

RAJIV GANDHI INSTITUTE OF PETROLEUM TECHNOLOGY, JAIS AMETHI

B. Tech. – Ist Year (Even Semester)

End-Semester Examination

Question Paper for Modern Physics (PY-112)

SECTION - A

TIME: 1 hour

[MAX. MARKS: 30]

- Instructions: Attempt all questions

1. In an experiment of photoelectric effect, it is observed that for a light of wavelength 3000\AA , the stopping potential is 1.85 volt and for light of wavelength 4000\AA , the stopping potential is 0.82 volt. From these data determine (i) Planck's constant; (ii) work function of the substance (iii) threshold wavelength for the substance. [6 MARKS]

2. X-rays of wavelength 1.0\AA are scattered by a carbon block. The scattered radiations are observed at 60° . Find (a) Compton shift (b) kinetic energy imparted to the recoil electron. [4 MARKS]

3. A particle of mass m moving in a one-dimensional box of length L , with boundaries at $x = 0$ and $x = L$. Thus, $V(x) = 0$ for $0 \leq x \leq L$, and $V(x) = \infty$. The normalized eigenfunctions for this system is given by

$$\psi_n(x) = \left(\frac{2}{L}\right)^{1/2} \left(\sin \frac{n\pi x}{L}\right) \text{ Where the quantum number } n \text{ can take on the values } n = 1, 2, 3 \dots$$

(a) Assume that particle is in the eigen state, $\psi_n(x)$, calculate the probability that the particle is found somewhere in the region $0 \leq x \leq \frac{L}{4}$. Show that the probability depends on n .

(b) For what value of n is there the largest probability of finding the particle in the region $0 \leq x \leq \frac{L}{4}$ [6 MARKS]

4. The Schrodinger wave equation for hydrogen atom is

$$\psi_{2s} = \frac{1}{4\sqrt{2}\pi} \left(\frac{1}{a_0}\right)^{3/2} \left[2 - \frac{r_0}{a_0}\right] e^{-r/a_0}$$

where a_0 is the Bohr radius. If the radial node in 2s be at r_0 , then find r_0 in terms of a_0 . [4 MARKS]

5. Describe the principle, construction and working of He-Ne laser. [6 MARKS]

6. Calculate the half-life of the radioactive nuclei from the graph given below [4 MARKS]

