Paper IV: Thermodynamics &Radiation Physics
(For Maths Combinations)
IV SEMESTER
Work load: 60 hrs per semester   **4 hrs/week**

UNIT-I (10 hrs)
1. **Kinetic theory of gases**

Introduction –Deduction of Maxwell's law of distribution of molecular speeds, experimental verification. Transport phenomena – Mean free path - Viscosity of gases-thermal conductivity-diffusion of gases.

UNIT-II(12 hrs)
2. Thermodynamics

Introduction- Isothermal and adiabatic process- Reversible and irreversible processes-Carnnot's engine and its efficiency-Carnot's theorem-Second law of thermodynamics. Kelvin's and Claussius statements-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 of a perfect gas- change of entropy when ice changes into steam.

UNIT-III(12 hrs)
3. Thermodynamic potentials and Maxwell's equations

Thermodynamic potentials-Derivation of Maxwell's thermodynamic relations-Clausius-Clayperon's equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas.Joule Kelvin effect-expression for Joule Kelvin coefficient for perfect and vander Waal's gas.

UNIT-IV(12 hrs)
4. Low temperature Physics

Introduction-Joule Kelvin effect-Porous plug experiment - Joule expansion-Distinction between adiabatic and Joule Thomson expansion-Expression for Joule Thomson cooling-Liquefaction of helium, Kapitza's method-Adiabatic demagnetization, Production of low temperatures -applications of substances at lowtemperature-effects of chloro and fluoro carbons on ozone layer.

UNIT-V(14 hrs)
5. Quantum theory of radiation

Blackbody-Ferry's black body-distribution of energy in the spectrum of black body-Wein's displacement law,Wein's law, Rayleigh-Jean's law-Quantum theory of radiation-Planck's law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination – Angstrompyrheliometer-determination of solar constant, Temperature of Sun.

REFERENCE BOOKS:
1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Thermodynamics, R.C.Srivastava, S.K.Saha& Abhay K.Jain, Eastern Economy Edition.

3. Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath&Co.Ltd., Meerut
4. Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
5. Heat, Thermodynamics and Statistical Physics-N Brij Lal, P Subrahmanyam, PS Hemne,S.Chand& Co.,2012
6. Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
7. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

Practical Paper IV: Thermodynamics & Radiation Physics

Work load: 30 hrs   **2 hrs/week**
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.

<u>Scheme of Valuation</u>

<u>Practicals</u>   **50 marks**

Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give abrief seminar presentation.
Group discussion	- A topic from one of the units is given to a group of students and asked todiscuss and debate on it.
Assignment	- Few problems may be given to the students from the different units andasked them to solve.

Field trip   - Visit to Satish Dhawan Space Centre, Sriharikota /
Thermal andhydroelectric power stations / Science Centres, any other such visit
etc.
Study project   - Web based study of different satellites and applications.

Domain skills:
Logical derivation, experimentation, problem solving, data collection and analysis,
measurementskills

QUESTION BANK

Unit – 1

Essay Questions(10M)

1. Derive an expression for Maxwell's Law of Distribution of Molecular speed s in a
gas.

2. On the basis of Kinetic theory of gases derive an expression for viscosity of a gas and
discuss the conclusion

3. On the basis of Kinetic theory of gases derive an expression for thermal conductivity
of a gas and discuss the conclusion.

Short Answers (5M)

4. Deduce an expression for diffusion coefficient of gas on the basis of kinetic theory of
gases

5. Obtain expression for 1.average speed 2.most probable speed and RMS speed of
molecules in a gas from Maxwell speed distribution formula.

6. Explain transport phenomena.

Unit – 2

Essay Questions(10M)

7. State and prove Carnot's theorem. How does it lead to absolute scale of temperature?

8. What is T- S diagram? How efficiency can be determined from it. Mention its uses.

9. Explain the working of Carnot's engine and find its efficiency.

Short Answers (5)

10. State and explain Carnot's theorem.

11. What are reversible and irreversible processes? Give examples.

12. What is an indicator diagram? Write its uses.

13. State and explain second Law of thermodynamics.

14. Differentiate isothermal & adiabatic processes.

15. Show that the change in entropy in a reversible cycle is zero.

Unit – 3

Essay Questions(10M)

16. What are thermodynamic potentials? Derive Maxwell's thermo dynamic relations.

17. Define Cp and Cv. Why Cp greater than Cv. Derive expression for difference of specific heats.

Short Answers (5)

1. Give Classius – Clayperon's equation. Mention its applications.

2. Derive expression for difference of specific heats.

Unit – 4

Essay Questions(10M)

18. What is Joule Kelvin effect? Describe Porous plug Experiment and indicate the result. Obtain the expression for cooling produced when gas suffers Joule - Thomson effect.

19. Explain with the theory adiabatic demagnetization method for producing very low temperatures.

Short Answers (5M)

20. Explain the principle and working of refrigerator.

21. Distinguish between joule expansion adiabatic expansion and Joule Kelvin effect

Unit – 5

Essay Questions(10M)

1. Deduce the Plank's energy distribution formula for a black body radiation.

2. State Plank's hypothesis. Derive an expression for Plank's radiation Law. Deduce Wein's Law from it.

3. What is pyrometer? Describe the construction and working of optical pyrometer.

1. Define solar constant. Describe how solar constant is determined using Angstrom's pyro heliometers.

Short Answers (5M)

4. Write down the Characterstics of black Body Radiation.

5. Explain Steafan and Wein's displacement laws.