

SEAT No. _____

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SARDAR PATEL UNIVERSITY
T. Y. B.Sc. Examination, Semester V

Date & time: December, 24th 2020 ~~Thursday~~ 2:00 p.m. to 4:00 p.m.

Applied Physics, Course Code- US05CAPH21

Course title- Quantum and statistical mechanics

Maximum Marks: 70

Q-1 Write answers to the following multiple-choice questions in your answer book by selecting the proper option. [10]

- (1) In photoelectric effect if intensity of light is doubled then maximum kinetic energy of photoelectron will become.
(A) No change (C) Four time
(B) Double (D) Half
- (2) An iron rod is heated. The colors at different temperatures are noted. Which of the following colors shows that the iron rod is at the lowest temperature?
(A) Red (C) Orange
(B) White (D) Blue
- (3) The wave associated with a moving particle is called-
(A) Longitudinal wave (C) De Broglie wave
(B) Mechanical wave (D) Planck's wave
- (4) For a quantum wave particle, Energy (E) = _____
(A) $\hbar k$ (C) $\hbar k/2$
(B) $\hbar \omega$ (D) $\hbar \omega/2$
- (5) The total probability of finding the particle in space must be _____
(A) Zero (C) infinity
(B) Unity (D) double
- (6) Phase space is a _____
(A) 3-Dimensional Space (C) 5-Dimensional Space
(B) 4-Dimensional Space (D) 6-Dimensional Space
- (7) Maxwell Boltzmann statistics cannot be applied to-
(A) Atoms (C) Photons
(B) Molecules (D) Lattice
- (8) Maxwell-Boltzmann law is for the _____
(A) Distinguishable particles (C) Particles with half integral spin
(B) Indistinguishable Particles (D) Particles with integral spin
- (9) Fermi-Dirac statistics cannot be applied to _____
(A) Electrons (C) Fermions
(B) Photons (D) Protons
- (10) At high temperature the Fermi Dirac statistics approaches to
(A) Maxwell Boltzmann distribution (C) No change
(B) Bose-Einstein distribution (D) None of these

Q-2 Fill in the blanks/ True- False (All questions are compulsory)

- (1) Uncertainty principle is applicable to microscopic particles [True/ False]
- (2) Schrodinger Wave equation can be derived from Principles of Quantum Mechanics. [True/ False]
- (3) In Bose-Einstein statistics, one energy state can be occupied by more than one particle. [True/ False]
- (4) When the bosons are cooled to a low temperature, their behavior changes. [True/ False]
- (5) According to the Rutherford model at the center in an atom is
- (6) The normalized wave Schrodinger function must have Form.
- (7) The Helium shows Bose-Einstein condensation below temperature.
- (8) During the Bose-Einstein condensation all the atoms falls back to the

[08]

P.T.O.

Q-3 Short questions (Attempt any ten out of twelve)

[20]

- (1) Define Black body radiation.
- (2) Define work function.
- (3) What is space quantization?
- (4) State the de Broglie hypothesis
- (5) Define group velocity of the wave packet.
- (6) State the Fermat's principle.
- (7) Define partition function.
- (8) Define phase space.
- (9) Brief the micro canonical ensemble.
- (10) Define symmetric wave function.
- (11) Give the name of the statistics in which particles are distinguishable.
- (12) Brief the Bose Einstein condensate.

Q-4 Long Questions (Attempt any four out of eight)

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- (1) Discuss the motion of a wave packet and derive the expression of group velocity of wave packet.
- (2) What are the Bohr's postulates? Explain the Bohr's model of Hydrogen atom. Which properties explained with the help of Bohr's model.
- (3) Derive the one-dimensional Schrodinger equation for a free particle.
- (4) Discuss the Ehrenfest's theorem in detail.
- (5) Compare the canonical, Grand canonical, micro canonical ensemble.
- (6) Deduce the Maxwell Boltzmann's distribution law.
- (7) What are the Bose postulates to define a system of particles?
- (8) Give the Comparison of the all three statistics.

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