Reg. No.:

MANIPAL INSTITUTE OF TECHNOLOGY

MAHE, MANIPAL

FIRST SEMESTER B.Tech. END-SEMESTER MAKE-UP EXAMINATION

SUBJECT: ENGINEERING PHYSICS (PHY1051)

Time: 3 Hrs. **Max. Marks: 50**

Note: Any missing data may suitably be 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		

1A. Discuss qualitatively, the Fraunhofer diffraction at a single-slit. **[4]**

1B. 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]**

1C. 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 **486.1nm** light. **[3]**

2A. Solve the Schrödinger 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]**

2B. 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]**

2C. Distinguish between unpolarized and linearly polarized light. **[2]**

3A. Which are the features of photoelectric effect-experiment explained by Einstein's photoelectric equation? **[4]**

3B. Explain (i) Stefan's law (ii) Wien's displacement law (iii) Plank's law. **[4]**

3C. An electron has a kinetic energy of 3.0 eV. Find its de Broglie wavelength. **[2]**

4A. 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. ($N_A = 6.023 \times 10^{23}$) **[5]**

4B. Explain the following terms with respect to LASER (i) spontaneous emission (ii) stimulated emission (iii) population inversion. **[3]**

4C. Explain the origin of continuous X-rays. **[2]**

5A. Based on the allowed states of a particle in a three dimensional box, derive the density-of-states function. **[5]**

5B. 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. (Mass number: Carbon – 12, Oxygen – 16 and mass of proton $m_p = 1.67 \times 10^{-27}$ kg) **[3]**

5C. 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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