

## PHYSICS- 14: STATISTICAL MECHANICS

*(Include related problems for each topic)*

**Classical Statistics:** Macrostate and Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy(with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.

(14 Lectures)

**Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Spectral distribution of Black-body radiation, Kirchhoff's Law and applications, Radiation Pressure, Stefan-Boltzmann Law – Thermodynamical proof, Planck's Quantum Postulates, Planck's Law of Blackbody Radiation, deduction of Wien's Distribution Law, Rayleigh-Jeans Law, Stefan-Boltzmann Law and Wien's displacement Law from Planck's Law, Saha's Ionization formula and applications.

(8 Lectures)

**Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Thermodynamic functions of photon gas, Bose derivation of Planck's law.

(12 Lectures)

**Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.

(14 Lectures)

### **Reference Books:**

- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2<sup>nd</sup> Ed., 1996, Oxford Univ. Press.
  - Statistical Physics, Berkeley Physics Course, F Reif, 2008, Tata McGraw-Hill
  - Statistical Mechanics, K. Huang, Second Edition, 1987, Wiley.
  - Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
  - Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
  - Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
  - An Introduction to Statistical Mechanics & Thermodynamics, R.H.Swendsen, 2012, Oxford Univ. Press
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## PHYSICS PRACTICAL-VI

*(Students have to perform at least 4 experiments from the section VIC. Additional experiments may be included with the approval of the committee of courses)*

### PHYSICS LAB.-VIC

1. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
2. To determine the refractive Index of (1) Glass and (2) a Liquid by total internal reflection using a Gaussian eyepiece.
3. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
4. To verify the Stefan's law of radiation and to determine the value of Stefan's constant.
5. To determine the value of Boltzmann constant using forward characteristics of a PN diode.
6. To study the PE Hysteresis loop of a Ferroelectric Crystal.
7. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.

#### Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
  - Practical Physics, C.L Arora, 2001, S. Chand and Co.
  - A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal, New Delhi
  - Elements of Solid State Physics, J.P. Srivastava, 2<sup>nd</sup> Ed., 2006, Prentice-Hall of India
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