SRI V.S. SIVALINGAM CHETTIAR GOVERNMENT DEGREE COLLEGE (A)

SULLURPET, TIRUPATI DISTRICT, ANDHRA PRADESH (2025-2026)

DEPARTMENT OF PHYSICS

SYLLABUS-OUTCOMES

SRI V.S. SIVALINGAM CHETTIAR GOVERNMENT DEGREE COLLEGE

SULLURPETA, TIRUPATI DISTRICT, ANDHRA PRADESH

DEPARTMENT OF PHYSICS

SEMESTER-1

INTRODUCTION TO MATHEMATICAL PHYSICS

COURSE OUTCOMES:

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

- **Understand and apply basic mathematical methods used in physics such as algebra, calculus, and differential equations.**
- **Solve physical problems using mathematical techniques, including ordinary and partial differential equations.**
- **Apply vector algebra and vector calculus to analyze physical quantities like force, velocity, and fields.**
- **Use matrices and linear algebra to represent and solve systems of equations in physical applications.**
- **Interpret mathematical results in terms of physical concepts and understand their significance in physics.**
- **Develop problem-solving skills by connecting mathematical methods with real**

B.Sc., HONOURS IN PHYSICS (SINGLE MAJOR): SYLLABUS SEMESTER-I, COURSE 1: INTRODUCTION TO MATHEMATICAL PHYSICS

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVE

To equip students with foundational mathematical techniques such as vector calculus, linear algebra, complex numbers, probability, and Fourier analysis essential for understanding and solving problems in physics.

LEARNING OUTCOMES

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

1. **Apply concepts of vector differentiation and integration to analyze physical fields and prove integral theorems.**
2. **Use matrix operations and eigenvalue techniques to solve linear systems in physics.**
3. **Represent and manipulate complex numbers in various forms for solving AC circuit problems.**
4. **Interpret and apply basic probability concepts and distributions to model physical phenomena.**
5. **Analyze periodic signals using Fourier series and evaluate Fourier coefficients for common waveforms.**

UNIT-I - VECTOR ANALYSIS (9. Hrs.)

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II – LINEAR ALGEBRA (9. Hrs.)

Matrices: Types, Addition and Multiplication, Identity and Inverse, Determinant (2x2 and 3x3), Trace, Transpose- Eigenvalues and Eigen Vectors, calculation of Eigen values. System of Linear Equations: Solving 2-variable system using matrices, Simple examples from physics (Current, forces).

UNIT – III COMPLEX NUMBERS (9. Hrs.)

Basic Complex numbers: Real and imaginary parts, Conjugate of complex numbers, Modulus and argument (magnitude and phase), Polar and Exponential (Euler) form of complex numbers.

Addition and subtraction of complex numbers, Multiplication and division of complex numbers.

UNIT – IV PROBABILITY (9. Hrs.)

Probability Theory Basics, Sample space, events, conditional probability, and Bayes' theorem. Random Variables and Probability Distributions, Concept of random variables (discrete and continuous). Common distributions and their applications: Binomial, and Poisson.

UNIT V FOURIER ANALYSIS (9. Hrs.)

Introduction to periodic functions: Concept of periodicity (waves, oscillations, AC current), Need for Fourier analysis, Real world signals (heartbeat, electrical signal, musical tones), Fourier theorem and evaluation of Fourier coefficients, Analysis of periodic wave functions – Square wave, and saw tooth wave.

COURSE 1: INTRODUCTION TO MATHEMATICAL PHYSICS

Practical | Credits: 1 | 2 hrs/week

COURSE OBJECTIVE

To develop foundational computational and analytical skills through hands-on exercises that prepare students for understanding and solving problems in various realms of physics.

LEARNING OUTCOMES

1. **Graphing and Visualization:**

Students will be able to plot mathematical functions and visualize physical phenomena using Excel, Python, or MATLAB.

2. **Vector and Matrix Computations:**

Students will perform operations on vectors and matrices and represent them both analytically and graphically.

3. **Numerical Methods:**

Students will apply numerical techniques like Newton-Raphson, Bisection, and Euler's method to solve equations and differential equations.

4. **Data Analysis and Fitting:**

Students will analyze experimental data using tools like least squares fitting and compute statistical quantities such as mean, standard deviation, and error.

5. **Fourier and Complex Number Representation:**

Students will approximate functions using Fourier series and graphically represent complex numbers.

