ANDHRA KESARI UNIVERSITY
MINOR

Subject: Physics

w.e.f. AY 2023-24 COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Mechanics and Properties of Matter	3	3
			Mechanics and Properties of Matter Practical Course	2	1
II	III	2	Optics	3	3
			Optics Practical Course	2	1
	IV	3	Electricity and Magnetism	3	3
			Electricity and Magnetism Practical Course	2	1
		4	Modern Physics	3	3
			Modern Physics Practical Course	2	1

SEMESTER-III

COURSE 2: OPTICS

Theory Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Optics aims to provide students with a fundamental understanding of the behaviour and properties of light and its interaction with matter.

LEARNING OUTCOMES:

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

1. Explain about the different aberrations in lenses and discuss the methods of minimizing them
2. Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.
3. Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating and to describe the construction and working of zone plate and make the comparison of zone plate with convex lens
4. Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.
5. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields. To understand the basic principles of fibre optic communication and explore the field of Holography and Nonlinear optics and their applications.

UNIT-I Aberrations **9Hrs**

Introduction – monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration-the achromatic doublet. Achromatism for two lenses (i) in contact and (ii) separated by a distance.

UNIT-II **Interference**
9Hrs

Principle of superposition – coherence Conditions for interference of light. Fresnel's biprism determination of wavelength of light –change of phase on reflection. Oblique incidence of a plane wave on a thin film due to reflected light (cosine law) –colors of thin films- Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton'srings in reflected light. Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III Diffraction **9Hrs**

Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit-Fraunhoffer, Fraunhofer diffraction pattern with N slits (diffraction grating). Resolving power of grating, Determination of wavelength of light in normal incidence using diffraction grating. Fresnel's half period zones-area of the half period zones-zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

UNIT-IV **Polarisation**
9Hrs

Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's law- Mauls law-Nicol prism polarizer and analyser, Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade Polarimeter. Idea of elliptical and circular polarization

UNIT-V **Lasers and Holography**
9Hrs

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion, Laser principle-Einstein Coefficients-Types of lasers-He-Ne laser, Ruby laser- Applications of lasers. Holography:Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

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REFERENCE BOOKS:

1. BSc Physics, Vol .2, Telugu Academy, Hyderabad
2. A Text Book of Optics-N Subramanyam, L Brijlal, S. Chand& Co.
3. Unified Physics Vol. II Optics & Thermodynamics – Jai Prakash Nath & Co. Ltd., Meerut
4. Optics, F.A. Jenkins and H.G. White, Mc Graw-Hill
5. Optics, Ajay Ghatak, Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S. Chand & Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

SEMESTER-III

COURSE 2: OPTICS

Practical Credits: 1 2hrs/week

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for studying light and its interactions with matter.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying light and its interactions with matter.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing optics, including reflection, refraction, diffraction, interference, and polarization.

Minimum of 6 experiments to be done and recorded

1. Determination of radius of curvature of a given convex lens-Newton's rings.
2. Resolving power of grating.
3. Study of optical rotation –polarimeter.
4. Dispersive power of a prism.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Determination of wavelength of laser light using diffraction grating.
8. Resolving power of a telescope.
9. Refractive index of a liquid-hallow prism
10. Determination of thickness of a thin wire by wedge method
11. Determination of refractive index of liquid-Boy's method.

SEMESTER-III

COURSE 2: OPTICS

STUDENT ACTIVITIES

Suggested student activities

UNIT-I Aberrations:
Ask students to observe and sketch the different images produced by the lens at different distances. Build a simple optical system with two lenses in contact and ask students to calculate the focal length and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the effects of chromatic aberration and ask students to observe and discuss the changes in the image produced.
UNIT-II Interference:
Ask students to measure the diameter of the central bright spot and the diameter of the nth ring for different values of n, and then calculate the wavelength of light.

UNIT-III Diffraction:
Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask students to measure the distance between the needles, count the number of lines per unit length, and then calculate the grating spacing and the wavelength of light.

UNIT-IV Polarisation:
Ask students to measure the angle of rotation of the polarized light before and after passing through the sample, and then calculate the specific rotation of the sample.

