

MINOR COURSE- MN 1D	Thermal Physics	(Theory Credit -03) (Total Marks=60+15)
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Course Objective:

1. To understand the behavior of real gases and the deviations from ideal gas behavior using the Virial Equation and Van der Waals Equation of State.
2. To explore the critical constants, Boyle temperature, and Joule-Thomson effect, and understand their practical significance in thermodynamics.
3. To study the transport phenomena in gases, including the mean free path and its impact on viscosity, thermal conductivity, and diffusion in ideal gases.
4. To provide a detailed understanding of the laws of thermodynamics, including the Zeroth, First, Second, and Third laws, and their applications to thermodynamic processes and entropy changes.
5. To learn about thermodynamic potentials such as internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy, and their applications in various physical processes.
6. To analyze the phase transitions and derive Maxwell's relations, applying them to thermodynamic systems to explain various phenomena like cooling due to adiabatic demagnetization and phase transitions.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Explain the behavior of real gases, the deviations from ideal gas behavior, and apply the Virial Equation and Van der Waals Equation to calculate real gas properties.
2. Understand the concept of critical constants, Boyle temperature, and the Joule-Thomson effect, and explain their significance in thermodynamic processes such as cooling and expansion.
3. Calculate and analyze transport phenomena like viscosity, thermal conductivity, and diffusion in gases, and understand their relationship with the mean free path and gas properties.
4. Apply the laws of thermodynamics to various thermodynamic processes, and understand the concept of entropy, including its changes in reversible and irreversible processes.
5. Understand the principles of thermodynamic potentials and apply them to calculate various properties such as work done, heat, and free energy in different physical processes.
6. Derive and apply Maxwell's relations to solve practical thermodynamic problems, including phase transitions and the relationship between various thermodynamic variables.

Course Contents:

Behavior of Real Gases (15 HRS): Deviations from the Ideal Gas Equation. The Virial Equation. Critical Constants. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. P-V diagrams. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van Der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

Transport Phenomena in Gases (05 HRS): Mean Free Path, Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: Viscosity, Thermal Conductivity and Diffusion.

Laws of thermodynamics (15 HRS): Zeroth Law of thermodynamics, Concept of heat, Work done, Internal energy, First law of thermodynamics, conversion of heat into work, Various thermodynamical Processes, Applications of First Law: General Relation between C_p and C_v , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law, Entropy, Carnot's cycle & theorem, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, unattainability of absolute Zero.

Thermodynamic Potentials & Maxwell's Relations (10 HRS): Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, their definitions, properties and applications, cooling due to adiabatic demagnetization, first and second order Phase Transitions with examples, derivations and applications of Maxwell's Relations, Maxwell's Relations :(1) Clausius Clapeyron equation, (2) Values of C_p-C_v , TdS Equations.

Reference Books:

1. Core Physics for Class 11, S B Mathur & A Kumar, Bharati Bhawan, Patna.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Heat and Thermodynamics, A. B. Gupta and H. P. Roy.
8. Heat and Thermodynamics, P. K. Chakraborty.

MINOR COURSE- MN 1D	Thermal Physics	(Practical Credit-01) (Total Marks=25)
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1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee'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 calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method and to determine Neutral Temperature.
6. Determination of Stefan's constant.
7. Verification of Planks radiation formulae.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.