

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

Faculty of Science and Technology

B.Sc. Part-II (PHYSICS) Semester III

Syllabus

3S Physics

Thermal Physics, Statistical Mechanics & Solid State Devices-I

Course outcomes

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

1. Gain knowledge of the fundamental laws of thermodynamics, concept of enthalpy, develop critical understanding of concept of thermodynamic potentials and formulation of Maxwell's thermodynamic relations with its applications.
2. Understand the basic aspects of kinetic theory of gases, Maxwell's distribution law of velocities, Mean free path of molecular collisions and transport phenomena in ideal gases.
3. Examine the nature of black body radiations and understand Stefan-Boltzmann's Law, Rayleigh-Jeans Law and Wien's displacement Law with their significance.
4. Understand the properties of macroscopic systems using the knowledge of individual particles by different theories and comparison of Maxwell's-Boltzmann, Fermi-Dirac and Bose-Einstein statistics.
5. Explain the fundamental understanding of static and dynamic behaviour of P-N junction diode, Zener diode, light emitting diode and Transistor.
6. Understand concept of rectification, Ripple Factor and Filter Circuits and gain a knowledge of construction of Regulated Power supply.
7. Explain the structure and the operations of transistor and recognize the different types of transistor and their applications.

Thermal Physics, Statistical Mechanics & Solid State Devices-I

Unit-I

Introduction of laws of thermodynamics: Zeroth law, first law, second law, third law of thermodynamics and concept of entropy.

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and internal energy functions, Maxwell's relations & applications, Joule-Thomson effect, Clausius- Clapeyron equation, Expression for $(C_P - C_V)$, C_P/C_V , TdS equations, Numerical. (12 Lectures)

Unit-II

Kinetic Theory of Gases: Mean free path, **Transport phenomena:** viscosity, conduction and diffusion.

Theory of radiation: Blackbody radiation, spectral distribution, concept of energy density, Wien's distribution law, Rayleigh-Jeans Law, Planck's quantum hypothesis, 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, Numerical. (12 Lectures)

Unit-III

Statistical Mechanics: Phase space, unit cell, 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, Numerical

(12 Lectures)

Unit-IV

Semiconductor Devices: P-N junction diode, Zener diode and light emitting diode (construction, biasing, characteristics and applications)

Rectifiers: Half wave rectifier, full-wave rectifier, bridge rectifier, ripple factor, rectification efficiency (Qualitative only) comparison of rectifiers. **Filter circuits** (Qualitative only): capacitor filter, inductor filter, L-section and π - section filter.

Power Supply: Ordinary power supply, line and load regulation, regulated power supply, Zener diode as voltage regulator, Numerical. (12 Lectures)

Unit-V

Transistor: construction and working of PNP and NPN transistor, different modes, characteristics of transistor in CB and CE mode, current gain in CB and CE mode and relation between them, CE transistor amplifier, active, cut-off and saturation regions, dc load line, operating point. **Junction Field Effect Transistor (JFET):** Types, construction, working and characteristics, parameters of JFET and their relation, difference between JFET and BJT, Numerical. (12 Lectures)

Unit-VI Skill Enhancement Module (SEM)

Introduction to soldering Technique: Introduction, Types of solder, Solder flux, Soldering Irons and types, Contamination and cleaning of soldering iron, Desoldering techniques, Hazards involved in soldering.

Breadboard: Introduction, basics and its connections.

Regulated Power Supply: Definition, Block Diagram, Characteristics (Load and line regulation), its Application,

List of Activities: (any one)

1. Construction of Regulated power supply by using Bread board
2. Construction of Regulated power supply by using soldering technique.
3. Checking and repairing of old power supply.
4. Construction of Adjustable regulated power supply by using IC LM317 on PCB.

3S Physics Practical

Practical for Thermal Physics, Statistical Mechanics & Solid State Devices-I

Course outcomes

On successful completion of this Practical course, the students would be able to:

1. Understand basic concept of heat transfer and analyze process of heat transfer (conduction, convection and radiation)
2. Demonstrate an understanding of concepts involved in semiconductor devices operation and their characteristics.
3. Identify and handle different types of semiconductor devices like diodes & Transistors.
4. Acquire skills in observing and measuring different type of errors.
5. Perform procedures and techniques related to experiments based on Thermal and Semiconductor Physics.
6. Learn best practices for handling, cleaning and maintaining the instruments.

List of Experiments

1. To determine Mechanical Equivalent of Heat by Callender and Barn's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine C_p/C_v by Clement and Desorm's method.
4. To verify Stefan's law.

5. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
6. To determine the temperature co-efficient of resistance by Platinum Resistance Thermometer.
7. To study the variation of thermo-emf across two junctions of a thermocouple with temperature.
8. To verify MB/FD/BE distribution law using dice/ coins.
9. To study characteristics of P-N Junction diode.
10. To study characteristics of Zener diode.
11. To study characteristics of Light emitting diode (LED).
12. To determine energy gap of a semiconductor using PN junction diode in reverse bias mode
13. To study characteristics of CB transistor
14. To study characteristics of CE transistor
15. To study Half Wave Rectifier with filters
16. To study Half Wave Rectifier without filters
17. To study Full Wave Rectifier with filters
18. To study Full Wave Rectifier without filters
19. To study Bridge Wave Rectifier with filters
20. To study Zener regulated power supply
21. To study Transistor series regulated power supply
22. To study variation of gain of CE amplifier with load at fixed frequency.
23. To study variation of gain of CE amplifier with frequency at fixed load.
24. To Study FET characteristics
25. To study FET as a voltmeter

References Books

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. Narosa.
3. Physics for degree students (B.Sc.2nd year) by C. L. Arora & P.S. Hemne, S. Chand Publication.
4. Physics for degree students (B.Sc. 1st year)by C. L. Arora & P.S. Hemne, S. Chand Publication.
5. Heat Thermodynamics and Statistical Physics, Brijlal, N. Subrahmanyam, P.S. Hemane, S.Chand Publication, 2007
6. Elementary Statistical Mechanics , Gupta and Kumar, (Pragati Prakashan), 2005
7. Element of Statistical Mechanics , Kamal Singh & S P Singh, S.Chand Publication, 1984
8. Basic Electronics by B. L. Theraja, S. Chand Publication.
9. Principles of Electronics by V. K. Mehta, S. Chand Publications
10. Electronics Devices & Circuits, Sanjeev Gupta, Dhanpat Rai Publication (2010)
11. Electronics Devices & Circuits-I & II – Godse & Bakshi (Tech. Pub. , Pune) (2010)
