Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2019

Subject Name : Quantum Mechanics-II and Statistical Mechanics

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

Semester : 2 Date : 25/04/2019 Time : 02:30 To 05:30 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. Which coordinate system is best suitable to understand the phenomena of scattering?
b. What is the significance of Rayleigh's formula?
c. Under what conditions are phase shifts introduced?
d. Name the function that is used to convert the Schrodinger equation into its integral form.
e. Name any one method used to understand the scattering problem.
f. Give the relation between differential scattering cross section and scattering amplitude.
g. Mention the unit of differential scattering cross section.

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

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

OR

Q-2 Attempt all questions

a. Explain in detail the partial wave analysis technique used in understanding the scattering process. **(12)**
b. Define i) Cross section and ii) Flux in a scattering process. **(02)**

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

a. If the Fourier transform of Green's function is $\frac{1}{(2\pi)^{3/2}}\int e^{is.r}\, g(s)d^3s$; **(14)**

Derive the formula for Green's function while solving Cauchy's integrals.

OR

Q-3 **a.** Explain the concept of Yukawa potential and determine the formula for scattering cross section. **(07)**

b. Derive the Integral form of Schrodinger equation. **(04)**

c. Explain what Born series is. **(03)**

SECTION – II

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

a. State the Equipartition theorem.

b. Under which condition does canonical ensemble get reduced to micro canonical?

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

d. Which two parameters (quantities) are altered to attain Bose Einstein Condensation?

e. Why is He^4 gas used in understanding the concept of Bose Einstein condensation?

f. Define a grand canonical ensemble.

g. Why was partial wave analysis introduced to understand scattering?

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 the distribution function (ρ) in a canonical ensemble. **(07)**

OR

Q-5 **a.** Explain Bose-Einstein condensation taking the case of an ideal Bose gas. **(09)**

b. State and prove the Virial's theorem. **(05)**

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

a. Derive the distribution function for velocities based on the Maxwell-Boltzmann distribution. **(10)**

b. What is a density matrix? Write the postulates to be followed by an operator to be a density matrix operator. **(04)**

OR

Q-6 **Attempt all Questions**

a. Explain in detail the properties of an ideal Fermi gas. **(07)**

b. Explain Diamagnetic and Paramagnetic materials taking the help of quantum statistics. **(07)**