

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN PHYSICS (WITH MATHS)**

**III - SEMESTER**

**(Under CBCS W.E.F. 2021-22)**

**Course-III: HEAT AND THERMODYNAMICS**

**(For Mathematics Combinations)**

**Work load: 60hrs per semester**

**4 hrs/week**

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**Course outcomes:**

*On successful completion of this course, the student will be able to:*

- *Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases*
- *Gain knowledge on the basic concepts of thermodynamics, the first and the second law of thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations.*
- *Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency*
- *Develop critical understanding of concept of Thermodynamic potentials, the formulation of Maxwell's equations and its applications.*
- *Differentiate between principles and methods to produce low temperature and liquefy air and also understand the practical applications of substances at low temperatures.*
- *Examine the nature of black body radiations and the basic theories.*

**UNIT-I: Kinetic Theory of gases:**

**(12 hrs)**

Kinetic Theory of gases-Introduction, Maxwell's law of distribution of molecular velocities (qualitative treatment only) and its experimental verification, Mean free path, Degrees of freedom, Principle of equipartition of energy (Qualitative ideas only), Transport phenomenon in ideal gases: viscosity, Thermal conductivity and diffusion of gases.

**UNIT-II: Thermodynamics:****(12hrs)**

Introduction- Isothermal and Adiabatic processes, Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem. Second law of thermodynamics: Kelvin's and Clausius statements, Principle of refrigeration, Entropy, Physical significance, Change in entropy in reversible and irreversible processes; Entropy and disorder-Entropy of Universe; Temperature-Entropy (T-S) diagram and its uses; change of entropy when ice changes into steam.

**UNIT-III: Thermodynamic Potentials and Maxwell's equations:****(12hrs)**

Thermodynamic potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Applications to (i) Clausius - Clayperon's equation (ii) Value of  $C_P - C_V$  (iii) Value of  $C_P/C_V$  (iv) Joule-Kelvin coefficient for ideal and Van der Waals' gases

**UNIT-IV: Low temperature Physics:****(12hrs)**

Methods for producing very low temperatures, Joule Kelvin effect, Porous plug experiment, Joule expansion, Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Liquefaction of air by Linde's method, Production of low temperatures by adiabatic demagnetization (qualitative), Practical applications of substances at low temperatures.

**UNIT-V: Quantum theory of radiation:****(12 hrs)**

Blackbody and its spectral energy distribution of black body radiation, Kirchoff's law, Wein's displacement law, Stefan-Boltzmann's law and Rayleigh-Jean's law (No derivations), Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh- Jean's law from Planck's law, Solar constant and its determination using Angstrom pyroheliometer, Estimation of surface temperature of Sun.

## REFERENCE BOOKS:

- ❖ B.Sc. Physics, Vol.2, Telugu Academy, Hyderabad
- ❖ Thermodynamics, R.C.Srivastava, S.K.Saha&AbhayK.Jain, Eastern Economy Edition.
- ❖ Unified Physics Vol.2, Optics & Thermodynamics, Jai PrakashNath & Co .Ltd., Meerut
- ❖ Fundamentals of Physics. Holiday/Rudnick/Walker. Wiley India Edition 2007
- ❖ Heat and Thermodynamics -N Barilla, P Subrahmanyam, S.Chand& Co.,2012
- ❖ Heat and Thermodynamics- MS Yadav, An mol Publications Pvt. Ltd, 2000
- ❖ University Physics, HD Young, MW Zemansky, FW Sears, Nervosa Publishers, New Delhi



BOS Chairman

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**B.Sc. DEGREE COURSE IN PHYSICS (WITH MATHS)**  
**III- SEMESTER**

(Under CBCS W.E.F. 2021-22)

**Practical Course-III: Heat and Thermodynamics**

**Work load: 30 hrs**

**2**

**hrs/week**

*On successful completion of this practical course, the student will be able to;*

- *Perform some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, variation of thermo-emf of a thermocouple with temperature difference at its two junctions, calibration of a thermocouple and Specific heat of a liquid.*

**Minimum of 6 experiments to be done and recorded**

1. Specific heat of a liquid –Joule's calorimeter –Barton's radiation correction
2. Thermal conductivity of bad conductor-Lee's method
3. Thermal conductivity of rubber.
4. Measurement of Stefan's constant.
5. Specific heat of a liquid by applying Newton's law of cooling correction.
6. Heating efficiency of electrical kettle with varying voltages.
7. Thermoemf- thermo couple - Potentiometer
8. Thermal behavior of an electric bulb (filament/torch light bulb)
9. Measurement of Stefan's constant- emissive method
10. Study of variation of resistance with temperature - Thermistor.

**RECOMMENDED CO-CURRICULAR ACTIVITIES:**

MEASURABLE

- ❖ Assignments (in writing and doing forms on

the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)

- ❖ Student seminars (on topics of the syllabus and related aspects (individual activity))

- ❖ Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams))
- ❖ Field studies (individual observations and recordings as per syllabus content and related areas (Individual or team activity))
- ❖ Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity))

#### GENERAL

- ❖ Group Discussion
- ❖ Visit to Research Stations/laboratories and related industries
- ❖ Others

#### **RECOMMENDED ASSESSMENT METHODS**

Some of the following suggested assessment methodologies could be adopted;

- ❖ The oral and written examinations (Scheduled and surprise tests),
- ❖ Problem-solving exercises,
- ❖ Efficient delivery using seminar presentations,
- ❖ Viva voce interviews.

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BOS Chairman