List of Practical

Minimum of 6 experiments to be conducted and recorded

1. **Graphing standard functions: sin(x), cos(x), e^x, ln(x), x^2, $\sqrt{x}$ etc. using Excel/Python/Graph paper**

2. **Experimental determination and vector diagram verification of vector addition and scalar product using graphical methods.**
3. **Using MATLAB/Python to visualize vector fields and compute gradient, divergence, and curl.**
4. **Solve simple non-linear equations (e.g., x3−x−1=0) using graphical methods and bisection/newton-Raphson method (Python or Excel).**
5. **Fit experimental data (e.g., Hooke's law) to a straight line using least squares method in Excel or Python.**
6. **Linear equation Solution and System of linear equation solution using MATLAB/OCTAVE.**
7. **Fourier approximation of a square wave up to 5 terms using Python/MATLAB and plotting the result.**
8. **Numerical solution of dy/dx=x+y, given initial condition using Euler's method.**
9. **Single coin tossing and four-coin tossing using MATLAB/OCTAVE and verification of statistical laws**
10. **Use Python/Excel to perform addition, multiplication, and finding inverse of 2x2 and 3x3 matrices.**
11. **Simulate and plot s-t, v-t graphs using s=ut+0.5gt2s = ut + 0.5gt^2 using Excel or Python.**
12. **Calculate mean, standard deviation, and percentage error for a given data set using Excel/Python/Manual calculations**
13. **Represent the given complex numbers on graph paper**
14. **Determine the Eigen Values of the given matrix using characteristic equation**

MECHANICS AND PROPERTIES OF MATTER

COURSE OUTCOMES:

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

- **Understand the fundamentals of mechanics, including motion, force, work, energy, and momentum, and apply Newton's laws to physical systems.**
- **Analyze different types of motion, such as linear, circular, and rotational motion, using appropriate mathematical and physical principles.**
- **Explain the mechanical properties of matter, including elasticity, stress, strain, and elastic constants.**
- **Describe fluid properties and behavior, including pressure, viscosity, surface tension, and fluid flow.**
- **Apply principles of mechanics and material properties to solve practical and numerical problems in physics and engineering.**
- **Develop problem-solving and analytical skills through the application of theoretical concepts to real-world situations.**

COURSE 2: MECHANICS AND PROPERTIES OF MATTER

Theory | Credits: 3 | 3 hrs/week

COURSE OBJECTIVE

To provide students with a foundational understanding of classical mechanics and the physical properties of matter, including particle dynamics, central forces, elasticity, fluid behavior, and the basic principles of special relativity.

LEARNING OUTCOMES

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

1. **Apply Newton's laws to variable mass systems and analyze particle collisions using conservation laws and scattering theory.**
2. **Describe motion under central forces and derive orbital dynamics including Kepler's laws and satellite motion.**
3. **Explain elastic behavior of materials using stress-strain relations, and analyze the bending of beams and torsional motion.**
4. **Interpret fluid dynamics concepts such as streamline flow, Bernoulli's principle, and viscosity with practical applications.**
5. **Understand the key postulates of special relativity and apply Lorentz transformations to problems involving time dilation, length contraction, and mass-energy equivalence.**

UNIT-I MECHANICS OF PARTICLES (9 hrs.)

Newton's Laws of motion, motion of variable mass system, Equation of motion of a rocket. Brief introduction and applications of Gaganyaan, Adithya-L1, Chandrayaan-3, and NISAR. Conservation of energy and momentum, collisions in two and three dimensions, concept of impact parameter, scattering cross-section.

UNIT-II CENTRAL FORCES (9 hrs.)

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equations of motion under a central force, derivation of Kepler's laws, Geo-stationary satellites.

UNIT III: ELASTICITY AND BENDING OF BEAMS (9 hrs.)

Stress and strain, Hooke's Law, Elastic moduli – Young's, bulk, and shear modulus, and their relation. Poisson's ratio - Physical meaning. Bending of beams- Types, point and distributed load, Cantilever -Torsional pendulum working principle and uses.

UNIT IV: FLUID MECHANICS (9 hrs.)

Fluids properties and classification, streamline vs. turbulent flow, Reynolds number, Bernoulli's theorem statement and derivation, venturimeter, equation of continuity – Viscosity – Poiseuille's law- Surface tension, examples, qualitative ideas and its determination.

UNIT V: SPECIAL THEORY OF RELATIVITY (9 hrs.)

Galilean relativity- absolute frames- Michelson-Morley experiment, negative result-postulates of special theory of relativity- Lorentz transformation- time dilation-length contraction- addition of velocities- mass-energy relation.

COURSE 2: MECHANICS AND PROPERTIES OF MATTER

Practical Credits: 1 2 hrs/week

COURSE OBJECTIVE

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems.

LEARNING OUTCOMES

1. **Demonstrate a practical understanding of classical mechanics by performing experiments on momentum, collisions, and motion under force.**
2. **Analyze physical systems involving elasticity, fluid flow, and torsion through hands-on measurements and data interpretation.**
3. **Apply fundamental physics principles to explain satellite motion, scattering phenomena, and beam bending using experiments and simulations.**
4. **Use scientific simulations and digital tools to visualize and investigate abstract concepts such as rocket motion, central forces, and relativity.**
5. **Develop experimental, observational, and analytical skills including data recording, graph plotting, and error estimation in real and virtual environments.**

Minimum of 6 experiments to be conducted and recorded

1. **Young's modulus by uniform bending**
2. **Young's modulus by non-uniform bending**
3. **Rigidity modulus using torsional pendulum**
4. **Surface tension by capillary rise method**
5. **Flywheel – Determination of moment of inertia**
6. **Bifilar suspension – moment of inertia of a rectangular body**
7. **Radius of capillary tube by Hg thread method**

