Question Paper

Exam Date & Time: 25-Nov-2019 (08:30 AM - 11:30 AM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2019

Engineering Physics [PHY 1051 - 2018 -PHY]

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

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) What are Newton rings? Why they are circular? With a neat geometry, obtain an expression for the radii of dark rings. Mention two applications of Newton rings experiment. (5)

A)

B) The first-order diffraction maximum is observed at 12.6° for a crystal having a spacing between plane of atoms of 0.250 nm. (a) What wavelength X-ray is used to observe this first-order pattern? (b) At what angle, second order maximum is observed (c) How many orders can be observed for this crystal at this wavelength? (3)

C) Monochromatic light of wavelength 538 nm falls on a single slit with width 0.10 mm. Consider a point on the screen at 9.0° from the central maximum. Calculate the ratio of the intensity at this point to the intensity at the central maximum. (2)

2) Explain Compton Effect. Derive the Compton shift equation. For what value of photon scattering angle, we obtain maximum Compton shift (5)

A)

B) Explain the polarization phenomena by a) reflection b) double refraction (3)

C) An electron has a kinetic energy of 3.0 eV. (a) Find its wavelength. (b) Also find the wavelength of a photon having the same energy. Mass of an electron is 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (2)

3) Sketch the potential-well diagram of finite height U and length L, obtain the general solution of the Schrödinger equation for a particle of mass m in it. (5)

A)

B) A quantum simple harmonic oscillator consists of an electron bound by a restoring force proportional to its position relative to a certain equilibrium point. The proportionality constant is 8.99 N/m. Calculate its energy in level n = 3. What is the longest wavelength of light that can excite the oscillator? Mass of an electron is 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (3)

C) A tungsten target is struck by electrons that have been accelerated from rest through a 40.0-kV potential difference. Find the shortest wavelength of the radiation emitted. What is the kinetic energy of the accelerating electrons? Mass of an electron is 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (2)

4) Explain the following terms: a) population inversion b) meta stable states. With relevant diagrams, briefly explain the working principle of laser. (5)

A)

B) Explain briefly (a) ionic bonding, (b) covalent bonding, (c) van der Walls bonding (3)

C) 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 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (2)

5) Obtain an expression for rotational energy of a diatomic molecule. Sketch schematically these rotational energy levels. (5)

A)

B) 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. Mass of an electron is 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (3)

C) A light-emitting diode (LED) made of the semiconductor GaAsP emits red light (λ= 650nm). Determine the energy-band gap E_g in the semiconductor. Calculate the frequency of the emitted photon. Mass of an electron is 9.1×10^{-31} Kg ; speed of light in vacuum = 3×10^{8} m/s; Planck's constant=6.63×10^{-34} Js; Avagadro number = 6.023×10^{23} / mol; Boltzmann constant=1.38×10^{-23} J/K (2)

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