



বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.A./B.Sc./B.Com. Part-III (1+1+1) Examination 2020

3rd Year (Honours)

Subject: PHYSICS

Paper: VI

Full Marks: 80 (Theory)

Time: 4 Hours (Theory)

*Candidates are required to give their answer in their own words as far as practicable.
Questions are of equal value.*

Answer **one question** [within 250 words] from the following:

1. State the defining properties of linear operators and Hermitian operators. Show that eigen values of a Hermitian operator are real and eigen functions of a Hermitian operator are orthogonal. Evaluate the commutator brackets: $[\hat{x}, \hat{p}_x]$ and $[\hat{x}, \hat{p}_y]$. Comment on the compatibility of two observables and commutability of their operators.
2. (a) Find out the ground energy of linear harmonic oscillator using uncertainty principle.
(b) The ground state of Harmonic oscillator is $\psi_0(x) = Ae^{-\frac{a^2x^2}{2}}$ Plot it.



3. Evaluate the commutator $[L_x, L_y]$. Give the expressions of L_x and L^2 in spherical polar coordinates. Evaluate $\langle r \rangle$ for the ground state of hydrogen atom and comment on its relation with 1st Bohr orbit.
4. (a) Explain the concept of a nuclear cross-section. State the conservation laws which are obeyed in a nuclear reaction.
(b) Find the parity for the ground state of ${}_{13}\text{Al}^{27}$ nucleus.
5. (a) The following reactions are forbidden, Why?
(i) $\pi^- + p \rightarrow K^+ + K^-$
(ii) $\pi^- \rightarrow \mu^- + e^+ + e^-$
(b) What are the different types of interactions? Name intermediate particles (mediators) for these interactions.
6. Describe in brief the principle of operation of a fixed frequency cyclotron and mention its limitations.
7. Discuss with examples the meaning of the terms "identical and distinguishable" and "identical and indistinguishable" related to classical and quantum statistics respectively.
8. Write down MB, BE and FD distribution functions. Draw the distributions functions w.r.t. energy ($T > 0$).
9. Establish the Richardson-Dushman thermionic emission equation using Fermi-Dirac distribution function.
10. Discuss different types of closed packed structures.
11. Give Einstein's assumptions for obtaining the lattice heat capacity of solids. To what extent is Einstein's treatment successful in explaining the experimental results and where does it fail? What are the striking features of Debye's assumptions in resolving the shortcomings of Einstein's theory?
12. (a) Discuss briefly the electronic structures of materials having dia-, para- and ferromagnetic properties.
(b) Explain briefly the Meissner effect with a suitable diagram.