8. **Simulation of rocket motion using water rocket or computer simulation.**
9. **Verification of Kepler's third law using orbit simulation.**
10. **Simulation-based study of Rutherford scattering.**
11. **Determination of modulus of rigidity using Maxwell's needle.**
12. **Measurement of Poisson's ratio of a rubber tube.**
13. **Verification of Bernoulli's theorem using a horizontal tube setup.**
14. **Demonstration of lift on an airfoil using airflow setup.**
15. **Simulation of Michelson-Morley experiment.**
16. **Visualization of time dilation and length contraction using simulation.**

SEMESTER-II

WAVES AND OPTICS

COURSE OUTCOMES:

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

- **Understand the fundamentals of oscillations and waves, including simple harmonic motion (SHM) and different types of wave motion in various media.**
- **Analyze damped, driven, and coupled harmonic oscillators and explain their behavior using mathematical models and differential equations.**
- **Apply Fourier series and wave equations to describe wave propagation and understand the significance of electromagnetic waves.**
- **Explain interference phenomena of light, including experiments such as Young's double-slit experiment, Newton's rings, and interferometers.**
- **Describe diffraction, polarization, and other optical phenomena using the wave theory of light and apply these concepts to optical instruments.**
- **Perform experiments and measurements in optics laboratories, such as determining the wavelength of light using Newton's rings or Fresnel biprism .**

COURSE 3: WAVES AND OPTICS

Theory	Credits: 3	3 hrs/week

COURSE OBJECTIVE

The course aims to develop a foundational understanding of oscillatory motion, wave behavior in strings and bars, and optical phenomena like interference, diffraction, and polarization. Students will learn to mathematically analyze vibrations and light behavior through theoretical and experimental approaches.

LEARNING OUTCOMES

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

1. **Describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed and utilize mathematical relationships related to wave characteristics.**
2. **Distinguish between Longitudinal and Transverse waves.**
3. **Understand the phenomenon of interference of light and its formation in Thin films and Newton's rings.**
4. **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**
5. **Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.**

UNIT-I:SIMPLE HARMONIC, DAMPED & FORCED OSCILLATIONS (9 Hrs.)

Simple Harmonic Oscillator: Solution of differential equation, and physical characteristics, Principle of superposition, Combination of two mutually perpendicular SHMs (1:1) -Lissajous figures. Damped Harmonic Oscillator: Solution of differential equation, Logarithmic decrement, relaxation time, quality factor - Forced Oscillations: Solution of differential equation.

UNIT-II VIBRATING STRINGS AND BARS (9 Hrs.)

Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Longitudinal vibrations in bars- wave equation and its general solution. Bar fixed at both ends Tuning fork.

UNIT-III: INTERFERENCE (9 hrs.)

Principle of superposition – 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's rings in reflected light. Determination of wavelength of monochromatic light using Newton's rings.

UNIT-IV: DIFFRACTION (9 hrs.)

Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit, 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, Difference between interference and diffraction.

UNIT-V: POLARIZATION (9 hrs.)

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

COURSE 3: WAVES AND OPTICS

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

1. **Determine fundamental mechanical quantities like acceleration due to gravity and spring constant using compound pendulum and spring-based experiments, applying principles of oscillatory motion.**
2. **Apply statistical methods to analyze experimental data, estimate errors, and understand the importance of precision in repeated time-period measurements using a simple pendulum.**
3. **Explore wave phenomena through sonometer experiments, verifying laws of vibrations in stretched strings, and understand the relationship between frequency, tension, and length.**
4. **Analyze interference patterns in Newton's rings and wedge method to determine lens curvature and wire thickness, demonstrating coherence and phase concepts in light.**
5. **Examine diffraction effects using grating and prisms to determine wavelength and dispersive power, and assess optical resolving capabilities of telescopes and gratings.**
6. **Investigate polarization phenomena through polarimetry and understand optical activity by determining specific rotation of optically active substances.**

Minimum of 6 experiments to be conducted and recorded

1. **Determination of 'g' by compound/bar pendulum**
2. **Determination of the force constant of a spring by static and dynamic method.**

3. **Verification of laws of vibrations of stretched string –sonometer.**
4. **Determination of radius of curvature of a given convex lens-Newton's rings.**
5. **Resolving power of grating.**
6. **Study of optical rotation – polarimeter.**
7. **Fourier transform simulation of single slit diffraction**
8. **Fourier transform simulation of diffraction at circular, rectangular aperture, edge**
9. **Dispersive power of a prism.**
10. **Determination of wavelength of light using diffraction grating-normal incidence method.**
11. **Determination of wavelength of laser light using diffraction grating.**
12. **Resolving power of a telescope.**
13. **Refractive index of a liquid-hallow prism.**
14. **Determination of thickness of a thin wire by wedge method.**

