Question Paper

Exam Date & Time: 01-Jan-2019 (08:30 AM - 11:30 AM)

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

FIRST SEMESTER B.TECH END SEMESTER MAKE UP EXAMINATIONS, DEC 2018

Engineering Physics [PHY 1051 - 2018 -PHY]

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

A

Answer all the questions.

Instructions to Candidates: Missing data may be suitably assumed

Physical Constants:

Speed of light in vacuum	$= 3.00 \times 10^{8}$ m/s	Electron charge	$= 1.60 \times 10^{-19}$ C
Electron mass	$= 9.11 \times 10^{-31}$ kg	Planck's constant	$= 6.63 \times 10^{-34}$ J.s
Boltzmann constant	$= 1.38 \times 10^{-23}$ J/ K		

1) Discuss qualitatively, the Fraunhofer diffraction at a single-slit. (4)

A)

B) A converging lens of diameter d = 32 mm has a focal length f = 24 cm. What angular separation (θ_R) must two distant point objects have to satisfy Rayleigh's criterion? Assume that the wavelength is λ = 550 nm. How far apart (Δx) are the centers of the diffraction patterns in the focal plane of the lens? (3)

C) The intensity on the screen at a certain point in a double-slit interference pattern is 64.0% of the maximum value. (i) What minimum phase difference (in radians) between sources produces this result? (ii) Express this phase difference as a path difference for 486.1 nm light. (3)

2) Solve the Schrodinger equation for a quantum particle of mass **m** trapped in a one-dimensional infinite potential well (box) of length **L** and obtain the expressions for wave-functions of the particle. (5)

A)

B) A 30 eV electron is incident on a square barrier of height 40 eV. What is the probability that the electron will tunnel through the barrier if its width is 0.10 nm? (3)

C) Distinguish between unpolarized and linearly polarized light. (2)

3) What are the features of photoelectric effect-experiment explained by Einstein's photoelectric equation? (4)

A)

B) Explain (i) Stefan's law (ii) Wien's displacement law (iii) Plank's law. (4)

C) An electron has a kinetic energy of 3.0 eV. Find its de Broglie wavelength. (2)

4) 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 (5)

A)

charge carriers and (b) the Fermi energy. ($N_A = 6.023 \times 10^{23}$)

B) Explain the following terms with respect to LASER (i) spontaneous emission (ii) stimulated emission (iii) population inversion. (3)

C) Explain the origin of continuous X-rays. (2)

5) Based on the allowed states of a particle in a three dimensional box, derive the density-of-states function. (5)

A)

B) The J = 0 to J = 1 rotational transition of the CO molecule occurs at a frequency of 1.15×10^{11} Hz. (i) Use this information to calculate the moment of inertia of the molecule. (ii) Calculate the bond-length of the molecule. (3)
(Mass number: Carbon - 12, Oxygen - 16 and mass of proton $m_p = 1.67 \times 10^{-27}$ kg)

C) Most solar radiation has a wavelength of 1 μm. What energy gap should the material in solar cell have in order to absorb this radiation ? (2)

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