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Total Pages : 3

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**May 2026**

**B.Sc. (PHYSICS) IV SEMESTER**

**Elements of Modern Physics (BPH24–402T)**

Time : 3 Hours] [Maximum Marks : 75

*Instructions :*

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any **four** questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

## PART–A

1. (a) What do you mean by Eigenvalue and Eigenfunction? (1.5)

   (b) Write the outcomes of Gamma ray microscope thought experiment. (1.5)

   (c) Give physical significance of the wave function. (1.5)

   (d) What is Bohr's correspondence principle? (1.5)

   (e) What are black body radiations? (1.5)

   (f) What do you understand by Mosley's law? (1.5)

   (g) Define the expectation value of the operators. (1.5)

(h) What is pumping and how many types of pumping are there? (1.5)

(i) What is the population inversion? (1.5)

(j) Write the importance of metastable state in laser action. (1.5)

## PART–B

2. (a) Give Planck's quantum hypothesis to derive Planck's radiation law. (7)

   (b) What is Compton scattering? Discuss its theory and calculate Compton wavelength. Show that it is independent of the nature of scatterer. (8)

3. (a) Discuss the failures of classical physics and how does quantum mechanics overcome these failures? (5)

   (b) Give the formulation of time dependent Schrödinger equation for a free particle. What do you understand by position probability density and normalization of the wave function? (10)

4. (a) Discuss Uncertainty principle. Give any one example to illustrate the uncertainty principle. (5)

   (b) Define one-dimension potential box. By using the Schrödinger wave equation, calculate the energy eigenvalues and the normalized wave functions for a particle in box. Explain zero-point energy for the particle in the box. (10)

5. (a) What is potential barrier (Tunnel Effect)? Calculate the reflection and transmission across a step and rectangular potential barrier. (10)



   (b) What are X-rays? How are they produced? How do you get the continuous and sharp line spectrum in X-rays? (5)

6. (a) Explain the Sommerfeld's extension of Bohr's model with the relativistic correction. (10)

   (b) Explain the stimulated absorption, spontaneous emission and stimulated emission with diagrams and mathematical equations. (5)

7. (a) Explain the principle, construction and working of He-Ne laser with energy level diagram and give its applications. (10)

   (b) Discuss the Einstein's coefficients. Derive relation between them. (5)

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