Birla Institute of Technology and Science-Pilani Hyderabad Campus

**AUGSD**

**First Semester 2023–2024**

**Course Handout (Part II)**

*Date: 11th Aug 2023*

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 :**  **SARMISTHA BANIK**

**Instructors :** Sarmistha Banik, Rahul Nigam

1. **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 physics of Compact stars 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.

1. **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, K Huang
3. **Course Plan:**

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| --- | --- | --- | --- |
| 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 3, Ch.6 |

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| 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 |

1. **Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| Component | Duration | Weightage  (%) | Date & time | Nature |
| Quiz1 | 50 min | 15 | TBA | Open Book |
| Mid-Sem | 90 min | 30 | 12/10 - 4.00 - 5.30PM | Close Book |
| Quiz2 | 50 min | 15 | TBA | Open Book |
| Comprehensive exam | 180 min | 40 | 16/12 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 prior to exam. 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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