QUANTUM MECHANICS

1. Define uncertainty principle and give its origin. (2) {JUN 15 [GNE]}
2. If the mass of a neutron is $1 \cdot 66 \times 10^{-27}\, kg$, then find the de-Broglie wavelength at 300K. (Given $k = 1 \cdot 38 \times 10^{-38}\, JK^{-1}$) (2) {JUN 15 [GNE]}
3. A wavefunction of a particle in a one dimensional box of length L is given as $\Psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right)$; n = integer . Show that this wave function satisfies one dimensional time independent Schrodinger equation. Given that $E = \frac{n^2 \pi^2 \hbar^2}{2mL^2}$ and U = 0. (4) {JUN 15 [GNE]}
4. Define wavefunction. Give its significance and write conditions for a wavefunction to be well behaved. (4) {JUN 15 [GNE]}
5. Using energy-time uncertainty principle, show that no excited state in atom can be mono-energetic in nature. (2) {JUN 15 [PTU]}
6. Why a particle trapped in a box cannot be at rest? (2) {JUN 15 [PTU]}
7. What is the matter wave associated with a moving particle? Derive expression for phase and group velocities of such a wave packet. (4) {JUN 15 [PTU]}
8. Give a brief account of need and origin of quantum mechanics. (4) {JUN 15 [PTU]}
9. Explain briefly uncertainty principle. (2) {DEC 14 [GNE]}
10. Derive expression for time independent Schrodinger wave equation. (4) {DEC 14 [GNE]}
11. Derive relation between group velocity and phase velocity. Hence discuss the cases of normal and anomalous dispersion. Which dispersion is must for group velocity to be less than velocity of light? (4) {DEC 14 [GNE]}
12. What are essential conditions for a wave function to be well behaved? (2) {DEC 14 [PTU]}
13. Show that Heisenberg's Uncertainty principle is a natural consequence of wave nature associated with moving material particles. (4){DEC 14 [PTU]}
14. Obtain time independent Schrodinger equation. Argue qualitatively that energy quantization is embedded in this equation. (4) {DEC 14 [PTU]}
15. Discuss the formation of wave packet and hence prove that particle velocity is equal to the group velocity. (4) {JUN 14 [GNE]}
16. Calculate the energy Eigen values and Eigen functions for the motion of a particle in one dimensional box. (4) {JUN 14 [GNE]}
17. Can $\psi(x) = x^2$ be an acceptable wave function in quantum mechanics? (2) {JUN 14 [GNE]}
18. Calculate the de-Broglie wavelength associated with electrons, which are accelerated by a voltage of 50kV. (3) {JUN 14 [PTU]}

19. Solve Schrodinger equation for a particle confined to an infinite potential box of width L in order to derive the expression for energy eigen values. (5) {JUN 14 [PTU]}
20. What is the physical significance attached to the conditions of continuity and single valued nature of an acceptable wavefunction? (2) {JUN 14 [PTU]}
21. What do you understand by wave particle puzzle? (2) {Dec 2013 [PTU]}
22. Derive time dependent Schrodinger equation and discuss its significance in today's context. (4) {Dec 2013 [PTU]}
23. What is the significance of uncertainty principle for macroscopic bodies? (4) {Dec 2013 [PTU]}
24. What is de-Broglie hypothesis. (2) {Dec 2013 [PTU]}
25. An electron is bound in one dimensional box of size $4\times10^{-10}\,m.$ What will be the minimum energy? (2) {Dec 2013 [PTU]}
26. State and explain Heisenberg's uncertainity principle. (4) {Dec 2013 [PTU]}
27. At time t = 0, a particle is represented by a wave function

$$\Psi(x)=\begin{cases} A\dfrac{x}{a} & \text{for } 0\le x\le a \\ A\dfrac{(b-x)}{(b-a)} & \text{for } a\le x\le b \\ 0 & \text{elsewhere} \end{cases}$$; where A, a and b are constants.

    (i) Normalize $\Psi(x,0)$
    (ii) Sketch $\Psi(x,0)$ as a function of x.
    (iii) Where is the particle most likely to be at t = 0 ?
    (iv) What is the probability of finding the particle to the left of x = a at t = 0? (4) {Dec 2013 [PTU]}
28. Explain Uncertainity principle. (2) {Dec 2013 [GNE]}
29. Calculate the energy eigen values and eigen functions for the motion of a particle confined in a 1-D box. (4) {Dec 2013 [GNE]}
30. At a certain time, the normalized wave function of the particle moving along the X-axis is given by: $\Psi(x)=\begin{cases} x+\beta & \text{for } -\beta < x < 0 \\ -x+\beta & \text{for } 0 < x < \beta \\ 0 & \text{elsewhere} \end{cases}$. Find the value of β and the probability that the particle's position is between $x=\dfrac{\beta}{2}$ & $x=\beta$. (4) {Dec 2013 [GNE]}
31. Differentiate between phase velocity and group velocity. (2) {Jun 2013 [PTU]}
32. Obtain Bohr's condition of quantization of angular momentum using de Broglie's idea of matter waves. (3) {Jun 2013 [PTU]}
33. Develop energy time relation and discuss some relevant application. (5) {Jun 2013 [PTU]}
34. Write the expression of normalized wave function for a particle confined in a potential box. (2) {Jun 2013 [GNE]}

