BACHELORS WITH PHYSICS AS MAJOR
6th SEMESTER

PHY622J1 PHYSICS _ STATISTICAL PHYSICS

CREDITS: THEORY – 3, PRACTICAL: 1

THEORY (3 CREDITS: 45 HOURS)

COURSE LEARNING OUTCOMES:

The learning outcomes cover a wide range of topics in statistical mechanics, thermodynamics, and the behavior of gases and radiation. Students completing this course should have a strong understanding of these subjects and their applications in physics and thermodynamics.

1. *Explain the concept of equipartition of energy and its implications for systems with different degrees of freedom.*
2. *Calculate the specific heat of monatomic, diatomic, and triatomic gases and understand their behavior at low temperatures.*
3. *Describe Maxwell's velocity distribution and the distribution of speeds in gases.*
4. *Analyze the transport phenomena in gases, including molecular collisions, mean free path, and collision cross-section.*
5. *Explain Brownian motion and its connection to Einstein's theory.*
6. *Describe the properties of thermal radiation and the concept of blackbody radiation.*
7. *Explain the Stefan-Boltzmann Law and Wien's Displacement Law its significance in characterizing blackbody radiation.*
8. *Analyze the spectral distribution of blackbody radiation and the different laws governing it, including Wien's Distribution Law and Rayleigh-Jeans Law.*
9. *Explain the phase space and differentiate between microstates and macrostates.*
10. *Define entropy and its connection to thermodynamic probability.*
11. *Explain the Maxwell-Boltzmann Distribution Law and its applications in statistical mechanics.*
12. *Describe the ensemble concept and its role in statistical mechanics.*
13. *Understand distribution functions, including classical, Bose-Einstein, and Fermi-Dirac distributions, and their significance in describing particle statistics.*

UNIT-I (15 HOURS)

Basic concepts: Degrees of freedom, Equipartition of energy. Specific heat of monatomic diatomic and tri-atomic gases, behaviour at low temperatures, Maxwell's velocity distribution, distribution of speeds; mean values. Transport phenomena in gases: Molecular collisions, mean free path and collision cross section. Transport Phenomenon: transport of momentum, mass and energy and their inter- relationship. Brownian motion, Einstein's theory.

UNIT-II (15 HOURS)

Properties of Thermal Radiation. Blackbody Radiation. Stefan Boltzmann Law and Wien's Displacement law. Stefan Boltzmann Law: Thermodynamic Proof. Radiation Pressure. Spectral Distribution of Black Body Radiation. Wien's Distribution Law. Rayleigh Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation.

UNIT-III (15 HOURS)

System and ensemble, phase space, micro and macrostates, Postulate of classical and quantum statistics, Entropy and Thermodynamic Probability. Maxwell Boltzmann Distribution Law. Ensemble Concept. Law of Equipartition of Energy – Applications to Specific Heat and its Limitations. Distribution functions: Classical, Bose-Einstein and Fermi-Dirac distributions.

PRACTICALS (1 CREDIT: 30 HOURS)

1. Determination of Stefan's Constant.
2. Determination of thermal conductivity be Lees Disc method.
3. Determination of Thermal Conductivity by Searle's method.
4. Study of Probability distributions of dice.
5. Experimental study of Brownian motion using a Microscope.

TEXT BOOKS:

1. Thermal Physics: Thermodynamics and Statistical Mechanics for Scientists and Engineers" by Robert F. Sekerka.
2. Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics by Garg, Bansal and Ghosh, McGraw Hill.
3. An Introduction to Thermal Physics" by Daniel V. Schroeder; Oxford.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
5. B.Sc. Practical Physics by C.L. Arora
6. A Textbook of Advanced Practical Physics by S. Ghosh: New Central Book Agency.