FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Diploma / Degree/Honors)*		Semester - III	Session: 2024-2025
1	Course Code	PHSE-01	
2	Course Title	Introduction to Statistical Mechanics	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning. Outcomes(CLO)	➢ Differentiate between macrostate and microstate and calculate their numbers ➢ Comprehend the concept of ensembles and its requirement in study of physical phenomenon ➢ Correlate and compare the classical and quantum statistical distribution laws. ➢ Apply concepts of statistical distribution laws for different physical systems.	
6	Credit Value	4 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No.of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwellian Distribution of Speeds In An Ideal Gas**: Distribution of speeds and velocity, experimental verification, distinction between mean, rms and most probable speeds, Doppler broadening of spectral lines, transport phenomena in gases: molecular collision, collision cross section, estimates of molecular diameter and mean free path; transport of mass , momentum and energy and inter-relationship, dependence on temperature and pressure. **Behaviour of Real Gases :**deviation from ideal gas equation, the Virial equation, Andrew's experiment on CO_2 gas; critical constants.	15
II	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. **Concept of Ensemble:** Concept of Gibb's ensemble, postulate of ensemble average, Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation. Phase space, Phase trajectory, Volume element in phase space, Quantization of phase space and number of accessible microstates for free particle in 1D, free particle in 3D.	15

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III	**Transition to quantum statistics:** *h* as a natural constant and its implications, cases of particle in 1D and 1Dimensional harmonic oscillator, **Quantum Statistical Distribution Laws:** In-distinguishability of particles and its consequences, Bose-Einstein & Fermi Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	**15**
IV	**Bose-Einstein Distribution Law and its Applications:** Bose-Einstein Statistics: Heat capacity, Bose Einstein condensation, Radiation as a photon gas, Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law **Fermi-Dirac Distribution Law and its Applications:** Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States, Specific Heat of Metals (Density of Orbitals).	**15**
Keywords	Macrostate & Microstate, ensemble, distribution laws, Bose-Einstein Statistics, Fermi-Dirac Statistics	

Name and Signature of Convener & Members of CBoS:

10/6/24