UNIT-V Lasers and Holography:
Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

SEMESTER-IV

COURSE 3: ELECTRICITY AND MAGNETISM

Theory Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Electricity and Magnetism aims to provide students with a fundamental understanding of the principles of electricity, magnetism, and their interactions

LEARNING OUTCOMES:

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

1. Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.
2. To learn the methods used to solve problems using loop analysis, Nodal analysis, Thvenin's theorem, Norton's theorem, and the Superposition theorem
3. Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.
4. Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.
5. Develop an understanding on the unification of electric, and magnetic fields and Maxwell's equations governing electromagnetic waves.
6. Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits

UNIT-I Electrostatics and Dielectrics 9hrs

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere, Electrical potential–Equipotential surfaces, Potential due to a uniformly charged sphere. Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, Dielectric strength, Electric displacement D, electric polarization Relation between D, E and P, Dielectric constant and electric susceptibility.

UNIT-II Current electricity 9hrs

Electrical conduction-drift velocity-current density, equation of continuity, ohms law and limitations, Kirchhoff's Law's, Wheatstone bridge-balancing condition - sensitivity. Branch current method, Nodal Analysis, star to delta & delta to star conversions. Superposition Theorem, Thevenin's Theorem, Norton'sTheorem, Maximum power transfer theorem.

UNIT-III Magneto statics 4hrs

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and itsapplication to Solenoid, Hall effect, determination of Hall coefficient and applications.

Electromagnetic Induction: 5 hrs

Faraday's laws of electromagnetic induction, Lenz's law, Self-induction and Mutual induction, Self-inductance of a long solenoid, Magnetic Energy density. Mutual inductance of a pair of coils. Coefficient of Coupling

UNIT-IV Electromagnetic waves-Maxwell's equations: 9hrs

Basic laws of electricity and magnetism- Maxwell's equations- integral and differential forms Derivation, concept of displacement current. Plane electromagnetic wave equation, Hertz experiment-Transverse nature of electromagnetic waves. Electromagnetic wave equation in conducting media. Pointing vector and propagation of electromagnetic waves

UNIT-V Varying and alternating currents: 9 hrs

Growth and decay of currents in LR, CR, LCR circuits-Critical damping. Alternating current - A.C. fundamentals, and A.C through pure R, L and C. Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

REFERENCE BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand & Co.,
4. "Electricity and Magnetism" by Brijlal and Subramanyam Ratan Prakashan Mandir, 1966
5. "Electricity and Magnetism: Fundamentals, Theory, and Applications" by R. Murugeshan, Kiruthiga Siva prasath, and M. Saravanapandian
6. "Electricity and Magnetism: Theory and Applications" by Ajoy Ghatak and S. Lokanathan
7. Electricity and Magnetism: Problems and Solutions" by Ashok Kumar and Rajesh Kumar
8. Electricity and Magnetism, R.Murugeshan, S. Chand & Co.

SEMESTER-IV

COURSE 3: ELECTRICITY AND MAGNETISM

Practical Credits: 1 2 hrs/week

COURSE OBJECTIVE:

The course objective for a practical course in electricity and magnetism may include to develop practical skills in handling electrical and electronic components, such as resistors, capacitors, inductors, transformers, and oscillators.

LEARNING OUTCOMES:

Demonstrate a thorough understanding of the fundamental concepts and principles of electricity and magnetism.

Apply the laws and principles of electricity and magnetism to analyze and solve electrical and magnetic problems.

Design, construct, and test electrical circuits using various components and measuring instruments.

Measure and analyze electrical quantities such as voltage, current, resistance, capacitance, and inductance using appropriate instruments.

Apply the principles of electromagnetism to understand and analyze the behavior of magnetic fields and their interactions with electric currents

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –Sonometer.
4. Verification of Kirchhoff's laws and Maximum Power Transfer theorem.
5. Verification of Thevenin's and Norton's theorem
6. Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.
7. Charging and discharging of CR circuit-Determination of time constant
8. A.C Impedance and Power factor
9. Determination of specific resistance of wire by using Carey Foster's bridge.

