

Roll No. :

Total No. of Questions : 11]

[Total No. of Printed Pages : 3

BPP-1098

M.Sc. (Previous) Examination, 2022

PHYSICS

Paper - III

(Quantum Mechanics)

Time : 3 Hours]

[Maximum Marks : 75

Section-A

(Marks : 2 × 10 = 20)

Note :- Answer all *ten* questions (Answer limit 50 words). Each question carries 2 marks.

Section-B

(Marks : 5 × 5 = 25)

Note :- Answer all *five* questions. Each question has internal choice (Answer limit 200 words). Each question carries 5 marks.

Section-C

(Marks : 10 × 3 = 30)

Note :- Answer any *three* questions out of five (Answer limit 500 words). Each question carries 10 marks.

Section-A

1. (i) Write any *two* inadequacy of classical mechanics.
- (ii) Calculate the uncertainty in the velocity of an electron if the uncertainty in its position is 1 Å.

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- (iii) Define unitary transformation with help of an example.
- (iv) Define C.G. coefficient.
- (v) Show that the ground state of hydrogen atom does not show Stark effect.
- (vi) Define Sudden approximation.
- (vii) Define WKB approximation.
- (viii) What are the problem to explain probability current density in the K.G. equation ?
- (ix) Write the relation between scattering cross-section and scattering amplitude.
- (x) What do you mean by scattering length ?

Section-B

Unit-I

2. Calculate minimum energy of a proton in one-dimensional box of width 1 Å.
(Given $m_p = 1.6 \times 10^{-27}$ kg and $\hbar = 1.05 \times 10^{-34}$ Js)

Or

Determine the solution of harmonic oscillator by Schrödinger equation.

Unit-II

3. State and prove Wigner-Eckart theorem.

Or

Prove that the generators of unitary transformation for translation and rotation in space are linear momentum and angular momentum respectively.

Unit-III

4. What do you mean by Zeeman effect ? Explain the Zeeman effect in the hydrogen atom.

Or

What do you mean by time dependent perturbation ? Determine transition probability in the Harmonic perturbation.

Unit-IV

5. Derive K.G. equation and discuss their weakness.

Or

Discuss collision of identical particle.

Unit-V

6. Determine the differential scattering cross-section by square well potential.

Or

Establish the condition for validity of the Born approximation.

Section-C

7. Deduce expression of energy of n^{th} energy state of one-dimensional harmonic oscillator by operator method.
8. Determine the solution of Schrödinger equation for hydrogen atom.
9. Define Stark's effect. Show the Stark's effect in the hydrogen atom.
10. Obtain the ground state energy of the helium atom using by variational principle.
11. Explain briefly, the method of partial wave analysis for scattering problem. Discuss their applicability. Obtain expression for total scattering cross-section.