
Semester III

Course Code: PHYSICS-GE-3

Course Title: THERMAL PHYSICS AND STATISTICAL MECHANICS

Nature of the Course: GENERIC ELECTIVE

Total Credits assigned: 06

Distribution of credits: Theory – 04, Practicals-02

Course objectives: At the completion of this course, a student will be able to

1. Develop the working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics.
2. Provide insight to the postulates of Statistical Mechanics and statistical interpretation of thermodynamics
3. Understand the laws of radiation and acquire knowledge for their applications in various disciplines in Physics, Chemistry, Biology, Earth and Atmospheric Sciences.
4. Develop application oriented knowledge on laws of statistical mechanics in selected problems
5. Use the methodologies, conventions and tools of thermal and statistical physics to test and communicate ideas and explanation

PHYSICS-GE-3: THERMAL PHYSICS AND STATISTICAL MECHANICS (THEORY) **(60 Lectures, 60 Marks)**

Laws of Thermodynamics:

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

(22 Lectures, 22 Marks)

Thermodynamic Potentials:

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for $(CP - CV)$, CP/CV , TdS equations.

(10 Lectures, 10 Marks)

Kinetic Theory of Gases:

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-

atomic and diatomic gases.

(10 Lectures, 10 Marks)

Theory of Radiation:

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **(6 Lectures, 6 Marks)**

Statistical Mechanics:

Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics. **(12 Lectures, 12 Marks)**

Recommended readings:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
 - A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
 - Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
 - Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
 - Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L. Salinger. 1988, Narosa
 - University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
 - Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
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PHYSICS-GE-3:THERMAL PHYSICS AND STATISTICAL MECHANICS (LAB)

60 Lectures, 20 Marks

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Recommended readings:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
 - A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
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Mode of Assessment/ Assessment Tools (%)

Internal:	20	
Assignment /Presentation/ attendance/ Class room interaction/quiz etc.:		10
Written Test for theory and/or Viva Voce for Laboratory:		10
Final (End Semester):	80	
Written Test for theory and/or Laboratory experiments:		80
(Equal weightage to be assigned to each credit)		

Expected learner Outcomes: This course will enable the students to

1. Apply laws of thermodynamics and statistical mechanics to a range of situations in real world problems.
 2. Conduct scientific problems and experiments on thermodynamics and allied disciplines .
 3. Demonstrate a working knowledge of the physical principles describing the thermal physics..
 4. Explain thermal physics as logical consequences of the postulates of statistical mechanics
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Semester IV

Course Code: PHYSICS-GE-4

Course Title: WAVES AND OPTICS

Nature of the Course: GENERIC ELECTIVE

Total Credits assigned: 06

Distribution of credits: Theory – 04, Practicals-02

Course objectives: At the completion of this course, a student will be able to

1. Learn the basic ideas of the behaviour of light based on its wave nature.