PHY 210/SE321 : THERMAL PHYSICS

Time Table: Lec on MTTh 8:00, Tut on W at 8:00 in L5
Course Web page: http://home.iitk.ac.in/~anjankg/teaching/Phy210-2010.html
Contents:

1. Principles of Thermodynamics and illustration with applications to simple fluids (12)
2. Applications of Thermodynamics (15)
3. Elementary kinetic theory of gases (06)
4. Entropy multiplicity and disorder (04)
5. Thermodynamics of irreversible processes (03)

Detailed description

1. *Principles of Thermodynamics* (12 Lec)
   Concept of thermodynamic state, extensive and intensive variables; Heat and work, internal energy function and the first law of thermodynamics; fundamental relation and equations of state; concepts of entropy and temperature as conjugate pair of variables; second law of thermodynamics entropy maximum and energy minimum principles; thermodynamic potentials enthalpy Helmhotz potential Gibbs potential; conditions of equilibrium concepts of stable metastable and unstable equilibrium; components and phases Gibbs-Duhem relations; First order phase transitions and Clausium-Clapeyron equation; concepts associated with critical and multi-critical phenomena.
2. *Applications of Thermodynamics* (15 Lec)

   Some chosen applications from among following:
   (i) Surfaces and interfaces- Laplace pressure; Young-Dupre equation and wetting
   (ii) Chemical reactions, mixture and solutions; non-ionic solutions osmotic pressure; alloys and order-disorder transitions; mixtures of chemically reactive species; ionic solutions.
   (iii) Magnetic materials-magneto-caloric, electro-strictive and magneto-elastic phenomena.
   (iv) Dielectric materials- electro-caloric electro-strictive and piezo-electric phenomena.
   (v) Superconducting materials- thermodynamics of normal-to-superconducting phase transition.
   (vi) Heat engines- Carnot engine.
   (vii) Black body radiation- Stefan- Boltzmann law, radiation pressure.
3. *Elementary kinetic theory of gases* (6 Lec)

   equilibrium properties- pressure and equation of state; transport processes- momentum transport and viscosity, energy transport and thermal conductivity, charge transport and electrical conductivity (without introducing ensembles).
4. *Entropy multiplicity and disorder* (4 Lec.)

   Entropy measures multiplicity rather than disorder, illustration with simple examples; Maxwell's Demon; qualitative justifications of laws of thermodynamics. (without introducing ensembles).
5. *Thermodynamics of irreversible processes* (3 Lec.)

   Entropy production; Onsager-Casimir reciprocity relations

References:

1. H.B. Callen, Thermodynamics and an Introduction to Thermostatistics (John Wiley 1985)
2. E.A. Guggenheim, Thermodynamics (North-Holland 1988)
3. R. Bairlein, Thermal Physics (Cambrdge University Press, 1999)
4. M. W. Zeemansky, Heat and Thermodynamics

Grading: (out of 220)
MS-I (40), MS-II (40), HW (20), End-Sem (120: 27+27+66)