HEAT AND THERMODYNAMICS

COURSE OUTCOMES:

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

- **Understand the basic concepts of heat, temperature, and thermal expansion in different materials.**
- **Apply the principles of heat transfer such as conduction, convection, and radiation to physical systems.**
- **Explain the laws of thermodynamics and their applications in physical and engineering processes.**
- **Analyze thermodynamic systems using concepts such as work, heat, internal energy, and entropy.**
- **Evaluate the efficiency and performance of heat engines, refrigerators, and thermodynamic cycles.**

COURSE 4: HEAT AND THERMODYNAMICS

Theory Credits: 3 3 hrs/week

COURSE OBJECTIVE

The course on Heat and Thermodynamics aims to provide students with a fundamental understanding of the principles of heat and energy transfer and their applications in various fields

LEARNING OUTCOMES

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

1. **Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases**
2. **Gain knowledge on the basic concepts of thermodynamics, the first and the second law of thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations. Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency**
3. **Develop critical understanding of concept of Thermodynamic potentials, the formulation of Maxwell's equations and its applications.**
4. **Differentiate between principles and methods to produce low temperature, liquefy air, and understand the practical applications of substances at low temperatures.**
5. **Examine the nature of black body radiations and the basic theories.**

UNIT-I: KINETIC THEORY OF GASES (9 hrs.)

Kinetic Theory of gases- Introduction, Maxwell's law of distribution of molecular velocities, Mean free path, Principle of equipartition of energy, Transport phenomenon in ideal gases: viscosity and Thermal conductivity.

UNIT-II: THERMODYNAMICS (9 hrs.)

Introduction- Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature, second law of thermodynamics Entropy: Physical significance, change in entropy in reversible and irreversible processes-Temperature- Entropy (T-S) diagram and its uses.

UNIT-III:THERMODYNAMIC POTENTIALS AND MAXWELL'S EQUATIONS (9 hrs.)

Thermodynamic Potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Clausius-Clayperon's equation, Joule-Kelvin coefficient for ideal and Van der Waals' gases.

UNIT-IV: LOW TEMPERATURE PHYSICS (9 hrs.)

Methods for producing very low temperatures, Critical temperature, Inversion temperature, Joule Kelvin effect, porous plug experiment, Joule expansion, Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Production of low temperatures by adiabatic demagnetization, Refrigeration.

UNIT-V: QUANTUM THEORY OF RADIATION (9 hrs.)

Black body, Ferry's black body, Spectral energy distribution of black body radiation, Wein's displacement law and Rayleigh- Jean's law (No derivations), Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh- Jean's law from Planck's law, Solar constant and its determination using Angstrom pyrheliometer, Estimation of surface temperature of Sun.

COURSE 4: HEAT AND THERMODYNAMICS

Practical   Credits: 1   2 hrs/week

COURSE OBJECTIVE

The objectives for practicals in Heat and Thermodynamics can vary depending on the specific course or program, but here are some general objectives that may apply, to develop practical skills in the use of laboratory equipment and experimental techniques for studying heat and thermodynamics.

LEARNING OUTCOMES

1. **Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying heat and thermodynamics.**
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 heat and thermodynamics, including the laws of thermodynamics, heat transfer, and thermodynamic cycles.**

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 bad conductor - Lee's method**

3. **Thermal conductivity of rubber.**
4. **Measurement of Stefan's constant.**
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 - Potentiometer**
8. **Thermal behavior of an electric bulb (filament/torch light bulb)**
9. **Study of variation of resistance with temperature - Thermistor.**
10. **Thermal expansion of solids using metal ball and a ring.**

SEMESTER-III

OPTICS

CORSE OUTCOMES:

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

- **Understand the fundamental principles of light and the nature of electromagnetic waves.**
- **Explain the phenomena of interference of light and analyze interference patterns in different optical setups.**
- **Describe diffraction of light and evaluate diffraction patterns produced by single slit, double slit, and diffraction gratings.**
- **Understand the concept of polarization of light and explain methods of producing and analyzing polarized light.**
- **Apply the principles of optics to study optical instruments such as microscopes, telescopes, and spectrometers.**

COURSE 5: OPTICS

Theory **Credits: 3** **3hrs/week**

COURSE OBJECTIVE

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

LEARNINGOUTCOMES

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

1. **Explain 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.**

UNIT-I ABERRATIONS (9 hrs.)

Introduction- Monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration, achromatic doublet, achromatism for two lenses in contact and separated by a distance.

UNIT-II INTERFERENCE (9 hrs.)

Principle of superposition, conditions for interference of light. Fresnel's bi- prism, determination of wavelength of light. 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 nonparallel reflecting surfaces (Wedge shaped film) and determination of diameter of wire. Newton's rings in reflected light, determination of wavelength of monochromatic light using Newton's rings. Construction and working of Michelson Interferometer.

UNIT-III DIFFRACTION (9 hrs.)

