

**Continuous Assessment Test (CAT - II), May 2023**

Programme	: B.Tech	Semester	: Winter 2022-2023
Course Title	: Engineering Physics	Course Code	: BPHY101L
School	: School of Advanced Sciences	Slot	: B2+TB2
Duration	: 90 mins	Max. Marks	: 50
Class No	: 4916, 4918, 4920, 4922, 4924, 4926, 4928, 4930, 4950		

Part – A (5 x 10 = 50)

Answer ALL Questions

Sl. No	Questions	Max Marks
1	What are matter waves? How do they differ from electromagnetic waves? Discuss and analyze an experiment which proves the existence of matter waves with proper diagram.	10
2	Obtain one dimensional Schrodinger's steady-state wave equation for an electron considering it as a de-Broglie wave. How does the Schrodinger's time dependent equation differ from the classical wave equation (vibrations on a string)?	10
3	(a) Through the conservation of energy and momentum, prove that a photon cannot transfer all of its energy to a free electron.  (b) A beam of X rays is scattered by a target. At 45 degree angle from the beam direction the scattered X rays have a wavelength of 10.7 pm. What is the wavelength and energy of X rays in the direct beam?	5  5
4	Prove that an electron confined in a one-dimensional box of width ranging from $x = -\frac{a}{2}$ to $x = +\frac{a}{2}$ can have only discrete values of energy. Discuss the eigen-functions and the corresponding probabilities for the first three energy levels using necessary diagrams.	10
5	(a) How does the energy level distribution in nanomaterials differ from that of the bulk? How does the degree of confinement differ from the degree of freedom for the motion of an electron in a solid?  (b) Consider an electron with energy <u>2 eV</u> incident on a barrier of height <u>10 eV</u> and width <u>0.5 nm</u> . Calculate the transmission probability of the electron. If the electron is replaced by a proton with same energy, what do you expect, an increase or decrease in transmission probability and why?	5  5

