THERMAL PHYSICS

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IIT Kharagpur

TYPE OF COURSE : New | Core | UG
COURSE DURATION : 12 Weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : April 24, 2022

PRE-REQUISITES : None

INTENDED AUDIENCE : BSc students (across CBCS platform)

INDUSTRIES APPLICABLE TO : Nil

COURSE OUTLINE :

Thermal physics is a course that is designed to fulfil the requirements of 1 st and 2nd year BSc students studying physics. Starting from basic understanding, this course will take the students through all fundamental aspects of thermodynamics in a simple way. The first part of the course deals with the Kinetic theory of gases, that bridges the connection between macroscopic and microscopic orld. In here, we have also included transport phenomenon involved in ideal gases, the theory of specific heat and behavior of real gases. In second half of the course, effort is made to understand the fundamental laws of thermodynamics and applications to various thermodynamical systems and processes.Additionally, a discussion on black body as a thermodynamic system has been included.

ABOUT INSTRUCTOR :

Prof. Debamalya Banerjee has joined department of physics, Indian Institute of Technology, Kharagpur in December 2013. Over last 7 years he has taught several core courses to undergraduate physics students including 1st year physics, Physics 2, classical mechanics, computational physics and thermal physics. His present research interest includes experimental studies of charge transport processes in different organic and inorganic semiconductors and electron paramagnetic resonance.

COURSE PLAN :

Week 1: Kinetic theory of gasses:

Week 2: Mean free path, collision probability, Fundamentals of transport phenomena

Week 3: Viscosity, diffusion, effusion, thermal conductivity in gasses.

Week 4: Brownian motion and its significance, Einstein's theory of molecular diffusion, Perrin's experiment, random walk (concept only)

Week 5: Principle of equipartition of energy, degrees of freedom, Specific heat of monoatomic, diatomic and polyatomic gasses, Specific heat of solids, Dulong-petit law, Einstein and Debye theory of specific heat of solids

Week 6: Real gasses, deviation from ideal gas equation, The Van-der Walls equation of state, the virial coefficients, other equation of state (elementary discussion)

Week 7: Zeroth and 1 st law of thermodynamics, quasi static processes, work and internal energy, isothermal and adiabatic processes, elastic coefficients of matter

Week 8: 2 nd law of thermodynamics, Entropy, Clausius' theorem, Carnot's theorem and Carnot's cycle, Otto and diesel cycles

Week 9: Enthalpy, Helmholtz and Gibbs free energies, Maxwell's thermodynamics relations, the TdS equations, thermodynamic equilibrium and free energies.

Week 10: Equilibrium between phases, 1 st and 2nd latent heat equations, 1 st and 2nd order phase transitions. Phase diagram and Triple point,

Week 11: Thermodynamics at triple point, Ehrenfest equations, Thermodynamic potentials across phase transition, Gibbs phase rule and simple applications

Week 12: Blackbody as a thermodynamic system, 3 rd law of thermodynamics, entropy at absolute zero temperature