w.e.f. July, 2021

L	T	P	C
4	1	0	5

PH-9103 Statistical Physics

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Learn fundamental principle of individual particles and their interactions as microscopic and macroscopic phenomenon

CO2: Learn thermodynamic equilibrium conditions for isolated, closed as well as open systems

CO3: Build systematic foundation to handle interacting systems in new problem areas of classical and quantum nature

CO4: Calculate and manipulate partition functions and to derive thermodynamic state functions analytically in some specific cases

CO5: Learn to solve problems with non-interacting fermions, bosons and quasi-particles

CO/PO Mapping	S- strong, M-medium and W-weak indicate the strength of correlation											
COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			-	M				-	-	-	-
CO2	S			-					-	-	-	-
CO3	M			-	S		S		-	-	-	-
CO4	S			-	-	-	-		-	-	-	-
CO5	S		S	-	-	-	-		-	-	-	-

w.e.f. July, 202

PH-9103 Statistical Physics

L	T	P	C
4	1	0	5

UNIT-I

Classical Statistical Mechanics I:
Foundations of statistical mechanics; specification of states in a system, contact between statistics and thermodynamics, the classical ideal state, the entropy of mixing and Gibbs paradox. The phase space of a classical system, Liouville's theorem and its consequences.

(14 Hrs)

Classical Statistical Mechanics II:
Basic idea about independent and dependent distinguishable particle systems, The microcanonical ensemble with examples. The canonical ensemble and its thermodynamics, partition function and properties, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. A system of harmonic oscillators. The statistics of paramagnetism. The grand canononical ensemble, the physical significance of the statistical quantities, examples, fluctuation of energy and density. Cluster expansion of classical gas, the virial equation of state.

(16 Hrs)

UNIT-II

Quantum Statistical Mechanics I:
Quantum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator. Significance of Boltzamann formula in classical and quantum statistical mechanics.

(14Hrs)

Quantum Statistical Mechanics II:
An ideal gas in quantum mechanical microcanonical ensemble. Statistics of occupation numbers, concepts and thermodynamical behaviour of an ideal Bose-Einstein gas. Bose Einstein condensation. Discussion of a gas of photons and phonons. Thermodynamical behavior of an ideal Fermi gas, electron gas in metals, Pauli's theory of paramagnetism, statistical equilibrium of white dwarf stars.

(16 Hrs)

Total: 60 Hrs

Theory: 60 Hrs

BOOKS:

1. Statistical Mechanics: R.K. Pathria: Pergamon Press, 1972.
2. Statistical Mechanics: Kerson Huang, 2nd Ed. Wiley-1987.
3. The Elements of Classical Thermodynamics for Advanced Students of Physics: A.B. Pippard, University Press, 1966.
4. Statistical Mechanics: A set of lectures: Feynman, Richard Phillips: Westview Press, 1998.
5. Statistical Physics of Particles: Kardar Mehran, Cambridge University Press, 2007

c/BoS

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