UG (CBCS) Even Semester Examination, May 2025

EDUCATION
(B.Sc. B.Ed.)

8th Semester

Course No. : BSPH - 801

(Quantum Mechanics, Astro physics, Cosmology and Nuclear physics)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

(*Answer five questions*)

1. (a) Establish the following relation. 5+5=10

$$\frac{\partial}{\partial t}\langle p_x \rangle = -\left\langle \frac{\partial v}{\partial x} \right\rangle$$

(b) For the given wave function $\psi(x) = A\, exp(-x^2/2\alpha)$, evaluate the uncertanity product $\Delta x\, \Delta p$.

Or

2. (a) Evaluate the current density J for the given wave function $\psi = \frac{A}{r}\, e^{i\vec{k}\,.\,\vec{r}}$

(b) For the given function $\psi(x) = Ax^n\, e^{-x/a}$, energy eigenvalues become $E = -\frac{\hbar^2}{2ma^2}$. Evaluate the value of potential $v(x)$. 5+5=10

3. Describe the nature of bound state of a particle moving under a potential. 10

$$v(x) = \begin{matrix} v_0 \\ o \\ v_0 \end{matrix}\Bigg\} \begin{matrix} x < -a/2 \\ -a/2 \le x \le a/2 \\ x > a/2 \end{matrix}$$

Or

4. Evaluate the ground state wave function, energy eigen values of a particles moving under a potential

$$v(x) = \begin{matrix} 0 & -a/2 \le x \le a/2 \\ \infty & else\ where \end{matrix}$$ 10

5. Evaluate the value of $\langle E \rangle$ for a L.H.O whose wave function is descrived as 5+5=10

(a) $\psi(x) = A\ e^{-\frac{1}{2}\alpha^2 x^2}$

(b) $\psi(x) = Ax\ e^{-\frac{1}{2}\alpha^2 x^2}$

Or

6. Evaluate the probility of finding an electron within the region $0.5\ a_O \le r \le 0.75\ a_O$ of a hydrogen atom at ground state. 10

7. Write short notes : 2+4+4=0

(a) Apparent magnitude

(b) Binary star

(c) CNO chain

Or

8. Write short notes on : 4+3+3=10

(a) nebula

(b) white dwarf

(c) black holes

9. Write short notes on the following properties of nucleus : 5+5=10

(a) nuclear force

(b) quarm pole moment

Or

10. Write short notes on : 6+4=10

(a) P-P chain

(b) Big Bang theory

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