

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI HYDERABAD CAMPUS**  
**Second Semester 2020-2021**  
**Course Handout (Part II)**

*Date: Jan 16 2021*

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** : **Souri Banerjee**

**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 (a part used bridge) Ch.6

22-32	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
33-42	Formulation of Quantum Statistics	Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics with their applications, Photon statistics, Electrons in Metal	Ch. 9

#### IV. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & time	Nature
Midsem	90 mins	30	03/03 1.30 - 3.00PM	Open Book
Quiz (Total 3 and best 2 to be taken) + Seminar*	-----	30	TBA	Open Book
Comprehensive exam	2 hours	40	08/05 AN	Open Book

*\*Topic: 1) Maxwell's velocity distribution, 2) BE-Condensation, 3) Phonon Gas, 4) White Dwarf, 5) Calculation of chemical potential of gases at the Classical limit 6) Statistical approach to understand Black Body radiation and 7) Density Matrix*

**Chamber Consultation Hour:** To be announced in the respective tutorials and lecture classes.

**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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