18BSP601 Statistical Mechanics											
Teaching Scheme					**Examination Scheme**						
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**		**Internal**	**Term Work**	**Practical/ Viva**	**Total Marks**
					MS	**ES**				
4	**0**	**0**	**4**	**4**	**25**	**50**	**25**	**--**	**---**	**100**

Course Objective:

1. To help students to learn basic concepts of Statistical Mechanics.
2. To enable students to construct ensemble of simple systems.
3. To examine formulation of quantum statistics and learn its application.
4. To compare two ideal quantum systems.

UNIT-I: Principles of Statistical Mechanics [16]

Macroscopic states, Microscopic states, Phase spaces, μ-space, Γ-space, Postulate of equal a priori probabilities, Ergodic hypothesis, Density distribution in phase space, Liouville's theorem, Principle of conservation of density in phase and principle of conservation of extension in phase, Condition for statistical equilibrium, Microcanonical ensemble, Canonical ensemble, Mean value and fluctuations, Grand canonical ensemble, Fluctuations in the number of particles of a system in a grand canonical ensemble, Statistical interpretation of basic thermodynamic variables, Ideal gas, Gibbs paradox, The equipartition theorem.

UNIT- II: Formulation of Quantum Statistics and Three Distributions [16]

Density matrix, Liouville's theorem in Quantum Statistical Mechanics, Condition for Statistical equilibrium, Ensemble in Quantum Mechanics, Symmetry of wave functions, the Quantum Distribution functions, the Boltzmann limit of Boson and Fermions Gases, Evaluation of the Partition function, Partition function for Diatomic Molecules (a) translation partition function (b) rotational partition function (c) vibration partition function (d)electronic partition function, Equation of state for an Ideal gas.

UNIT-III: Ideal Bose Systems [14]

Photon Gas, Einstein's derivation of Planck's law, Bose – Einstein Condensation, Specific heat from Lattice Vibration, Debye's Model of Solids: Phonon Gas.

UNIT-IV: Ideal Fermi Systems [14]

Fermi Energy, Mean Energy of Fermions at T=0k, Fermi Gas in Metals, Atomic nucleus as an Ideal Fermion Gas, Fermi Energy as Function of Temperature, Electronic Specific Heat, White Dwarfs.

Total: 60 Hrs

Course Outcome:

On completion of the course, students will be able to

1. Describe the principles of statistical mechanics in very elegant mathematical framework.
2. Apply the foundations to construct the ensembles of simple systems.
3. Employ the quantum distribution function where required.
4. Evaluate different partition function.
5. Compare and relate the ideal quantum systems with the real such systems.
6. Translate the concepts learned for in depth assessment of various topics of Physics.

Reference Books:

1. Fundamentals of Statistical and Thermal Physics by F. Reif, McGraw Hill Book Co.
2. Statistical Mechanics by R. K. Patharia.(Oxford: Butterworth, 1996).
3. Statistical Mechanics: K. Huang (2005) 2nd edition, John Wiley and Sons
4. Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publishers
5. Introduction to Modern Statistical Mechanics: D. Chandler (1979) Oxford University Press
6. Statistical Physics of Particles: Mehran Kardar (2007) Cambridge University Press
7. A Textbook of Statistical Mechanics by Suresh Chandra, CBS Publishers
8. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, Francis W. Sears & Gerhard L. Salinger, Narosa, 1986.
9. Introduction to Statistical Mechanics by S.K. Sinha, Narosa Publication

10. Statistical Mechanics by B.K. Agarwal & Melvin Eisner, Wiley Eastern
11. Statistical Mechanics - An introduction by Evelyn Guha, Narosa publication
12. Statistical and Thermal Physics: an introduction by S.Lokanathan and R.S.Gambhir. (P.H.I., 1991)