

ANDHRA UNIVERSITY  
DEPARTMENT OF PHYSICS  
M.Sc. MATERIALS SCIENCE  
(EFFECTIVE FROM 2003-2004 ADMITTED BATCH)

II SEMESTER SSPS-211/216

MIS 202: STATISTICAL MECHANICS  
(Common Paper for M.Sc. MATERIALS SCIENCE-M.Sc. PHYSICS,  
M.Sc. SPACE PHYSICS, & M.Sc. (Tech.) ELECTRONICS)

1. Basic Methods and Results of Statistical Mechanics:

Specification of the state of a system, phase space and quantum states, Liouville's theorem, Basic postulates, Probability calculations, concept of ensembles, thermal interaction, Mechanical interaction, quasi static process, distribution of energy between systems in equilibrium, statistical calculations of thermodynamic quantities, Isolated systems (Microcanonical ensemble), Entropy of a perfect gas in microcanonical ensemble, Canonical ensemble - system in contact with heat reservoir, system with specified mean energy, connection with thermodynamics, Energy fluctuations in the canonical ensemble, Grand canonical ensemble, Thermodynamic function for the grand canonical ensemble, Density and energy fluctuations in the grand canonical ensemble, Thermodynamic equivalence of ensembles, Reif Ch:2, 3.3, 3.12 Ch:6

2. Simple Applications of Statistical Mechanics:

Partition functions and their properties, Calculation of thermodynamic quantities to an ideal mono atomic gas, Gibbs paradox, validity of the classical approximation, Proof of the equipartition theorem, Simple applications - mean K.E. of a molecule in a gas, Brownian motion, Harmonic Oscillator, Specific heats of solids (Einstein and Debye model of solids), Paramagnetism, Partition function for polyatomic molecules, Electronic energy, vibrational energy and rotational energy of a diatomic molecule, Effect of Nuclear spin-ortho and para Hydrogen, Reif Ch:7, Ch:9.12

3. Quantum Statistics:

Formulation of the statistical problem, Maxwell-Boltzmann statistics, Photon statistics, Bose-Einstein statistics, Fermi-Dirac statistics, Quantum statistics in the classical limit, calculation of dispersion for MB, BE & FD statistics, Equation of state of an Ideal Bose Gas, Black-body radiation, Bose-Einstein condensation, Equation of state for a weakly degenerate and strongly degenerate ideal Fermi gas, Thermionic emission, The theory of white dwarf stars, Reif Ch:9

4. Non Ideal Classical Gas:

Calculation of the partition function for low densities, Equation of state and virial coefficients (Van Der Waals equation) Reif Ch:10.3, 10.4

5. Phase Transitions and Critical Phenomena:

Phase transitions, conditions for Phase equilibrium, First order Phase transition - the Clausius-Clayperon equation, Second order phase transition, The critical indices, Vander-Waals theory of liquid gas transition, Curie-Weiss theory of magnetic transitions, Order parameter Landau theory, Correlation of fluctuation and correlation length, Scaling hypothesis, Sinha Ch:10

Text Books

1. Fundamentals of Statistical and Thermal Physics by F. Reif
2. Statistical Mechanics, Theory and Applications by S.K. Sinha
3. Statistical Mechanics by R.K. Pathria

PLEASE SET TWO DIFFERENT  
QUESTION PAPERS.  
\*KNILLY MUST REFER TO THE  
SYLLABUS STRICTLY.