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

1. A text book of Optics, N. Subrahmanyam, Brijlal, M. N Avadhanulu, S. Chand Publication
2. Physics for degree students (B.Sc.1st year), C. L. Arora and P.S. Hemne, S. Chand Publication
3. Fundamentals of Optics, Devraj Singh, PHI Learning Pvt. Ltd
4. Optics by Ajoy Ghatak, McGraw Hill Education (India) Private Limited.
5. Optics by N. B. L. Mathur, Anmol Publications Pvt.Ltd.
6. Optics and Spectroscopy, P. K. Mittal, S. Chand & Company LtdMechanics & Properties of Matter, J. C. Upadhyaya, Ram Prasad Publications
7. A Textbook of Optics, N. Subrahmanyam, Brij Lal, M.N. Avadhanulu, S. Chand Publications.

8. Optics, Ajoy Ghatak, 4th Edition, McGraw Hill Publication.
9. Lasers, Theory and Application, Thaygrajan and Ajay Ghatak, Macmillan India Ltd
10. Laser and Nonlinear Optics, B. B. Laud (2nd Ed.), New Age International.
11. Fibre Optics – Kaiser, McGraw Hill.
12. Fiber Optic Communication, D. C. Agarwal, Wheeler Publishing
13. Optoelectronics & Fiber Optics Communication, C.K Sarkar, D.C. Sarkar, New Age International.
14. An introduction to Fiber Optics – R. Allen Shotwell, Prentice Hall
15. Properties of Matter , D. S. Mathur, S.Chand & Company Ltd
16. Properties of Matter, Brijlal and N. Subrahmanyam, S.Chand & Company Ltd
17. Basic Electronics Solid State ,B. L. Theraja, S. Chand & Co. Publications
18. Solid State Electronics Devices , B. G. Streetman, PHI Learning Pvt. Ltd
19. Electronics devices & Circuits, A. Mottershead, PHI Learning Pvt. Ltd
20. Solid State Devices & Electronics , Kamal Singh & S. P. Singh, S. Chand & Co. Publication
21. Electronic Devices and Circuits , Sanjeev Gupta, Dhanpat Rai Publication
22. Physics for Degree Students B.Sc. Second Year, C. L. Arora and P.S. Hemane, S-Chand Publication Reprint, 2015
23. Integrated Electronics , J. Millman and C. C. Halkias (Mc Graw Hill), 2001
24. Electronic Fundamentals and Applications, D. Chattopadhyay and P. C. Rakshit, New Age International

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