Introduction, distinction between Fresnel and Fraunhoffer diffraction. Fraunhoffer diffraction due to single slit and N slits. Resolving power of grating, determination of wavelength of light in normal incidence using diffraction grating. Fresnel's half period zones, zone plate, comparison of zone plate with convex lens, difference between interference and diffraction.

UNIT-IV POLARIZATION (9 hrs.)

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

UNIT-V LASERS AND HOLOGRAPHY (9 hrs.)

Lasers: introduction, stimulated absorption, 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.

COURSE5: OPTICS

Practical **Credits:1** **2hrs/week**

COURSEOBJECTIVE

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

LEARNINGOUTCOMES

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.**

HEAT AND THERMODYNAMICS

COURSE OUTCOMES:

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

- **Understand the fundamental principles of light and the nature of electromagnetic waves.**
- **Explain the phenomena of interference of light and analyze interference patterns in different optical setups.**
- **Describe diffraction of light and evaluate diffraction patterns produced by single slit, double slit, and diffraction gratings.**
- **Understand the concept of polarization of light and explain methods of producing and analyzing polarized light.**
- **Apply the principles of optics to study optical instruments such as microscopes, telescopes, and spectrometers.**

COURSE 6: HEAT AND THERMODYNAMICS

Theory **Credits:3** **3hrs/week**

COURSE OBJECTIVE

The course on Heat and Thermodynamics aims to provide students with a fundamental understanding of the principles of heat and energy transfer and their applications in various fields.

LEARNING OUTCOMES

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

1. **Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases.**
2. **Gain knowledge on the basic concepts of thermodynamics, the first and the second law of thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations. Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency**
3. **Develop critical understanding of concept of Thermodynamic potentials, the formulation of Maxwell's equations and its applications.**
4. **Differentiate between principles and methods to produce low temperature, liquefier, and understand the practical applications of substances at low temperatures.**
5. **Examine the nature of black body radiations and the basic theories.**

UNIT-I KINETIC THEORY OF GASES (9 hrs.)

Kinetic Theory of gases- Introduction, Maxwell's law of distribution of molecular velocities. Mean free path, principle of equipartition of energy. Transport phenomenon in ideal gases: viscosity, diffusion and thermal conductivity.

UNIT-II: THERMODYNAMICS (9 hrs.)

Introduction- Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature, Second law of thermodynamics. Entropy: Physical significance, Change in entropy in reversible and irreversible processes, Temperature-Entropy (T-S) diagram and its uses.

UNIT-III THERMODYNAMIC POTENTIALS AND MAXWELL'S EQUATIONS (9 hrs.)

Thermodynamic Potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance. Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Clausius - Clayperon's equation, Joule-Kelvin coefficient for ideal and Vander Waals' gases.

UNIT-IV LOW TEMPERATURE PHYSICS (9 hrs.)

Methods for producing very low temperatures, Joule Kelvin effect, porous plug experiment, Joule expansion, distinction between adiabatic and Joule Thomson expansion, expression for Joule Thomson cooling, production of low temperatures by adiabatic demagnetization.

UNIT-V QUANTUM THEORY OF RADIATION (9 hrs.)

Spectral energy distribution of black body radiation. Concept of Wein's displacement law, Rayleigh-Jean's law and Planck's law of black body radiation. Deduction of Wein's law and Rayleigh- Jean's law from Planck's law. Solar constant and its determination using Angstrom pyrheliometer, estimation of surface temperature of Sun.

COURSE6: HEAT AND THERMODYNAMICS

Practical Credits:1 2hrs/week

COURSE OBJECTIVE

The objectives for practical in Heat and Thermodynamics can vary depending on the specific course or program, but here are some general objectives that may apply, to develop practical skills in the use of laboratory equipment and experimental techniques for studying heat and thermodynamics.

LEARNING OUTCOMRES

1. **Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying heat and thermodynamics.**
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 heat and thermodynamics, including the laws of thermodynamics, heat transfer, and thermodynamic cycles.**

Minimum of 6experiments to be done and recorded

1. **Specific heat of a liquid –Joule's calorimeter–Barton's radiation correction**
2. **Thermal conductivity of bad conductor-Lee's method**

3. **Thermal conductivity of rubber.**
4. **Measurement of Stefan’s constant.**
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 e.m.f of a thermocouple-Potentiometer**
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.**

ELECTRONIC DEVICES AND CIRCUITS

COURSE OUTCOMES:

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

- **Understand semiconductor fundamentals such as energy bands, charge carriers, and the working principles of PN junction diodes.**

- **Analyze the characteristics of semiconductor devices like diodes, Zener diodes, BJTs, and FETs used in electronic circuits.**

- **Explain the operation of rectifiers, filters, and voltage regulators used in power supply circuits.**

- **Design and analyze transistor amplifier circuits including common emitter, common base, and common collector configurations.**

- **Evaluate the performance of electronic circuits using different biasing techniques and small-signal models.**

- **Apply electronic devices in practical circuits such as switching circuits and simple amplifier applications.**

COURSE7: ELECTRONIC DEVICES AND CIRCUITS

Theory **Credits:3** **3hrs/week**

COURSEOBJECTIVE

The course on Electronic Devices and Circuits aims to provide students with a fundamental understanding of electronic devices and their applications in various circuits.

