3-4-116

PAPER IV: THERMODYNAMICS &RADIATION PHYSICS

(FOR MATHEMATICS COMBINATIONS)

IV SEMESTER

Work load: 60hrs per semester **4 hrs/week**

UNIT-I (10hrs)

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(12hrs)

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(12hrs)

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(12hrs)

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 Temperature of inversion-Liquefaction of helium, Kapitza's method-Adiabatic demagnetization, Production of low temperatures -applications of substances at low temperature-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 energy distribution law, Rayleigh-Jean's law-Quantum theory of radiation- Planck's law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer – Angstrom pyroheliometer-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&AbhayK.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: 30HRS **2HRS/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 good conductor-Searle's method
3. Thermal conductivity of bad conductor-Lee's method
4. Thermal conductivity of rubber.
5. Specific heat of a liquid by applying Newton's law of cooling correction.
6. Heating efficiency of electrical kettle with varying voltages.
7. Thermo emf- thermo couple
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.

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 a brief seminar presentation.

Group discussion :- A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment :- Few problems may be given to the students from the different units and asked them to solve.

Field trip :- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric 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, measurement skills

***** Documental evidence is to be maintained for the above activities.**

MODEL PAPER

THREE YEAR B.Sc DEGREE EXAMINATION

CHOICE BASED CREDIT SYSTEM

FOURTH SEMESTER: PART II: PHYSICS

Paper IV: Thermodynamics & Radiation physics

(For Mathematics Combinations)

Time: 3 Hours Max. Marks: 75

Section-A (Essay type)

Answer All questions **Marks :5x10 = 50**

1. a) Derive an expression for the Maxwell's law of distribution of molecular speeds in a gas.

OR

b) What are transport phenomena? Derive an expression for the coefficient of viscosity of a gas.

2. a) Describe the working of a Carnot's engine and derive an expression for its efficiency.

OR

b) What is entropy? Derive an expression for the change in entropy of a perfect gas undergoing a reversible process.

. 3.a) What are thermodynamic potentials? Derive Maxwell's thermodynamic relations.

OR

b) State the Maxwell's thermodynamic equations and hence derive the ratio of specific heats.

4. a) What is Joule- Kelvin effect ? Explain the porous plug experiment and also explain inversion temperature.

OR

b) Explain adiabatic demagnetization. Describe an experiment of producing very low temperature.

5. a) Deduce Wien's displacement law, Rayleigh Jeans law and Stefan's law from the Planck's law.

OR

b) Define solar constant. Explain how the solar constant and hence the temperature of the sun determined experimentally.

Section-B (Short answer type)

Answer any three questions **3 x5 = 15 Marks**

6. Explain the mean free path of the molecules of a gas.
7. Explain the concept of Entropy and the entropy of the universe.
8. Explain the Clausius Claperon's Latent heat equation.
9. Write the applications of substances at low temperature.
10. What is a black body? Explain Ferry's black body.

Section-C

Answer any two questions **2x5 = 10 Marks**

11. At what temperature is the r.m.s speed of oxygen molecules twice their r.m.s speed at 27^{o} C?

12. The efficiency of a Carnot's engine is 25% .On reducing the temperature of the sink by 50% the efficiency is 50%.What are the initial temperatures of the source and sink?

13. Calculate the change in entropy when 1gm of ice at -10^{o} C gets converted into steam at 100^{o}C

14. Determine the temperature of the body with the help of Wien's displacement law, given b value is 2.92×10^{-3} mK and maximum wave length is $4900A^{o}$.

15. A body at 1500^{o}K emits maximum energy at a wavelength $20{,}000A^{o}$. If the sun emits maximum energy at a wavelength $6000A^{o}$, find the temperature of the sun.