SEMESTER-IV

COURSE 3: ELECTRICITY AND MAGNETISM

STUDENT ACTIVITIES

UNIT-I Electrostatics and Dielectrics:
Conduct a simulation to visualize equipotential surfaces for a given charge distribution.
Conduct a group discussion on the significance of electric field lines and how they can be used to predict the motion of charged particles in electric fields.

UNIT-II Current electricity:
Conduct a Wheatstone bridge experiment in class and discuss the balancing condition and sensitivity.
Conduct a group activity where students are divided into groups and assigned a different circuit analysis method (nodal analysis, mesh analysis, superposition theorem, etc.) and asked to present their findings to the class.

UNIT-III Magneto statics and Electromagnetic Induction:
Conduct a demonstration to show the Hall effect and measure the Hall coefficient of a given material.
Conduct a group activity where students are divided into groups, and assigned a different application of Faraday's law (electromagnetic induction, transformers, etc.) and asked to present their findings to the class.

UNIT-IV Electromagnetic waves:
Conduct a group activity where students are asked to research the history of the development of Maxwell's equations and present their findings to the class.
Conduct a simulation to visualize the propagation of electromagnetic waves in different media (vacuum, air, water, etc.) and discuss the differences in the behaviour of waves in different media.

UNIT-V Varying and alternating currents:
Conduct a demonstration to show the resonance in an LCR circuit and measure the Q-factor.
Conduct a group activity where students are divided into groups and assigned a different power factor correction method (capacitor banks, synchronous condensers, etc.) and asked to present their findings to the class.

SEMESTER-IV

COURSE 4: MODERN PHYSICS

Theory Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Modern Physics aims to provide students with an understanding of the principles of modern physics and their applications in various fields.

LEARNING OUTCOMES:

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

1. Understand the principles of atomic structure and spectroscopy.
2. Understand the principles of molecular structure and spectroscopy
3. Develop critical understanding of concept of Matter waves and Uncertainty principle.
4. Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.
5. Increase the awareness and appreciation of superconductors and their practical applications

UNIT-I: Introduction to Atomic Structure and Spectroscopy: (9 hrs

Bohr's model of the hydrogen atom -Derivation for radius, energy and wave number - Hydrogen spectrum, Vector atom model – Stern and Gerlach experiment, Quantum numbers associated with it, Coupling schemes, Spectral terms and spectral notations, Selection rules. Zeeman effect, Experimental arrangement to study Zeeman effect.

UNIT-II: Molecular Structure and Spectroscopy (9 hrs

Molecular rotational and vibrational spectra, electronic energy levels and electronic transitions, Raman effect, Characteristics of Raman effect, Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect. Spectroscopic techniques: IR, UV-Visible, and Raman spectroscopy

UNIT-III: Matter waves & Uncertainty Principle: (9 hrs

Matter waves, de Broglie's hypothesis, Properties of matter waves, Davisson and Germer's experiment, Heisenberg's uncertainty principle for position and momentum & energy and time, Illustration of uncertainty principle using diffraction of beam of electrons (Diffraction by a single slit) and photons (Gamma ray microscope).

UNIT-IV: Quantum Mechanics: (9 hrs

Basic postulates of quantum mechanics, Schrodinger time independent and time dependent wave equations-Derivations, Physical interpretation of wave function, Eigen functions, Eigen values, Application of Schrodinger wave equation to (one-dimensional potential box of infinite height (Infinite Potential Well)

UNIT-V: Superconductivity: (9 hrs

Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect, London's Equation and Penetration Depth, Isotope effect, Type I and Type II superconductors, BCS theory, high Tc super conductors, Applications of superconductors

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Atomic Physics by J.B. Rajam; S.Chand& Co.,
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
5. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
6. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publ.Co.)
7. K.K.Chattopadhyay&A.N.Banerjee, Introd.to Nanoscience and Technology(PHI Learning Priv. Limited).
8. Nano materials, A K Bandopadhyay. New Age International Pvt Ltd (2007)
9. Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, Baldev Raj,BB Rath and J Murday-Universities Press-IIM

SEMESTER-IV

COURSE 4: MODERN PHYSICS

Practical Credits: 1 2 hrs/week

COURSE OBJECTIVE:

The course objective for a practical course in Modern Physics may provide hands-on experience with experimental techniques and equipment used in modern physics experiments.

