Question Paper

Exam Date & Time: 11-Jan-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH. EXAMINATIONS - JANUARY 2023
SUBJECT: PHY 1071 / PHY-1071 - ENGINEERING PHYSICS

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

Answer all the questions.

1A)	i) Explain the term Poynting vector. ii) Obtain an expression for radii of the m^{th} order dark fringes in Newton's rings.	(5)
1B)	Light of wavelength 500 nm is incident normally on a diffraction grating. If the third-order maximum of the diffraction pattern is observed at 32.0°, (a) what is the number of rulings per centimeter for the grating? (b) Determine the total number of primary maxima that can be observed in this situation.	(3)
1C)	"A superconductor is not only a perfect conductor; it is also a perfect diamagnet" - Justify the statement.	(2)
2A)	i) Write the conditions for constructive and destructive interference of reflected light from a thin soap film in air, assuming normal incidence. ii) With the help of a neat diagram state the Rayleigh's criterion for resolution.	(5)
2B)	A material having an index of refraction of 1.30 is used as an antireflective coating on a piece of glass (n = 1.50). What should the minimum thickness of this film be to minimize reflection of 500-nm light?	(3)
2C)	An electron has a kinetic energy of 12 eV. The electron is incident upon a rectangular barrier of height 20 eV and thickness 1 nm. By what factor would the electron's probability of tunnelling through the barrier increase assuming that the electron absorbs all the energy of a photon with wavelength 546 nm?	(2)
3A)	Using the energy and momentum conservation, derive an expression for the wavelength of the scattered photon in a Compton effect experiment.	(5)
3B)	Incident photons strike a photocathode having a work function of 2.26 eV, causing photoelectric emission. When a stopping potential of 2.69 V is imposed, there is no photocurrent. Find the wavelength of the incident photons and the speed of the most energetic photoelectrons.	(3)
3C)	The nucleus of an atom is of the order of 2.0 x 10^{-14} m in diameter. For an electron to be confined to a nucleus its de Broglie wavelength would have to be on this order of magnitude or smaller. What would be the total relativistic energy of the electron?	(2)
4A)	Sketch schematically the plots of Fermi-Dirac distribution function for zero kelvin and for temperature above zero kelvin. Derive an expression for density-of-states.	(5)
4B)	Explain briefly the BCS theory of superconductivity in metals. Why all conductors are not superconductors?	(3)
4C)	For copper at 300 K, calculate the probability that a state with an energy equal to 99.0% of the Fermi energy is occupied. Fermi energy of copper is 7.05 eV. Mass of an electron is 9.1x10^{-31} Kg ; speed of light in vacuum = 3x10^{8} m/s; Planck's constant=6.63x10^{-34} Js; Avagadro number = 6.023x10^{23} / mol; Boltzmann constant=1.38x10^{-23} J/K.	(2)

5A)	Based on the allowed states of a particle in a three-dimensional infinite potential well, 'box', derive the density-of-states function	(5)
5B)	Consider a cube of gold (d =1.00 mm) on an edge. Calculate the approximate number (N) of conduction electrons in this cube whose energies lie in the range E = 4.000 eV to E+ ΔE = 4.025 eV. Fermi energy for gold = 5.53 eV	(3)
5C)	What is top-down and bottom-up approach of nano material synthesis?	(2)

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