Question Paper

Exam Date & Time: 01-Mar-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH. EXAMINATIONS - FEBRUARY/MARCH 2023
SUBJECT: PHY 1071 / PHY-1071 - ENGINEERING PHYSICS
(MAKEUP)

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

Answer all the questions.

1A)	State and explain the Maxwell's equations. Mention its significance.	(5)
1B)	A ruby laser emits light at a wavelength of 694.4 nm. If a laser pulse is emitted for $12x10^{-12}$ second and the energy release per pulse is 150 mJ, (a) what is the length of the pulse, and (b) how many photons are there in each pulse?	(3)
1C)	What are superconductors? Draw a representative graph of Resistance Vs Temperature for a superconductor.	(2)
2A)	Explain the numerical aperture of an optical fiber. With necessary diagram, derive an expression for angle of acceptance and numerical aperture for an optical fiber placed in air.	(5)
2B)	Solar cells are often coated with a transparent, thin film of silicon monoxide (SiO, n = 1.45) to minimize reflective losses from the surface. Suppose a silicon solar cell (n = 3.5) is coated with a thin film of silicon monoxide for this purpose. Determine the minimum film thickness that produces the least reflection at a wavelength of 550 nm, near the center of the visible spectrum.	(3)
2C)	An electron with kinetic energy E = 5.0 eV is incident on a barrier with thickness L = 0.20 nm and height U = 10 eV. Calculate the probability that the electron will tunnel through the barrier.	(2)
3A)	Explain photoelectric effect. List experimental observations in the experiment on photoelectric effect. Sketch schematically the following graphs with reference to the photoelectric effect: (a)photoelectric current vs applied voltage (b) kinetic energy of most-energetic electron vs frequency of incident light.	(5)
3B)	The radius of our Sun is 6.96×10^8 m, and its total power output is 3.77×10^{26} W. (a) Assuming that the Sun's surface emits as a black body, calculate its surface temperature. (b) Using the result, find λ_{max} for the Sun.	(3)
3C)	Explain the term phase velocity and group velocity of a quantum particle.	(2)
4A)	Apply the Schrödinger equation to a particle in a one-dimensional "box" (infinite potential well) of length L and derive the expression for energy values of the particle.	(5)
4B)	A K^+ ion and a Cl- ion is separated by 5.00×10^{10} m. Assuming the two ions act like point charges, determine (a) the force each ion exerts on the other and (b) the potential energy of the two-ion system in electron volts. Given: Charge of an electron is $1.6x10^{-19}$ C.	(3)
4C)	Explain the term ionic bonding and covalent molecular bonding.	(2)
5A)	Distinguish between conductors, insulators and semiconductors on the basis of band theory.	(5)
5B)	Sodium is a monovalent metal having a density of 971 kg/m^3 and a molar mass of 0.023 kg/mol. Use this information to calculate (a) the density of charge carriers and (b) the Fermi energy. Given: Avogadro Number = 6.023×10^{23}.	(3)

5C) Write a note on surface to volume ratio. Mention its significance in nanoscience. (2)

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