BACHELOR WITH PHYSICS AS MAJOR

4th SEMESTER

PHY422J1: THERMAL PHYSICS **CREDITS: THEORY – 3, PRACTICAL: 1**

THEORY (4 CREDITS: 60 HOURS) **MAXIMUM MARKS: 100, MINIMUM MARKS: 36**

Course Learning Outcomes:

This syllabus aims to equip students with a comprehensive understanding of the principles and applications of thermodynamics, enabling them to analyze and solve complex thermodynamic problems and apply these concepts to various real-world scenarios.

1. Students will be able to differentiate between intensive and extensive thermodynamic variables and apply these concepts to describe the properties of a system.
2. Students will learn how heat can be converted into work and vice versa, gaining an appreciation for the energy balance in thermodynamic processes.
3. Students will explore the practical applications of the First Law of thermodynamics.
4. Students will comprehend the Second Law of Thermodynamics and its implications, including the concept of entropy, and they will distinguish between reversible and irreversible processes.
5. Students will study deviations from ideal gas behavior and become familiar with the van der Waals equation of state.
6. Students will learn about the cooling effect achieved through adiabatic demagnetization, a technique used in cryogenics.

UNIT-I

Intensive and Extensive thermodynamic variable. Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heatinto work.

Applications of First Law: General Relation between Cp & Cv , Work Done during Isothermal and Adiabatic Processes,Compressibility & Expansion Coefficient, Reversible & irreversible processes

Unit-II

Second law & Entropy. Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications: Joule-Thompson Effect, Clausius- Clapeyron Equation: application to phase equilibrium. Expression for (Cp – CV), Cp /Cv , TdS equations.

Unit-III

Real Gases: Deviation from perfect gas behaviour, van der Waals' equation ofstate, nature of Vander Waals forces, comparison with experimental results, the critical constants. Joules expansion of ideal gas and of a Vander Waals gas, Joule coefficient, estimates of J-T cooling. Liquefaction of gases: Boyles temperature and inversion temperature, principle of regenerative cooling and of cascade cooling. Cooling due to adiabatic demagnetization.

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PRACTICALS (1 CREDIT: 30 HOURS) **MAXIMUM MARKS: 50**

MINIMUM MARKS: 18

1. To determine efficiency of an electric kettle by varying voltage.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To determine Mechanical Equivalent of Heat (J) by Callender and Barne's constant flow method.
6. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.

Text Books:

1. Thermal Physics by S. C. Garg, R. M. Bansal and C. K. Ghosh (McGraw Hills)
2. Fundamentals of Statistical and Thermal Physics by F.Reif (Waveland Press, Inc.)
3. Heat and Thermodynamics by M. W. Zemansky and H. Dittman (McGraw Hill)
4. Thermodynamics Kinetic Theory and Statistical Thermodynamics F. W. Sears and G. L. Salinger (Narosa Publishing House)

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