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Paper Code : BS-PH101/BSPH101 Physics-I

UPID : 001003

Time Allotted : 3 Hours   Full Marks :70

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer *any ten* of the following :   [1 x 10 = 10]

    (I)   Write an expression for Compton Wavelength of an electron.

    (II)   MB statistics is applicable for photons. State True or False.

    (III) What is the displacement of a particle executing SHM, when the velocity is maximum?

    (IV)   What is poulation inversion?

    (V)   For which type of materials magnetic susceptibility is negative?

    (VI)   Phase velocity and group velocity are equal when the medium is _____

    (VII) Which statistical distribution is followed by free electrons in a conductor?

    (VIII) Write the differential equation for SHM.

    (IX)   What is Optic Axis of a crystal?

    (X)   What is the dimension of $\mu_0 \epsilon_0$?

    (XI)   An electron and a proton are accelerated through the same potential difference. The de Broglie wavelength of the proton is larger than that of the electron. State True or False.

    (XII) Give one example of Uniaxial Crystal.

Group-B (Short Answer Type Question)

Answer *any three* of the following :   [5 x 3 = 15]

2. a) Draw the plot for blackbody radiation against wavelength for three different temperatures T1<T2<T3   [5]
    b) What do you mean by Ultra-Violet Catastrophe?

3. (a) Show that the gradient of a scalar field u(x,y,z) is perpendicular to the surface u(x,y,z)=constant   [5]
    (b) Find Gradient of the following scalar field at the point (1, -2, -1).
    $u(x,y,z) = xy^2z + 4x$

4. State Brewster's Law. Calculate the polarizing angle for light traveling from water to glass. Refractive index of glass=1.53 and water =1.33   [5]

5. Differentiate between Amplitude resonance and velocity resonance. What is logarithmic decrement in damped oscillation?   [5]

6. A particle is trapped in an infinite one dimensional potential well of width 'L' . Write its wavefunction and probability density function in its first excited state. Find the probability density at x=L/2.   [5]

Group-C (Long Answer Type Question)

Answer *any three* of the following :   [15 x 3 = 45]

7. (a) Show that the gradient of a scalar function is an irrotational vector,   [3]

    (b) Show that Curl of position vector is zero.   [3]

    (c) Is the magnetic field an irrotational vector or a solenoidal vector? Is the electric field an irrotational vector or a solenoidal vector?   [2]

    (d) Solve the following .   [4]
    If $\psi(x,y,z) = 3xy^2 - 5x^2z + 2z^2$, find $\nabla^2 \psi$

    (e) Determine the constant 'q' so that the following field is solenoidal   [3]
    $$\vec{F} = (2x + 3yz)\hat{i} + (3y - z^2)\hat{j} + (y^3 + qz)\hat{k}$$

8. (a) Distinguish between Fresnel and Fraunhofer Diffraction   [3]

    (b) Write the characteristics of LASER.   [4]

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(c) Mention three methods of producing plane polarized beam of light. [3]

(d) Explain briefly what do you mean by double refraction. [3]

(e) State Malus law. [2]

9. (a) What is Grating element? Write and plot the intensity distribution of a single slit diffraction pattern and find the positions of maxima, minima and secondary maxima. [2+1+2+4]

(b) Find the minimum thickness of a half wave plate and a quarter wave plate for a light wave of wavelength 5893 Angstrom. Given $\mu_0 = 1.66$ and $\mu_e = 1.47$ [2]

(c) What are the three basic components of a LASER? What is a optical resonator? [2+2]

10. (a) X-Ray photon of wavelength 2 angstroms is scattered at an angle of 45 degrees by a carbon block. [2+3]
(i) Calculate the wavelength of scattered X ray
(ii) Find the fraction of energy lost by the X-Ray photon during this event.

(b) A particle of mass m is confined in an infinite potential well between x=0 and x=L. Solve the time independent Schrodinger equation for such a system and Find the normalized eigenfunctions and eigenvalues. Using the normalized eigenfunctions find the expectation value of x. [5+2]

(c) Plot the Fermi distribution of a particle at T=0 K and T>0 K. [3]

11. (a) Calculate the number of photons emitted per sec by a 20 W source of monochromatic light of wavelength 431 nm. [4]

(b) What do you mean by degeneracy? https://www.makaut.com [2]

(c) State the Heisenberg's Uncertainty Principle. The average time interval that elapses between the excitation of an atom and the time it radiates energy is 10^(-8) seconds. Calculate the uncertainty in energy of emitted photons. [2+3]

(d) Compare Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics on the basis of minimum three characteristics. [4]

*** END OF PAPER ***