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

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2. Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. Narosa.
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6. Elementary Statistical Mechanics , Gupta and Kumar, (Pragati Prakashan), 2005
7. Element of Statistical Mechanics , Kamal Singh & S P Singh, S.Chand Publication, 1984
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9. Principles of Electronics by V. K. Mehta, S. Chand Publications
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11. Electronics Devices & Circuits-I & II – Godse & Bakshi (Tech. Pub. , Pune) (2010)

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SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
Faculty of Science and Technology
B.Sc. Part-II (PHYSICS) Semester IV

Syllabus

4S Physics

Physical Optics, Fluid Dynamics & Solid State Devices-II

Course outcomes:

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

1. Understand the phenomenon of Interference of light and its formation in thin films, Newton's rings and Michelson interferometer (division of amplitude.)
2. Distinguish between Fresnel and Fraunhoffer diffraction and observe the diffraction patterns in case of double slit and diffraction grating.
3. Describe the construction and working of zone plate and compare the zone plate with convex lens.
4. Explain various methods of production of plane, circularly and elliptically polarized light and their detection.
5. Comprehend the basic principle of LASER, the working of He-Ne laser and Ruby laser and their applications in various fields.
6. Understand the parameters of fiber-optics and explore their applications.
7. Understand the kinematics of moving fluid by different theorems and Laws.
8. Gain Knowledge about different applications of transistor by operational amplifier and oscillator circuits.

Physical Optics, Fluid Dynamics & Solid State Devices-II

Unit I

Interference of Light : Introduction, conditions for steady interference, Interference in thin film due to reflected and transmitted light, variable thickness (wedge shaped) film, Newton's rings (formation, theory and applications such as determination of wavelength and refractive index), Michelson Interferometer (principle, construction & working), Numerical.

Unit II

Diffraction of Light : Rectilinear propagation of light, half period zones, zone plate (construction and theory), difference between zone plate and convex lens, Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at double slit, theory of plane transmission grating, determination of wavelength of light by diffraction grating.
Polarization: Transverse nature of light waves, plane polarized light, half and quarter wave plate, circular and elliptical polarization (production and analysis). Numerical.

Unit III

LASER: Introduction, properties of Laser, stimulated absorption, spontaneous and stimulated emission, metastable state and population inversion. Components of Laser (active medium, pumping, optical resonant cavity), three level and four level laser system, construction and working of Ruby laser and Helium Neon (He-Ne) laser. Applications of laser in medical and industrial field.
Fibre Optics: Introduction, structure, types, total internal reflection, propagation of light wave through an optical fibre, acceptance angle and acceptance cone, numerical aperture. Numerical.

Unit IV

Kinematics of Moving Fluids: viscosity, streamline and turbulent flow, critical velocity, equation of continuity, energy of the liquid, Bernoulli's theorem and its applications (Venturimeter, Atomizer), derivation of Poiseuille's equation for flow of liquid through a capillary tube, Reynold's number and its physical significance, terminal velocity, Stokes' law and its deduction. Numerical.

Unit V

Operational amplifier: Differential Amplifiers, OP-AMP Block Diagram, Parameters of OP-AMP, Characteristics of Ideal OP-AMP, Inverting and Non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator.

Sinusoidal Oscillators: Feedback in amplifier, Barkhausen Criterion, Phase Shift Oscillator (Construction and working), Oscillatory Circuit (Tank Circuit), Colpitt's and Hartley Oscillator (Construction and working). Numerical.

Unit VI Skill Enhancement Module (SEM)

Design and Handling of Microscopes and Telescopes

Contents:

1. Optical Components in Microscopes and Telescopes
   - Objective lenses and eyepieces
   - Mirrors and prisms
   - Filters and diaphragms
   - Optical coatings and materials
2. Microscope Design and Operation
   - Compound and stereo microscope systems
   - Illumination techniques
   - Magnification and resolving power
   - Image formation and focusing mechanisms
3. Telescope Design and Operation
   - Refracting and reflecting telescope systems
   - Aperture and focal length considerations
   - Mounts and tracking mechanisms
   - Observing techniques and celestial objects
4. Alignment and Calibration Techniques
   - Aligning optical components in microscopes and telescopes
   - Collimation of telescopes
   - Testing and verification of alignment
   - Calibration of magnification and measurements
5. Handling and Maintenance of Microscopes and Telescopes
   - Proper handling techniques to avoid damage
   - Cleaning procedures for optical components
   - Environmental considerations for these instruments
   - Maintenance and troubleshooting common issues

Activities:

1. Lunar Observation: Organize a night-time session for students to observe the Moon using a telescope. Teach them about lunar features, such as craters, maria, and mountains, and guide them to locate and identify these features on the Moon's surface.
2. Planetary Viewing: Choose a clear night to observe planets visible to the naked eye, such as Jupiter or Saturn. Use a telescope to show students the planet's details, including its moons, rings, and cloud bands. Discuss planetary characteristics and encourage questions and discussions.
3. Microscopic Measurement: Introduce the concept of using a microscope for measurement. Provide a micrometer scale slide and guide students on how to calibrate and use it for measuring microscopic objects.
4. Microscopic Crystal Analysis: Collect various crystals like salt, sugar, or Epsom salt. Dissolve them in water and allow the solution to evaporate on a slide. Examine the resulting crystals under the microscope to observe their unique shapes and patterns.

4S Physics Practical

Practical for Physical Optics, Fluid Dynamics & Solid State Devices-II

Course outcomes:

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

1. Understand the different optical phenomena like Interference, Diffraction and Polarization.
2. Determine the wavelength of light by different phenomena like Interference and diffraction.
3. Demonstrate an understanding of the key concepts of LASER & Fiber Optics
4. List out, identify and handle different types of passive and active devices (resistors, capacitors, inductors, diodes & Transistors.
5. Acquire skills in observing and measuring different types of errors.
6. Perform procedures and techniques related to experiments based on Optics and Semiconductor Physics.
7. Learn best practices for handling, cleaning and maintaining the equipment, components & devices

List of Experiments

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light
2. To determine the value of Cauchy's Constants of a material of a prism.
3. To determine wavelength of Sodium light using Fresnel Biprism.
4. To determine wavelength of Sodium light using Newton's Rings.
5. To determine wavelength of Sodium light using plane diffraction Grating.
6. To determine the Resolving Power of a Plane Diffraction Grating.
7. To determine the wavelength of laser light by plane diffraction grating.
8. To find the number of lines per centimeter of the given diffraction grating.
9. To determine the resolving power of telescope.
10. To verify Malu's law.
11. To verify Brewester's law.
12. Study of elliptically polarized light using photodetector.
13. To determine specific rotation of sugar solution by half shade polarimeter.
14. To study the divergence of a LASER beam.
15. To determine the focal length of a given convex lens using LASER.
16. To determine Numerical Aperture of Optical Fiber.
17. To verify Stokes' law and hence to determine the viscosity of a liquid (glycerin).
18. To determine coefficient viscosity of water by Poiseuille's flow method.
19. To study Phase Shift oscillator.
20. To study Wien Bridge oscillator.
21. To study Hartley oscillator.
22. To study Colpitts oscillator.
23. Study of OP AMP as an Inverting amplifier.
24. Study of OP AMP as Non-inverting amplifier.
25. Study of OP AMP as an adder.
26. Study of OP AMP as subtractor.
27. Study of OP AMP as differentiator.
28. Study of OP AMP as an integrator.

References Books

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