BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI HYDERABAD CAMPUS
AUGSD
First Semester 2020–2021
Course Handout (Part II)

Date: 17 Aug 2020

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, 3rd. 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	Reference
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.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
Test 1, 2 and 3	30 minutes each	45	Sep 10 to 20, Oct 9 to 20 & Nov 10 to 20 (to be announced) Each 30 mins	Open Book
Seminar*	-----	20	Each 15 mins (Late Nov)	NA

Comprehensive exam	2 hours	35	120 mins	Open Book

Topic: 1) Use of canonical ensemble as an approximation under constraint relations, 2) Maxwell's velocity distribution, 3) BE-Condensation, 3) Phonon Gas, 4) White Dwarf, 5) Phase transformation and equation of state 6) Calculation of chemical potential of gases at the Classical limit 7) Statistical approach to understand Black Body radiation and 8) Superfluidity

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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