Question Paper

Exam Date & Time: 17-Mar-2021 (09:00 AM - 12:00 PM)

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

I SEMESTER B. TECH (ENGINEERING PHYSICS)
END SEMESTER EXAMINATION (PHY 1051)

ENGINEERING PHYSICS [PHY 1051 - 2020 -PHY]

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

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

1) What are coherent waves? Obtain an expression for intensity of light in double-slit interference. Sketch the plot of intensity versus path difference in the case of double slit experiment. (5)

A)

B) In a Newton rings experiment, a plano-convex glass (n = 1.52) lens having radius r = 5.00 cm is placed on a flat plate. When light of wavelength 650 nm is incident normally, 55 bright rings are observed, with the last one precisely on the edge of the lens. (a) What is the radius R of curvature of the convex surface of the lens? (b) What is the focal length of the lens? (3)

C) Explain the term Diffraction of light. (2)

2) Derive the Compton shift equation. (5)

A)

B) Explain briefly diffraction at a circular aperture. State and explain Rayleigh's criterion for optical resolution. (3)

C) The radius of our Sun is 6.96 x 10^8 m, and its total power output is 3.77 x 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. (2)

Speed of light in vacuum (c)= 3.00x10^8 m/s ; Electron charge = 1.60x10^{-19} C; Electron mass = 9.1x10^{-31} kg ; Boltzmann constant = 1.38x10^{-23} J/ K; Planck's constant = 6.63x10^{-34} J.s; Stefan Boltzmann constant = 5.67x10^{-8} W/m^2K^4

3) Apply the Schrödinger equation to a particle in a one-dimensional "box" of length L and obtain the wavefunction and energy values of the particle. (5)

A)

B) Electrons are ejected from a metallic surface with speeds up to 4.60 x 10^5 m/s when light with a wavelength of 625 nm is used. (a) What is the work function of the surface? (b) What is the cut-off frequency for this surface? (3)
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C) What minimum accelerating voltage would be required to produce an x-ray with a wavelength of 70.0 pm? (2)
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4) Explain three types of transitions between two energy levels, when radiation interacts with matter. Explain the characteristics of a laser beam. Explain metastable state and population inversion. (5)

A)

B) Explain briefly the BCS theory of superconductivity in metals. (3)

C) Calculate the energy of a conduction electron in silver at 800 K, assuming the probability of finding an electron in that state is 0.950. The Fermi energy is 5.48 eV at this temperature. (2)
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5) Assuming the Fermi-Dirac distribution function , obtain an expression for the density of free-electrons in a metal with Fermi energy E_F, at zero K and, hence obtain expression for Fermi energy (5)

A) E_F in a metal at zero K. [Given: density-of-states function $g(E) = \frac{8\sqrt{2}\,\pi m^{3/2}}{h^3} E^{1/2}\,dE$]

B) Calculate the probability that the electron in the ground state of H-atom will be found outside the Bohr radius. (3)

C) The energy gap for silicon at 300 K is 1.14 eV. (a) Find the lowest-frequency photon that can promote an electron from the valence band to the conduction band. (b) What is the wavelength of this photon? (2)
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