QP CODE: 23800348

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Reg No : .....

Name : .....

INTEGRATED PG DEGREE EXAMINATION, DECEMBER 2023

Third Semester

INTEGRATED MSC BASIC SCIENCE-PHYSICS

CORE - IPH3CR02 - QUANTUM MECHANICS -1

2020 ADMISSION ONWARDS

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Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Give Rayleigh-Jeans explanation of the black-body spectrum.
2. Give basic conclusions that we can draw from the Davisson-Germer experiment.
3. Discuss the inner product of two operators.
4. List out the postulates of quantum mechanics briefly.
5. Is a simultaneous measurement of energy and momentum with arbitrary precision possible in the case of microscopic particles?
6. Is the wave function a measurable quantity?
7. Is the statement True or False? For a stationary state, the probability density is constant.
8. Write the three-dimensional Schrodinger equation for a free particle.
9. What is the condition for energy levels to be continuous for a particle in an infinite square well?
10. The Electron of the hydrogen atom is excited to the second principal quantum number. What should be the energy absorbed in terms of E_1

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Discuss the failure of classical Physics.

12. Show that the De Broglie wavelength of an electron accelerated by a potential difference of V volts is $\lambda = \sqrt{\frac{150}{V}}\ A^o$.

13. Wave functions live in Hilbert's space. Comment.

14. State and prove generalized uncertainty principle.

15. Distinguish between phase velocity and group velocity.

16. Derive the quantum equivalent of the equations of motion of classical particles.

17. Write down the Schrodinger equation in polar coordinates for particle in spherically symmetric potential and separate out the three one-dimensional differential equations.

18. What is a rigid rotator? Show that the spacing between two energy level is increases with l

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Explain the Photoelectric effect. List out the basic experimental results of the photoelectric effect. How did Einstein succeed in explaining the same theoretically?

20. Write a short note on the following
    1. Expectation value of a dynamical quantity
    2. Orthonormality of wavefunctions.
    3. Operator representations of observables
    4. Commutator algebra

21. Deduce continuity equation in quantum mechanics and hence give the details of probability current density. Discuss the notion of stationary states from the continuity equation. Also, prove that total probability density is consatnt.

22. Set up the Hamiltonian of a simple harmonic oscillator and derive the expression of its energy eigenvalues.

(2×5=10 weightage)