LEARNING OUTCOMES

1. **Understand the behavior of P-N junction diodes in forward and reverse bias conditions and analyze the impact of junction capacitance on diode characteristics.**
2. **Analyze and compare the characteristics and operation of different BJT configurations (CB, CE, and CC) and demonstrate proficiency in biasing techniques.**
3. **Comprehend the operation and characteristics of FETs, including JFETs and MOSFETs, and explain the working principles and characteristics of UJTs.**
4. **Describe the operation and applications of various photoelectric devices such as LEDs, photo diodes, phototransistors, and LDRs.**
5. **Understand the operation of rectifiers (half-wave, full-wave, and bridge), analyze the ripple factor and efficiency, and demonstrate knowledge of different filter types and three-terminal voltage regulators.**

UNIT I: P N JUNCTION DIODES (9 hrs.)

P-N junction diode, formation of depletion region, forward and reverse bias, working, V-I characteristics and applications – tunnel diode: construction, working, V-I characteristics and applications, Zener diode: construction, working, V-I characteristics and applications

UNIT –II: BIPOLAR JUNCTION TRANSISTOR AND ITSBIASING (D.C) (9 hrs.)

Transistor construction, working of PNP and NPN transistors, active, cutoff and saturation conditions, configurations of transistor - CB, CE, and CC. Input and output characteristics of CE configuration.

Hybrid parameters of a transistor and equivalent circuit, BJT transistor biasing.

UNIT-III:FIELD EFFECT TRANSISTORS & POWER ELECTRONIC DEVICES (9 hrs.)

Difference between JFET and BJT, construction and working of JFET, drain and transfer characteristics. FET biasing: voltage divider biasing. UJT- construction, working, V-I characteristics. SCR construction, working and characteristics.

UNITIV: PHOTO ELECTRIC DEVICES

Light Emitting Diodes (LEDs) - construction, working, characteristics and applications. Photodiode - construction, working, characteristics and applications. Phototransistor - construction, working, characteristics and applications. Structure and operation of LDR, applications.

UNIT-V: POWER SUPPLIES

Rectifiers: half wave, full wave and bridge rectifiers - efficiency (no derivations), ripple factor- Zener diode as voltage regulator, filters- choke input (inductor), L-section, π-section filters. Three terminal fixed voltage IC-regulators (78XXand 79XX).

COURSE7: ELECTRONIC DEVICES AND CIRCUITS

Practical **Credits:1** **2 hrs/week**

COURSEOBJECTIVE

The course objectives for a practical course in Electronic Devices and Circuits might provide hands-on experience with the fundamental principles of electronic devices and circuits.

LEARNING OUTCOMES

1. **Understand the principles of electronic devices and circuits and their applications in realworld scenarios.**
2. **Analyze and design electronic circuits using diodes, transistors, and operational amplifiers.**
3. **Understand the importance of biasing and stability in electronic circuits and how to achieve them.**
4. **Develop the skills to design and analyze amplifier circuits and to understand the concept of feedback and its application in electronic circuits.**
5. **Analyze and design simple oscillators, power supplies, and filters.**
6. **Gain hands- on experience with electronic test equipment such as millimeters, oscilloscopes, and function generators.**
7. **Develop skills in circuit construction, measurement, and testing.**
8. **Learn how to troubleshoot and diagnose electronic circuit problems.**
9. **Understand the safety procedures for working with electronic circuits and equipment.**

Minimum of 6 experiments to be done and recorded

1. **V-I Characteristics of junction diode**
2. **V-I Characteristics of Zener diode**

3. **Transistor characteristics–CB configuration**
4. **Transistor characteristics–CE configuration**
5. **FET input and output characteristics**
6. **UJT characteristics**
7. **LDR characteristics**
8. **Full wave and Bridge rectifier with filters**

ANALOG AND DIGITAL ELECTRONICS

COURSE OUTCOMES:

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

- **Understand the basic concepts of analog and digital electronic components, including diodes, transistors, and logic gates.**
- **Analyze the operation and characteristics of analog circuits such as rectifiers, amplifiers, and transistor circuits.**
- **Explain the working principles of digital electronics, including number systems, Boolean algebra, and logic gates.**
- **Design and analyze combinational and sequential digital circuits like adders, multiplexers, flip-flops, and counters.**
- **Apply analog and digital electronic principles to solve practical circuit problems and basic electronic system design.**

COURSE8: ANALOG AND DIGITAL ELECTRONICS

Theory **Credits:3** **3hrs/week**

COURSE OBJECTIVE

The course on Analog and Digital Electronics aims to provide students with a fundamental understanding of the principles of electronic circuits and their applications in both analog and digital systems.

