

KATHMANDU UNIVERSITY

SCHOOL OF SCIENCE

Department of Natural Sciences (Physics)

Course Title: Thermodynamics and Statistical Physics

Course Code: PHYS 212

Level : B.Sc. (Applied Physics)

Cr. Hrs : 3

Year : II

Semester : II

- 1 Thermodynamic laws and application:** First law, Second law, Carnot's theorem and Carnot's engine, efficiency of ideal and practical heat engines, Entropy and entropy changes, Entropy and Second law (all without derivation), Third law of thermodynamics, Calculation of entropy [3 hrs]
- 2 Thermodynamic relations:** Claucius Clapeyron equation, Latent heat equations, Triple point, Thermodynamic potentials, Helmholtz's function, Enthalpy, Gibb's function, Maxwell's thermodynamic relation, Deduction from Maxwell's thermodynamic relation, Phase transition. [6 hrs]
- 3 Concept of ideal and real gases:** Introduction, Joule's expansion, Joule's law of perfect gas, Vander Waal's equation, Joule's coefficient for Vander Waal's gas, Critical constants for Vander Waal's gas, Joule-Thomson expansion, Porous plug experiment, Constancy of enthalpy, adiabatic expansion, Comparison of Joule's expansion, Joule-Thomson expansion and adiabatic expansion. [7 hrs]
- 4 Production of Low temperature:** Thermodynamics of refrigeration, refrigeration cycle, efficiency, cooling in Joule-Thomson expansion, regenerative cooling, Boyle's temperature, temperature of inversion, critical temperature and their relation. [4 hrs]
- 5 Transport phenomenon:** Mean free path, transport phenomenon: transport of momentum, energy and mass, Brownian motion. [3 hrs]
- 6 Classical statistical physics:** Phase Space, micro state and macro state, ensemble and its types, constraints and accessible state, thermodynamic probability, postulates of statistical mechanics, division of phase space into cells, entropy and probability, Boltzmann canonical distribution law, Maxwell distribution law of velocities, law of equipartition of energy, Partition function and its correlation with thermodynamical quantities. [12 hrs]
- 7 Quantum statistical physics:** Introduction, Bose-Einstein Statistics, Fermi-Dirac Statistics, Electron gas in metals, Fermi level and Fermi energy, Maxwell- Boltzmann Statistics, Comparison of BE, FD and MB distributions. [6 hrs]
- 8 Quantum theory of specific heat:** Specific heat of solids, Dulong and Petit's law and its drawbacks, Einstein's theory of specific heat and its drawbacks, Debye's theory of specific heat, Criticism of Debye theory. [5 hrs]

Text books:

- 1 Single S.S., Agrawal J. P. and Prakash S. *Heat, Thermodynamics and Statistical Physics*. Pragati Prakashan.
- 2 Gupta S. L. and Kumar V. *Statistical Mechanics*. Pragati Prakashan.
- 3 Srivastava R. K and Ashok J. *Statistical Mechanics*. PHI Learning Pvt. Ltd.
- 4 Zemansky. *Heat and thermodynamics*. Tata Mcgraw-hill co.

References:

- 1 Lokanathan S. and Gambhir R. S. *Statistical and Thermal Physics*. PHI Learning Pvt. Ltd.
- 2 Khandewal D. P. and Pande A. K. *Thermodynamics and Statistical Physics*. Himalayan Publishing House.
- 3 Panat P. V. *Thermodynamics and Statistical Mechanics*. Narosa Publishing House.
- 4 Cengel. *Thermodynamics (SIE)*. Tata Mcgraw-hill co.