Question Paper

Exam Date & Time: 27-Dec-2019 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATIONS NOVEMBER2019
I SEMESTER B.sc. (Applied Sciences) in Engg.
PHYSICS - I [IPH 111]

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

Answer all the questions.

PHYSICAL CONSTANTS

Elementary charge, e	:	1.602×10^{-19}C
Electron mass, m_e	:	9.11×10^{-31}kg
Proton mass, m_e	:	1.67×10^{-27}kg
Boltzmann constant	:	1.38×10^{-23}J/K
Planck's constant	:	6.626×10^{-34}J.s

Note: Any missing data may be suitably assumed.

1) Obtain an expression for intensity in double slit interference of light waves using phasor method. (3)

A)

B) State and explain law of Malus. (2)

C) Monochromatic light with wavelength 538 nm falls on a slit with width 25.2 mm. The distance from the slit to a screen is 3.48 m. Consider a point on the screen 1.13 cm from the central maximum. (a) Calculate θ. (b) Calculate α. (c) Calculate the ratio of the intensity at this point to the intensity at the central maximum. (3)

D) A soap film (n=1.33) in air is 320nm thick. If it is illuminated with white light at normal incidence, what color will it appear to be in reflected light? (2)

2) Explain Compton effect. (2)

A)

B) Write Einstein's photoelectric equation. Which are the features of photoelectric effect-experiment explained by Einstein's photoelectric equation? (3)

C) Electrons are ejected from a metallic surface with speeds up to 4.60 X10^5 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? (2.5)

D) A certain grating has 10^4 slits with a spacing of 2.1μm. It is illuminated with (2.5)

light of wavelength 589 nm. Find the angular position and angular width of second order principal maximum.

3) By solving the Schrödinger equation, obtain the wave-functions for a particle of mass m in a one-dimensional "box" of infinite height and length L. (4)

A)

B) State Heisenberg uncertainty principle. (1)

C) A 0.700 Mev photon scatters off a free electron such that the scattering angle of the photon is twice the scattering angle of the electron. Determine the scattering angle and the final speed of the electron. (3)

D) An electron is confined between two impenetrable walls 0.20nm apart. Determine the energy level of states n=1 and 2. (2)

4) Write the expression for Fermi-Dirac distribution function. Indicate the position of (a) Fermi-level (b) donor levels (c) acceptor levels, in the energy band diagram of a semiconductor. (3)

A)

B) Explain Meissner effect. (2)

C) A laser emits a 3mJ pulse in 1.00 ns, focused to a spot 30 μm in diameter on the retina. (i) Find the power per unit area at the retina. (ii) What energy is delivered to an area of molecular size, taken as a circular area 0.600 nm in diameter. (2.5)

D) Most solar radiation has wavelength of 1μm or less. What energy gap should the material in a solar cell have in order to absorb this radiation? (2.5)

5) Explain the following terms with reference to lasers: (3)
(a) Stimulated emission (b) Metastable state (c) Resonant cavity.

A)

B) Explain the origin of characteristic x-ray spectrum. Write Moseley's relation for the frequency of characteristic x-rays. (2)

C) Calculate the most probable value of radial distance for an electron in the ground state of the hydrogen atom. The corresponding wave function is given by (3)

$$\psi_{1s}(r) = \frac{1}{\sqrt{\pi\, a_o^3}} exp\left(-\frac{r}{a_o}\right)$$

D) If an electron has orbital angular momentum equal to 4.714×10^{34} J.s ,what is the orbital quantum number for the state of the electron ? (2)

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