Question Paper

Exam Date & Time: 08-Jul-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SECOND SEMESTER B.TECH. DEGREE EXAMINATIONS - JUNE/JULY 2023
SUBJECT: PHY 1071-PHY/ PHY 1071-B/ PHY 1051-B - ENGINEERING PHYSICS

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

Answer all the questions.

1A)	Obtain an expression for the radius of m^{th} order dark ring in the case of 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 proton is confined to move in a one-dimensional box of length L= 0.20 nm. Find the lowest possible energy E_1 of the proton.	(2)
2A)	Using atomic levels of He-Ne, explain the pumping, laser medium, and lasing action of the He-Ne laser.	(5)
2B)	An optical fiber has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Find (i) the refractive index of the core, (ii) the critical angle, and (iii) the acceptance angle in water, which has a refractive index of 1.33.	(3)
2C)	Draw the plot for the probability distribution for finding electrons at two different temperatures: $T = 0$ *K* and $T > 0$ *K*. And explains their physical significance.	(2)
3A)	Define (i) group speed and (ii) phase speed of a wave packet. Show that the group speed of a wave packet is equal to the particle speed for a free non- relativistic quantum particle.	(5)
3B)	In an experiment, tungsten cathode which has a threshold 230 nm is irradiated by ultraviolet light of wavelength 180 nm. Calculate (i) maximum energy of emitted photoelectrons, and (ii) work function for tungsten (in eV).	(3)
3C)	What is ultraviolet catastrophe? Explain with necessary equation.	(2)
4A)	The wave-function for a particle confined to moving in a one-dimensional box is $\psi(x) = A \sin\left(\frac{n\pi x}{L}\right)$ Evaluate the constant A. Obtain the energy values of the particle.	(5)
4B)	An electron with energy 2.5 eV is incident on potential barrier of height 4.5 eV and width 1 nm. If the width of the barrier is increased to ten times, how will the transmission and reflection probability be affected?	(3)
4C)	Can a molecule have zero vibrational energy? Justify your answer.	(2)
5A)	Prove that for an electron (or hole), the number of permissible states per unit volume $(g(E))$ is directly proportional to the square root of the energy (E), i.e., $g(E) \propto \sqrt{E}$.	(5)
5B)	The Fermi level in silver is 5.5 eV at zero kelvin. Calculate the number of free electrons per unit volume and the probability of occupation for electrons with energy 5.6 eV in silver at the same temperature.	(3)

5C) Describe the concept of a surface-to-volume ratio and discuss its significance. (2)

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