BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
First Semester 2019–2020
Course Handout (Part II)

Date: 01.08.2019

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 **:** **K. V. S. Shiv Chaitanya**

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 both man-made and naturally occurring phenomena. A few examples are semiconductor diodes, why a protein molecule folds, precision detectors, 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:

1. Statistical Mechanics, Second Edition, R. K. Pathria, Butterworth-Heinemann (1996).

Reference Books:

1. Statistical Mechanics, Donald McQuarrie, Harper and Row Publishers, 1976.
2. Fundamentals of Statistical and Thermal Physics, F.Reif, McGraw Hill International Editions, 1985.
3. Statistical Mechanics: Entropy, order and complexity, J.P. Sethna, Clarendon Press, 2016

III. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1-6	Introduction, Historical Perspective , Laws of Thermodynamics and Maxwell Potentials.	Introduction and Review of thermodynamics	Chapter 1
7-10	Thermodynamic connection to Statistics, definition of state in classical and quantum mechanics. Isolated system.	Classical Statistical mechanics- Introduction to ensemble theory- Microcanonical ensemble	Chapter 2
11-17	Legendre Transformation, Equilibrium, Physical significance of various statistical quantities in the canonical ensemble.	Canonical ensemble and applications	Chapter 3

Lecture No.	Learning Objectives	Topics to be covered	Reference
18-25	Physical significance of various statistical quantities in the Grand canonical ensemble. Phase equilibrium and Clausius-Claperon equation	Grand Canonical ensemble and applications	Chapter 4
25-29	Density matrix formalism, Examples of quantum statistics	Formulation of Quantum statistical mechanics	Chapter 5
30-33	Ideal gas in quantum mechanical microcanonical ensemble, and other ensembles. Chemical equilibrium.	Theory of Gasses	Chapter 6
34-37	Distinguishable and in distinguishable particles, Bosons and Fermions, Bose Einstein statistics, BEC	Ideal Bose systems	Chapter 7
38-40	Fermi Dirac Statistics, ideal fermi gas and electrons in metal	Ideal Fermi systems	Chapter 8
40-42	A dynamic model of Phase transition Ising model.	Phase Transitions	Chapter 12

IV. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & time	Nature of Component
Mid-semester test	90 minutes	35	28/9, 11.00 -- 12.30 PM	Closed Book
Assignments	Take	20		Open Book

	Home			
Comprehensive exam	3 hours	45	2/12 AN	Closed Book

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 **Physics** notice board.

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

(i) Debilitating illness.

(ii) 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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