SCHOOL OF SCIENCES

UTTARAKHAND OPEN UNIVERSITY, HALDWANI (NAINITAL)

उत्तराखण्ड मुक्त विश्वविद्यालय, हल्द्वानी (नैनीताल)

M.Sc. Physics (MSCPHY12)

First Year Assignment

Last Date of Submission: 15 May 2014

Course Title: Statistical Mechanics and Quantum mechanics — Course Code: PHY-502

Year: 2013-14 — Maximum Marks: 40

Section A

Section A contains 08 short answer type questions of 5 marks each. Students are required to answer 4 questions only. Answers of short answer type questions should be 250 words approximately.

1- Define probability current density and expectation value.
2- What is partition function and with the help of partition function arrive at various thermodynamic quantities.
3- Explain Clebsch- Gordan coefficients.
4- Define Hilbert Space and Dirac's Bra and Ket notations.
5- What are the suitable conditions for the study of scattering problem by the method of partial waves? The total scattering cross section is given by

$$\sigma = \frac{4\pi}{k^2} \sum_{l=0}^{\infty} (2l+1) sin^2\, \delta_l$$

6- Show that there is no first order Stark effect for the ground state of an atom and hence deduce it for first excited state at n=2.
7- Show that J_+ and J_- are ladder operators.
8- Use the WKB method to estimate the energy levels of a one dimensional harmonic oscillator.

Section B

Section B contains 04 long answers type question of 10 marks each and students are required to answers 02 questions only.

1. Explain canonical and grand canonical ensemble and obtain the thermodynamic functions with the help of partition function.
2. Solve the Schrödinger equation for harmonic oscillator and derive the eigen values and eigen function.
3. Define spin angular momentum. Derive Pauli spin matrics and state its properties.
4. Explain Klein Golden Rule. How Klein Golden equation can apply for hydrogen atom.