LEARNING OUTCOMES

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

1. **Understand Principles and Working of Operational Amplifier**
2. **Apply their knowledge on OP-Amp in different Applications**
3. **To understand the number systems, Binary codes and Complements.**
4. **To understand the Boolean algebra and simplification of Boolean expressions.**
5. **To analyze logic processes and implement logical operations using combinational logic circuits.**
6. **To understand the concepts of sequential circuits and to analyze sequential systems in terms of state machines.**

UNIT-I: OPERATIONAL AMPLIFIERS *(9 hrs.)*

a) **Concept of feedback, negative and positive feedback- basic concepts of differential amplifier, block diagram of Op amp and its equivalent circuit, IC Diagram (IC 741).**

b) **Voltage series feedback amplifier (Non-Inverting Op amp): gain and bandwidth derivations - voltage shunt feedback amplifier (Inverting Op amp): gain and bandwidth derivations.**

UNIT-II: PRACTICAL OPERATIONAL AMPLIFIER AND APPLICATIONS **(9 hrs.)**

a) Characteristics of an ideal and practical Operational Amplifier (IC 741), Input offset voltage, input bias current, input offset current, total output offset voltage, CMRR, slew rate and concept of virtual ground.

b) Applications of Op-Amp: voltage follower, summing amplifier, subtracting amplifier, integrator and differentiator.

UNIT-III: NUMBERSY STEMS, CODES AND LOGIC GATES (9 hrs.)

a) **Number Systems and Codes: Decimal, Binary, Octal and Hexadecimal number systems, conversions. BCD code and gray code conversions.**

b) **Logic Gates: Construction and truth tables of OR, AND, NOT, NOR, NAND and XOR Logic gates symbol and their truth tables. Universal gates: realization of logic gates using NAND and NOR gates.**

De Morgan's Laws.

UNIT-IV: ARITHMETIC CIRCUITS &DATA PROCESSING CIRCUITS

a) **Half Adder and Full Adder: truth tables and Circuits. Half Subtractor and Full Subtractor: truth tables and circuits.**

b) **Multiplexers - 2 to 1 multiplexer, 4 to 1 multiplexer, De-multiplexers: 1 to 2 demultiplexer, 1 to 4 demultiplexer, applications of multiplexers and demultiplexers. Decoders: 1 of 2 decoders, 2 of 4 decoders, applications of decoders.**

UNIT-V: SEQUENTIAL LOGIC CIRCUITS &CODE CONVERTERS

a) **Combinational Logic vs. sequential logic circuits, Flip-flops, Clocked SR Flip-flop, JK Flip-flop, D Flip-flop, Master-Slave Flip- flop.**

b) **Code Converters: BCD to Decimal Converter, BCD to Gray Code Converter, and BCD to 7 segment decoders.**

COURSE8: ANALOG AND DIGITAL ELECTRONICS

Practical Credits:1 2hrs/week

COURSEOBJECTIVES

The course objectives for a practical course in Analog and Digital Electronics might provide students with hands-on experience in designing, constructing, and testing analog and digital electronic circuits.

LEARNING OUTCOMES

1. **Understand the principles of analog and digital electronic circuits and their applications in realworld scenarios.**
2. **Analyze and design analog electronic circuits using diodes, transistors, and operational amplifiers.**
3. **Analyze and design digital electronic circuits using logic gates, flip-flops, and counters.**
4. **Understand the importance of biasing, feedback, and stability in electronic circuits and how to achieve them.**
5. **Develop the skills to design and analyze amplifier circuits and digital systems.**

Minimum six experiments to be done and recorded

1. **To study the operational amplifier as inverting feedback amplifier with verifying gain**
2. **To study the operational amplifier as non-inverting feedback amplifier with verifying gain**
3. **To study operational amplifier as adder**
4. **To study operational amplifier as subtractor**
5. **To study operational amplifier as differentiator**

6. **To study operational amplifier as integrator**
7. **Logic Gates- OR, AND, NOT and NAND gates. Verification of Truth Tables.**
8. **Verification of De Morgan's Theorems.**
9. **Construction of Half adder and Full adders – Verification of truth tables** **10. Flip flops**
11. **Multiplexer and De-multiplexer**
12. **Encoder and Decoder**

SEMESTER-IV

ELECTRICITY AND MAGNETISEM

COURSE OUTCOMES:

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

- **Understand the basic concepts of electrostatics, including Coulomb's law, electric field, electric potential, and Gauss's law.**
- **Analyze electric potential, capacitance, dielectric materials, and energy stored in electric fields.**
- **Explain magnetic fields produced by electric currents and apply laws such as BiotSavart law and Ampere's law.**
- **Understand electromagnetic induction, Faraday's law, Lenz's law, and the concept of self and mutual inductance.**
- **Describe Maxwell's equations and explain the fundamentals of electromagnetic waves and their applications.**

COURSE 9: ELECTRICITY AND MAGNETISM

Theory **Credits:3** **3hrs/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

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. Electric displacement D, electric polarization. Relation between D, E and P, dielectric constant and electric susceptibility.