35. Find the probability of finding a particle in a region $0 \cdot 4L$ to $0 \cdot 6L$ trapped in an infinite potential well of width L. (4) {Jun 2013 [GNE]}
36. Derive an expression for energy of a particle of mass m confined to infinite potential well of width L. Why such a particle cannot have zero energy? (4) {Jun 2013 [GNE]}
37. What do you understand by wave-particle duality? (2) {Dec 2012 [GNE]}
38. A particle of mass m is confined to move inside an infinite potential well described by following function:

$$V(x) = \begin{cases} +\infty & \text{for } x < a \\ 0 & \text{for } 0 \le x \le a \\ +\infty & \text{for } x > a \end{cases}$$

Calculate the wave function and energy of the particle. (4) {Dec 2012 [GNE]}
39. What is uncertainty principle? Explain the nonexistence of the electron inside the nucleus using this principle. (4) {Dec 2012 [GNE]}
40. What do you understand by wave packet? (2) {Dec 2012}
41. What is the minimum uncertainty in the energy state of an atom if an electron remains in this state for $10^{-8} s$? (3) {Dec 2012}
42. Develop time independent Schrodinger equation and discuss its significance. (5) {Dec 2012}
43. What are matter waves? (2) {June 2012}
44. Compute the de-Broglie wavelength of a proton of wavelength whose kinetic energy is equal to the rest energy of an electron. Given that mass of proton is 1840 times the mass of electron. (4) {June 2012}
45. What do you mean by normalization of a wave function? (4) {June 2012}
46. Calculate the wave number of 10keV neutron. (3) {Dec 2011}
47. Explain Heisenberg's uncertainty principle. (5) {Dec 2011}
48. What is the significance of wave function? (2) {June 2011}
49. What is the importance of uncertainty principle? (2) {June 2011}
50. Derive an expression for time dependent Schrodinger wave equation. (6) {June 2011}
51. What is the energy of Gamma ray having wavelength of $1 \mathring{A}$? (2) {June 2011}
52. What is de-Broglie's hypothesis? (2) {Dec 2010}
53. What is Compton Effect? (2) {Dec 2010}
54. What is Born's interpretation of wave function? (2) {Dec 2010}
55. What is the difference between phase velocity and group velocity? Show that the de-Broglie group velocity associated with the wave packet is equal to the velocity of the particle. (6) {Dec 2010}
56. Why $n = 0$ state is not allowed for a particle confined to an infinite potential box? (2) {June 2010}
57. What is the physical significance attached to the conditions of continuity and single valued nature of an acceptable wave function? (2) {June 2010}
58. Establish time dependent Schrodinger wave equation and further deduce tie independent equation from it. (4) {June 2010}
59. What are the characteristics of a well behaved wave function? (2) {June 2010}

60. Find the probability of a particle trapped in a box of length L to be found in the region $0 \cdot 45L \; to \; 0 \cdot 55L$ for the ground state. (2) {June 2010}
61. Differentiate between phase velocity and group velocity. (2) {Dec 2009}
62. Define wave function and obtain the expression for time dependent Schrodinger wave equation. (4) {Dec 2009}
63. Define Eigen values and Eigen functions. (2) {June 2009}
64. Define wave function and calculate the expression for Time Independent Schrodinger wave equation. (4) {June 2009}
65. Distinguish between phase and group velocity. (2) {Dec 2007}
66. If the energy of a particle is zero, then prove using quantum mechanics that it cannot exist in a one dimensional box. (4) {Dec 2007}
67. What do you mean by matter waves? (2) {May 2007}
68. What is the de Broglie wavelength of an electron, which has been accelerated from rest through a potential difference of 150V? (3)
69. Explain de Broglie concept of matter waves. (2) {May 2006}
70. What are orthogonal wave functions? (2) {May 2006}
71. Write the Schrodinger equation for particle in a box and solve it to obtain energy Eigen values and Eigen functions. (6) {May 2006}
72. Explain briefly Uncertainty Principle. (2) {May 2006}
73. What voltage must be applied to an electron to produce electrons of wavelength $0 \cdot 5 \overset{\circ}{\text{A}}$? Given that $h = 6 \cdot 62 \times 10^{-34} Js$, $e = 1 \cdot 6 \times 10^{-19} C$ & $m = 9 \cdot 1 \times 10^{-31} kg$. (2) {Dec2005}
74. What is the physical significance of wave function? (2) {Dec2005}
75. Explain briefly Uncertainty principle. (2)
76. What do you understand by Eigenvalues and Eigen functions? (2) {May 2005}
77. What is the need for quantum mechanics? Discuss the Born's interpretation of wave function and normalization of the wave function. (2,2) {May 2005}
78. At a certain time, the normalized wave function of the particle moving along the X-axis is given by: $\Psi(x) = \begin{cases} x + \beta & \text{for } -\beta < x < 0 \\ -x + \beta & \text{for } 0 < x < \beta \\ 0 & \text{elsewhere} \end{cases}$. Find the value of β and the probability that the particle's position is between $x = \frac{\beta}{2}$ & $x = \beta$. (4) {May 2005}
79. What is uncertainty principle? (2) {Dec 2004}
80. Give the Born's interpretation of wave function. (2) {Dec 2004}
81. Can every physical system be described by the time independent Schrodinger equation? Comment. (2) {May 2004}
82. Find the ground state energy of an electron confined to a one dimensional rigid box of length $1 \overset{\circ}{\text{A}}$. (2)
83. What is the utility of normalization of wave function? (2) {Dec2003}
84. The uncertainty principle imposes no restriction on the measurements related to macroscopic objects. Comment. (2) {Dec2003}