x,t) = \sin(ct - x)$ C. Both A and B D. None of these

(b) Show that the wave velocity in string is $\sqrt{\frac{T}{\rho}}$ where T is the tension in the string and ρ is the mass per unit length.

(c) Discuss the categories of sound waves.

Question(3) : (ILOs: A1,A10) ***(15 Marks)***

(a) Start from the boundary conditions show that the reflection and transmission coefficient of a wave between two strings are

$$\frac{\text{Reflected Energy}}{\text{Incident Energy}} = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2}\right)^2 \quad \text{and} \quad \frac{\text{Transmitted Energy}}{\text{Incident Energy}} = \frac{4Z_1Z_2}{(Z_1 + Z_2)^2}$$

(b) Show that when sound waves are normally incident on a plane steel water interface 86% of the energy is reflected. If the waves are travelling in water and are normally incident on a plane water-ice interface show that 82.3% of the energy is transmitted.

(The impedance values in kg m^{-2} s^{-1} for water = $1.43 * 10^6$, ice = $3.49 * 10^6$ and steel = $3.9 * 10^7$)

(c) A transverse harmonic force of peak value 0.3 N and frequency 5 Hz initiates waves of amplitude 0.1 m at one end of a very long string of linear density 0.01 kg/m. Find the rate of energy transfer along the string is and the wave velocity.

(d) Show that the solution for forced harmonic oscillation is:

$$x = \frac{-iF_0 e^{i(\omega t - \phi)}}{\omega Z_m}$$

where

$$Z_m = [r^2 + (\omega m - s/\omega)^2]^{1/2}$$

Assume any missing data

Best Wishes

Dr. Ahmed Saeed

Dr. Demyana Adel Abdel Masieh