BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: IMSC **SEMESTER : III**
BRANCH: MATHEMATICS AND COMPUTING **SESSION : MO/2025**

SUBJECT: PH111 PHYSICS-II

TIME: 02 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	Conservation of energy is the principle of first law of thermodynamics, where work done on the system or by the system is expressed as, $dW = \pm PdV$. Write the equation of first law of thermodynamics considering the positive sign of work done, i.e., $dW = +PdV$.	[2]	I	I, II
Q.1(b)	On what condition a body is called as source of heat. State the alternate statement of second law of thermodynamics. Discuss the alternate statement mathematically.	[3]	I	I, II
Q.2(a)	If a magnetic work ($dW = B_0 dM$) is done on a system, where B_0 is the magnetic flux and M is the resulting magnetization. Name and write the resulting equation which is a combination of the first and second laws of thermodynamics.	[2]	I	I, II, III
Q.2(b)	Write macroscopic and microscopic expression of temperature. If a microscopic phenomenon leads to the well description of a macroscopic phenomenon, analyze the below expression and write the result, where the variables in the expression have their usual meaning in thermodynamics. $$\left(\frac{\partial S}{\partial U}\right)_V = k_B \frac{dln(\Omega)}{dU}$$	[3]	I	IV
Q.3(a)	A particle limited to the x-axis has the wave function $\Psi = ax$ between $x = 0$ and $x = 1$; $\Psi = 0$ elsewhere. (a) Find the probability that the particle can be found between $x = 0.45$ and $x = 0.55$. (b) Find the expectation value $\langle x \rangle$ of the particle's position.	[2]	II	V
Q.3(b)	The quantum theory of radiation is supported by a very strong evidence, name such evidence and discuss the mathematical verification of it.	[3]	II	II
Q.4(a)	A particle associated with a wave function, $\psi = Asin(n\pi x/L)$ is confined within the limits $x = 0$ to $x = L$, calculate the constant A.	[2]	II	V
Q.4(b)	Discuss the mathematics of an experiment that directly verifies de Broglie's hypothesis of the wave nature of moving bodies.	[3]	II	II
Q.5(a)	Express mathematically the spectral energy density of blackbody radiation at low and high frequencies.	[2]	III	I
Q.5(b)	Explain schematically the optical fiber transmission modes for (a) multi-mode (b) multi-mode graded index, and (c) single-mode.	[3]	III	I, II

::::: 16/09/2025 :::::E