LEARNING OUTCOMES:

1. Apply experimental techniques and equipment to investigate and analyze phenomena related to modern physics, such as quantum mechanics, relativity, atomic physics, and nuclear physics.
2. Demonstrate a deep understanding of the principles and theories of modern physics through hands-on experimentation and data analysis.
3. Develop proficiency in using advanced laboratory instruments and techniques specific to modern physics experiments, such as spectroscopy, interferometry, particle detectors, and radiation measurement.
4. Analyze and interpret experimental data using statistical methods and error analysis, drawing meaningful conclusions and relating them to theoretical concepts.
5. Design and conduct independent experiments or investigations related to modern physics, demonstrating the ability to plan, execute, and analyze experimental procedures and results.

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Determination of the Planck's constant using LEDs of at least 4 different colours.
5. Determination of work function of material of filament of directly heated vacuum diode.
6. Determination of M & H.
7. Energy gap of a semiconductor using junction diode.
8. Energy gap of a semiconductor using thermistor.

SEMESTER-IV

COURSE 4: MODERN PHYSICS

STUDENT ACTIVITIES:

UNIT-I: Introduction to Atomic Structure and Spectroscopy

Spectroscopy Experiment:

Divide the students into small groups and provide each group with a spectrometer or spectroscope, a light source, and different samples or elements for analysis.

Instruct the students to carefully observe the spectra produced by the samples using the spectrometer. Encourage them to note the presence of specific spectral lines or patterns.

Data Collection:

Have the students record their observations in their lab notebooks or worksheets. They should note the wavelengths or colors of the observed spectral lines and any patterns they observe.

Analysis and Discussion:

Guide a class discussion on the observed spectra and their significance. Discuss how the observed spectral lines correspond to specific energy transitions in the atoms.

Ask students to compare the spectra of different samples or elements and identify any similarities or differences.

Discuss the concept of energy levels and how electrons transition between them, emitting or absorbing photons of specific wavelengths.

UNIT-II: Molecular Structure and Spectroscopy

Begin the activity with a brief introduction to molecular structure, discussing concepts such as chemical bonds, molecular geometry, and the importance of molecular structure in determining the properties and behavior of substances.

Explain the principles of spectroscopy, focusing on vibrational and rotational spectra and how they relate to molecular vibrations and rotations.

UNIT-III: Matter waves & Uncertainty Principle:

Begin the activity by introducing the concept of matter waves and the uncertainty principle. Discuss how the wave-particle duality of matter is a fundamental principle in quantum mechanics.

Provide a brief overview of the historical development of the uncertainty principle and its implications for our understanding of the behavior of particles on a microscopic scale.

UNIT-IV: Quantum Mechanics:

Begin the activity by providing an overview of quantum mechanics and its significance in understanding the behavior of particles on a microscopic scale. Discuss key concepts such as wave-particle duality, superposition, quantization, and the probabilistic nature of quantum systems

UNIT-V: Superconductivity:

Begin the activity by providing an overview of superconductivity, including its definition, properties, and significance in scientific and technological applications.

Discuss key concepts such as zero electrical resistance, Meissner effect, critical temperature, and type I and type II superconductors

ANDHRA KESARI UNIVERSITY-ONGOLE, PRAKASAM DISTRICT

Single Minor Programme from the Year 2023-24 Onwards

Programme-B.Sc. Honours Physics - Question Paper model,

Second Year-Semester-III & IV

Time: 3 Hours Total Marks: 75

PART –A

Out of Ten Answer any Five of the following

5X10=50 Marks

1.

2.

3.

4.

5.

6.

7.

8.

9.

10

PART –B

Answer Any Five of the following **5x5=25 Marks**

11.
12.
13.
14.
15.
16.
17.
18.
19.
20.