PHN-006
Quantum Mechanics and Statistical Mechanics

Spring 2022-23

Himanshu Fulara

Assistant Professor

Dept. of physics, IIT Roorkee

March 03, 2023

PHN 006: Quantum Mechanics and Statistical Mechanics

About the Course:

The course in intended to familiarize students with the basic principles of quantum mechanics and statistical mechanics.

Discipline: **CSE**

Batches: O1, O2, O3 and O4

MS Team Name: PHN-006: Quantum Mechanics and Statistical Mechanics

MS Team Code: **ze2t56l**

Lecture Schedule:

Days	Time
MONDAY	15:00 – 15:55
WEDNESDAY	15:00 – 15:55
FRIDAY	15:00 – 15:55

E-mail: himanshu.fulara@ph.iitr.ac.in

PHN 006: Course Contents

Part 1: Quantum Mechanics

(i) Black body radiation: Classical Rayleigh-Jeans law, Wien's law, Planck's Quantum radiation law, Stefan's law, Wien's displacement law, Photoelectric effect, Compton effect, Frank-Hertz experiment, wave particle duality and wave packets, de Broglie waves, phase and group velocities, Davisson-Germer experiment and gamma ray scattering from electrons, uncertainty principle (single slit thought experiment), applications of the uncertainty principle.

(ii) Basic postulates of quantum mechanics and physical meaning of the wave function, Schrödinger wave equation, stationary states, expectation values, probability current density; Applications: Particle in a 1-D box, 1-D step potential, reflection and transmission by a barrier and tunnelling and their applications in electronics, electron in periodic potential, energy band gap, qualitative discussion of Kronig-Penney model, 1-D linear harmonic oscillator.

(iii) H-atom and the related quantum numbers (*n, l, m*), normal and anomalous Zeeman effect, Anomalous Zeeman effect (Na D1 and D2 lines), Stern-Gerlach experiment, Fine structure of H_{α} line.

PHN 006: Course Contents

Part 2: Statistical Mechanics

(i) Postulates of classical statistical mechanics, the three ensembles: micro canonical, canonical and grand canonical; Micro canonical: Definition of entropy from microstates, Derivation of the laws of thermodynamics, concept of temperature from the derivative of entropy.

(i) Statistical distributions: Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions; Applications: equipartition of energy, Bose-Einstein Condensation, Stimulated emission, Einstein's A and B coefficients, Specific heat of solids, free electrons in a metal.

PHN 006: Books

Text Books:

1. A. Beiser, “Concepts of Modern Physics”, Tata McGraw Hill 2009
2. B. H. Bransden and C. J. Joachain, “Quantum Mechanics”, Second Edition, Pearson 2009
3. F. Reif, “Fundamentals of Statistical and Thermal Physics”, Sarat 2010
4. R. K. Pathria, “Statistical Mechanics”, Butterworth Heinemann 2001
5. D. J. Griffiths, “Introduction to Quantum Mechanics”, Pearson Education 2013
6. R. Shankar, “Principles of Quantum Mechanics”, Plenum Press 2011
7. I. S. Tyagi, “Principles of Quantum Mechanics”, Pearson Education 2013

Lecture notes and other relevant materials will be provided to students from time to time.

PHN 006: Course Evaluation

Marks Distribution (Weightage):

End Term Exam (ETE)	35 Marks
Mid Term Exam (MTE)	20 Marks
Practical Sessional (PRS)	25 Marks
Class Work Sessional (CWS)	20 Marks

Tutorials:

CWS will comprise of TWO assignments and ONE project. A separate sheet listing the problems will be provided. Students are expected to solve these problems and submit it before the deadline. The solution of these problems may be provided after the deadline.

Project:

Students will be asked to prepare and submit a write-up on a topic of their own choice (related with the course PHN-006).

Attendance:

As per the institute rule, 100% must be ensured by student. 75% is mandatory.