Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATIONS NOVEMBER/DECEMBER 2023
I SEMESTER B.Sc.(APPLIED SCIENCES) IN ENGG.

PHYSICS - I [IPH 111 - S2]

Marks: 50   **Duration: 180 mins.**

Answer all the questions.

Missing data, if any, may be suitably assumed

Useful constants

Planck's constant $h = 6.63 \times 10^{-34}$ Js,   Velocity of light $c = 3 \times 10^{8}$ ms^{-1}.

Charge on electron $= 1.6 \times 10^{-19}$ C.   Mass of electron $= 9.1 \times 10^{-31}$ kg.

Mass of proton $= 1.67 \times 10^{-27}$ kg.   Boltzmann constant: 1.38×10^{-23} J/K

Stefan-Boltzmann Constant: 5.67×10^{-8} W/m^{2}K^4 Avogadro's number : 6.022×10^{23}

1) A)	Discuss the theory of Newtons rings with a diagram and explain why it is circular and why the center of a Newton's ring is always dark	(5)
B)	A certain grating has 10^4 slits with a spacing of $d = 2100$ nm. It is illuminated with yellow sodium light ($\lambda = 589$ nm). Find the angular position of all principal maxima observed.	(3)
C)	The electric field in an electromagnetic wave is given by $E = (50$ N/C$) \sin \omega(t - x/c)$. Calculate the energy density and also find the energy contained in a cylinder of cross-section 10 cm^2 and length 50 cm along the x axis.	(2)
2) A)	What is a quantum particle ? Show that group velocity and particle velocity are the same. Also, prove that group velocity and phase velocity are different.	(5)
B)	A monochromatic source of light operating at 200 W emits 4×10^{20} photons per second. Find the frequency and wavelength of the light.	(3)
C)	X- Rays with wavelength 100 pm are scattered from a carbon target. The scattered radiation is viewed at 90° to the incident beam. What Kinetic Energy is imparted to the recoiling electron. ?	(2)
3)	By solving the Schrödinger equation, obtain an expression for the	(5)

A) quantized energy values for a particle of mass m, trapped in an infinite potential well.

B) A particle wave function is given by the equation $\psi(x) = A \exp(-ax^2)$. What is the value of A if this wave function is normalized? (3)

C) Electrons with energy 2 eV are incident on a barrier 10 eV height and 0.5 nm wide. Find the transmission and reflection probabilities. (2)

4) Discuss the X-Ray spectra by explaining the continuous and characteristic X-Rays. What is Cutoff wavelength λ_{min}. (4)
A)

B) A three level laser of emits light at a wavelength of 550 nm. What will be the ratio of population at 300 K of the upper level to that of lower level? Find, at what temperature the ratio of population would be 0.5 (3)

C) What are metastable states and population inversion and why they are important in Lasers (3)

5) Explain with a representative graph, what is superconductivity? Discuss Meissner effect with a schematic. (5)
A)

B) A H_2-molecule is in its vibrational and rotational ground states. It absorbs a photon of wavelength 2.2112 μm and jumps to the v = 1, J = 1 energy level. It then drops to the v = 0, J = 2 energy level, while emitting a photon of wavelength 2.4054 μm. Calculate the moment of inertia of the H_2-molecule about an axis through its centre of mass and perpendicular to the H-H bond. (3)

C) A quantum state has an energy of 5.3 eV, which is 0.10 eV above the Fermi energy. What is the probability that this energy state will be occupied? Assume a sample temperature of 750 K. (2)

-----End-----