

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI HYDERABAD CAMPUS**  
**AUGSD**

**First Semester 2020-2021**  
**Course Handout (Part II)**

*Date: 29 Aug 2022*

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

**Course No.** : PHY F312  
**Course Title** : Statistical Mechanics  
**Instructor-in-Charge** : **Rahul Nigam**

**I. Scope and Objective of course :**

Statistical mechanics is a unique pillar of physics. While classical mechanics deals with macroscopic objects and quantum mechanics deals with microscopic objects, statistical Mechanics concerns the physical description of a large collection of objects and their relationship with measurable macroscopic thermodynamic properties. Statistical mechanics helps understand arguably the largest variety of physically occurring phenomena. A few examples are Photon gas, Bose-Einstein Condensation, the origin of White dwarfs and other astrophysical objects, phase-equilibrium of mixtures. In this course, the rudiments of this subject will be taught and their application will be shown through illustrative examples.

**II. Text Books**

Fundamentals of Statistical and Thermal Physics, F Reif, McGraw Hill International Editions.

**Reference Books:**

1. Statistical Mechanics, 3<sup>rd</sup>. Edition, R K Pathria & P D Beale Elsevier
2. Introduction to Statistical Physics Silvio R A Salinas Springer

**III. Course Plan:**

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1-4	Introduction to Statistical Mechanics and useful statistics concepts	Why we need Statistical Mechanics, Random Walk Problem and its application in Physics	Ch.1
5-10	Statistical Description of system of particles	Macroscopic and Microscopic states, Basic postulates, Specification of a classical and quantum ensembles, Phase Space, Liouville's Theorem, Probability Calculations	Ch.2
11-21	Statistical ensemble	Micro-canonical, Canonical and Grand canonical ensembles and applications in different ensembles, Partition function, Connection with simple Thermodynamics	Ch. 3 ,Ch.6

22-30	Applications of statistical mechanics to describe some important physical situations	Calculations of thermodynamic quantities for specific systems, Gibbs paradox, Equipartition Theorem & its applications to various simple systems	Ch. 7
31-37	Formulation of Quantum Statistics	Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics with their applications, Photon statistics, Electrons in Metal	Ch. 9
38-42	Density Matrix	Formulation of density matrix and its appearance in different ensembles	Class notes

#### IV. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & time	Nature of Component
Midsem	1.5 hrs	30	01/11 9.00 - 10.30AM	Open Book
Quiz 1 and Quiz 2	50 mins	15 each		Open Book
Comprehensive exam	3 hours	40	20/12 FN	Close Book

Chamber Consultation Hour: To be announced.

Notices: Notices and solutions of tests & Final Comprehensive Examination will be displayed only on the CMS

Make-up Policy: It is applicable to the following two cases and it is permissible on production of evidential documents:

Debilitating illness and Out of station with prior permission from the Institute.

Academic honesty and integrity policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

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