Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPHC514	STATISTICAL MECHANICS	3	1	0	4

Course Objective
Systems, made up of large number of constituent particles are characteristic by many emergent properties which are understood by the laws of statistical mechanics. The course is meant to introduce these laws to the students.
Learning Outcomes
Students will be conversant with the general notions of Statistical Mechanics viz. ensemble theory. Using this approach they should be able to calculate properties of systems with many particles. They will also have the idea of the statistical basis of phase transitions and critical phenomena.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Phase space, trajectories and density of states, Liouville's theorem	2+1	At the end of this unit student will learn to represent a system of large number of particles with minimum as a point in phase space along with the time evolution of the system.
2.	Ensemble Theory: Microcanonical, Canonical and Grand canonical ensembles, partition function, calculation of statistical quantities, Energy and density fluctuations	9+4	This unit will introduce the concepts of the mathematical technique of ensemble theory to calculate the thermodynamics state of many body system.
3.	Density matrix, statistics of ensembles, statistics of indistinguishable particles	4+1	At the end of this unit students should be able understand the representation of quantum statistical systems.
4.	Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.	7+3	At the end of this unit student should be able to differentiate and explain between the behavior of Bosons and Fermions. They should be able to under the nature of such systems in extreme conditions.
5.	Cluster expansion for a classical gas, Virial equation of state	4+1	At the end of this unit students should be able understand the method to deal with many body interacting systems.
6.	Introduction of ising model: one, two and three dimensions; Exact solutions in one dimension	4+1	This unit will introduce first exactly solvable statistical model. Students should be able to appreciate the usefulness of such models in explaining the statistical mechanical methods.
7.	Landau theory of phase transition, critical indices, dimensional analysis.	5+1	At the end of this unit students should be able to understand the use of phenomenological theory of Landau to explain the phase transitions. The will also learn about universality and critical behavior of materials in certain thermodynamic conditions.
8.	Correlation of space-time dependent fluctuations, Fluctuations and transport phenomena, Brownian motion, Langevin theory, Fluctuation dissipation theorem, The Fokker Planck equation.	7+2	This unit will introduce the concepts of time dependent statistical mechanics. The students should be able to understand the concepts of fluctuations, transport phenomena and their understanding based on statistical approach.
	Total	**42+14**	

Text Books:

1. Statistical Mechanics: R. K. Pathria; Elsevier; 2002.
2. Fundamentals of Statistical and Thermal Physics; Reif; McGraw-Hill; 1965.
3. Thermodynamics and Statistical Mechanics; Greiner; Springer; 2007.

Reference Books:

1. Statistical Mechanics: K. Haung; Wiley Eastern; 2003.
2. Modern Theory of Critical Phenomena: Shang Keng Ma; Levant Books; 2007.
3. Statistical Mechanics: Landau and Lifshitz; Butterworth-Heinemann; 1976.
4. Introduction to Phase Transitions and Critical Phenomena; H. E Stanley; Oxford University Press; 1987.