Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name : Quantum Mechanics-II and Statistical Mechanics

Subject Code : 5SC02QMS1 **Branch: M.Sc. (Physics)**

Semester : 2 **Date : 02/05/2018** **Time : 10:30 To 01:30** **Marks : 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the Following questions** **(07)**

a. Why are spherical polar coordinates used in understanding the concept of scattering?
b. What is the dimension (according to its unit) of differential scattering cross section?
c. Give the relation between differential scattering cross section and scattering amplitude.
d. Name any one method used to understand the scattering problem.
e. Why Green's function is called the propagator in the Born series?
f. Why are the scattered particles represented by spherical waves?
g. Name the function involved in converting the Schrodinger equation into its integral form

Q-2 **Attempt all questions** **(14)**

a. Define hard sphere scattering. Derive the formula for the differential scattering cross section of such a scattering process. **(07)**
b. Explain Rutherford scattering and derive the formula for the differential scattering cross section of such a scattering process. **(07)**

OR

Q-2 **Attempt all questions** **(14)**

a. Explain the concept of partial wave analysis by deriving the formula for differential scattering cross section. **(12)**
b. When is the concept of phase shift used? Give the relation between partial wave amplitude and phase shift. **(02)**

Q-3 **Attempt all questions** **(14)**

a. Determine the integral form of wave function and Schrodinger equation using Helmholtz equation. **(04)**

b. Explain the concept of Yukawa potential and determine the formula for scattering cross section. **(08)**

c. Briefly explain the Born series. **(02)**

OR

Q-3 **a.** Starting with the Fourier transform of Green's function $(r) = \frac{1}{(2\pi)^{\frac{3}{2}}} \int e^{is.r}\, g(s) d^3 s$, solve the integrals using Cauchy's integral formula and derive the formula for Green's function for Helmholtz Equation. **(14)**

SECTION – II

Q-4 **Attempt the Following questions :** **(07)**

a. State the Equipartition Theorem.

b. Which type of magnetic materials is best explained using Ising model?

c. State the De Haas Van Alphen Effect.

d. Why Helium gas is preferred to understand the Bose Einstein Condensation?

e. Name the two statistics that follow quantum mechanics.

f. Name the two parameters which lead an ideal Bose gas towards Bose Einstein condensation.

g. Define a Canonical Ensemble.

Q-5 **Attempt all questions** **(14)**

a. Derive the formula for the entropy of a perfect gas in a micro canonical ensemble. **(07)**

b. Derive the formula for Maxwell Boltzmann distribution of velocity for a canonical ensemble. **(07)**

OR

Q-5 **a.** Define a grand canonical ensemble and derive the complete normalized formula for the distribution function of such an ensemble. **(08)**

b. State and prove the Virial theorem. **(06)**

Q-6 **Attempt all questions** **(14)**

a. Explain the Bose-Einstein condensation using an ideal Bose gas. Give the experimental proof of the same. **(12)**

b. State the postulates of the Density matrix. **(02)**

OR

Q-6 **Attempt all Questions**

a. Explain what you understand by an ideal Fermi gas. Highlight the properties exhibited by such gases. **(07)**

b. Explain the concept of Ising model. How is the one dimensional Ising model different from the general form? **(07)**