Course Code	Course Name	Credits
26PH002	THERMAL PHYSICS	04

Course Objectives

- To acquire a working knowledge of the zeroth, first and the second law of thermodynamics.
- To apply the laws of thermodynamics and their application to understanding thermodynamic behaviour.
- To link thermodynamics to the micro description used in Classical Statistical Mechanics.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Master zeroth to second laws, entropy calculations, heat engines, and Maxwell relations for thermodynamic system analysis.
- Apply Joule-Thomson effects, liquefaction techniques, and refrigeration principles to low-temperature engineering problems.
- Evaluate heat transmission via conductivity methods, blackbody laws, and solar radiation measurements.
- Analyze specific heats of solids/gases using Einstein-Debye models and quantum contributions for diatomic molecules.
- Compare Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics for electron/photon gases in equilibrium.

Unit 1 - Thermodynamics (12 Hrs.)

Zeroth law of thermodynamics – First law of thermodynamics – Heat engines – Reversible and irreversible process of Carnot's theorem – Second law of thermodynamics- Thermodynamic scale of temperature – Entropy – Change of entropy in reversible and irreversible processes – Temperature – entropy diagram (T.S) – Law of increase of entropy – Maxwell thermodynamical relations – Clausius's Claypeyron's latent heat equations.

Unit 2 – Low Temperature (12 Hrs.)

Joule - Thomson's effect – Porous plug experiment – Liquefaction of gases – Linde's method – Adiabatic demagnetization – Liquefaction of He – Practical applications of low temperature – Refrigerating mechanism – Air conditioning machines.

Unit 3 - Transmission of Heat (12 Hrs.)

Coefficient of thermal conductivity - Forbes method - Lee's method for bad conductors and liquids - Wiedemann – Franz law- convection and its applications - Black body - Stefan Boltzmann law - Wien's displacement law - Rayleigh - Jeans law - derivation and experimental verification of Stefan's law - Newton's law of cooling from Stefen's law - solar constant - temperature of the Sun - Angstrom's Pyrheliometer.

Unit 4 – Specific Heat (12 Hrs.)

Specific heat of solids – Einstein's theory of specific heat – Debye's theory –Specific heat of gases – Mayer's Relation – Quantization of various contributions to energy of diatomic molecules – Specific heat of diatomic gases – (Quantum Theory).

Unit 5 - Statistical Thermodynamics (12 Hrs.)

Statistical equilibrium - probability theorems in statistical thermodynamics - Maxwell Boltzmann distribution law - Maxwell - Boltzmann distribution in terms of temperature - Fermi-Dirac distribution law - application to electron gas - Bose-Einstein distribution law - application to photon gas comparison of the three statistics.

Reference Books:

1. Lal, B., Subrahmanyam, N., &Hemne, P. S (2018). Heat, Thermodynamics and Statistical Physics, (Revised Ed). S. Chand & Co.
2. S. Loknathan : Thermodynamics, Heat and Statistical Physics
3. Sharma and K.K. Sarkar : Thermodynamics, and Statistical Physics
4. Brijlal and Subrahmanyam : Heat and Thermodynamics
5. Garg, Bansal and Ghose : Thermal Physics, McGraw Hill, 2012.
6. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc26_ph20/preview
2. https://youtu.be/X3cuxQEc2gs?si=HVP8RGQT4jWI29E6
3. https://youtu.be/1IPT7fLvka0?si=wexF0tC2eqwEcSiF

COs and Bloom's Taxonomy Mapping – 26PH002		
Course Outcomes	**On completing U.G. program the students will be able to**	**BTL**
CO1	Recall and explain the laws of thermodynamics and fundamental thermal concepts.	K1, K2
CO2	Apply thermodynamic principles to analyze heat engines, entropy changes, and equilibrium conditions.	K3
CO3	Analyze heat transfer, radiation, and low-temperature phenomena in physical systems.	K4
CO4	Evaluate thermodynamic systems using statistical distributions and compare different statistical models.	K5
CO5	Develop solutions for real-world thermodynamic problems and interpret their physical significance.	K6

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

Relationship Matrix – 26PH002													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	3	1	1	1	1	1.58
CO2	3	2	3	1	1	1	2	2	3	2	1	1	1.83
CO3	3	3	2	1	1	1	2	2	3	2	2	1	1.92
CO4	2	2	2	2	1	1	2	1	2	3	3	1	1.83
CO5	3	2	3	1	1	2	2	2	3	2	2	3	2.17
												Total	1.87

Mean Score: 3- High, 2- Medium/Moderate, 1-Low