UNIT-II CURRENT ELECTRICITY

Electrical conduction, drift velocity, current density, equation of continuity, ohms law and limitations, Kirchhoff's Law's, Wheatstone bridge balancing condition and sensitivity. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem.

UNIT-III MAGNETO STATICS

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

Electromagnetic Induction

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

UNIT-IV ELECTROMAGNETIC WAVES-MAXWELL'S EQUATIONS

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, Pointing vector, propagation of electromagnetic waves.

UNIT-V VARYING AND ALTERNATING CURRENTS

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

COURSE 9: ELECTRICITY AND MAGNETISM

Practical Credits:1 2hrs/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

1. **Demonstrate a thorough understanding of the fundamental concepts and principles of electricity and magnetism.**
2. **Apply the laws and principles of electricity and magnetism to analyze and solve electrical and magnetic problems.**
3. **Design, construct, and test electrical circuits using various components and measuring instruments.**
4. **Measure and analyze electrical quantities such as voltage, current, resistance, capacitance, and inductance using appropriate instruments.**
5. **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.**

MODERN PHYSICS

COURSE OUTCOMES:

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

- **Explain the limitations of classical physics and describe the origin of modern physics concepts such as quantum theory and relativity.**
- **Understand and analyze phenomena like photoelectric effect, Compton effect, and wave-particle duality.**
- **Describe atomic models (Bohr model) and explain atomic spectra and energy levels.**
- **Understand basic principles of quantum mechanics including wave function, uncertainty principle, and Schrödinger equation.**
- **Apply quantum concepts to simple systems such as particle in a box, potential wells, and tunneling effects.**
- **Explain the fundamentals of nuclear physics and elemental particals and thier applications.**

COURSE10: MODRN PHYSICS

Theory Credits:3 3hrs/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 awarenessandappreciationofsuperconductorsandtheirpracticalapplications**

UNIT-I INTRODUCTION TO ATOMIC STRUCTURE AND SPECTROSCOPY

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, coupling schemes, spectral terms, spectral notations, and selection rules, Zeeman Effect.

UNIT-II MOLECULAR STRUCTURE AND SPECTROSCOPY

Molecular rotational and vibrational spectra, electronic energy levels and electronic transitions, Raman Effect, characteristics of Raman Effect, experimental arrangement, quantum theory of Raman Effect, applications of Raman Effect.

UNIT-III MATTER WAVES & UNCERTAINTY PRINCIPLE

Matter waves: de Broglie's hypothesis, properties of matter waves, Davisson and Germer's experiment. Heisenberg's uncertainty principle for position & momentum and energy & 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

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.

UNIT-V SUPERCONDUCTIVITY

Introduction to Superconductivity, experimental results, critical temperature, critical magnetic field. Meissner effect, Isotope effect, Type I and Type II superconductors, BCS theory, high T_c super conductors, applications of superconductors.

COURSE10: MODRN PHYSICS

Practical **Credits:1** **2hrs/week**

COURSEOBJECTIVE

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.

LEARNINGOUTCOMES

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 handson experimentation and data analysis.**
3. **Develop proficiency in using advanced laboratory instruments and techniques specific to modern physics experiments, such as spectroscopy, interferometer, 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. **DeterminationofthePlanck'sconstantusingLEDsofatleast4differentcolours.**
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.**

INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

COURSE OUTCOMES:

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

- **Understand the basic properties of atomic nuclei, nuclear forces, binding energy, and nuclear stability.**
- **Explain different types of radioactive decay such as alpha, beta, and gamma decay and apply decay laws.**
- **Describe nuclear reactions, nuclear fission and fusion processes, and their applications in energy production.**
- **Understand the classification and properties of elementary particles such as leptons, mesons, and baryons.**
- **Explain fundamental interactions and conservation laws involved in particle physics.**
- **Gain knowledge particle accelerators of nuclear detectors, and modern and particle physics.**

INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Theory Credits:3 3hrs/week

COURSE OBJECTIVE

The course aims to provide students with an understanding of the principles of Nuclear and Particle physics and their applications in various fields.

LEARNING OUTCOMES

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

1. **Know about high energy particles and their applications which prepare them for further study and research in particle physics.**
2. **Students can explain important concepts on nucleon-nucleon interaction, such as its short- range, spin dependence, isospin, and tensors.**
3. **Students can show the potential shapes from nucleon interactions.**
4. **Students can explain the single particle model, its strengths, and weaknesses 5. Students can explain magic numbers based on this model**

UNIT-I: INTRODUCTION TO NUCLEAR PHYSICS

Nuclear Structure: General Properties of Nuclei, Mass defect, Binding energy; Nuclear forces: Characteristics of nuclear forces- Yukawa's meson theory; Nuclear Models- Liquid drop model- nuclear shell model.

UNIT-II: ELEMENTARY PARTICLES AND INTERACTIONS

Discovery and classification of elementary particles, properties of leptons, mesons and baryons; Types of interactions- strong, electromagnetic and weak interactions; conservation laws, isospin, parity, charge conjugation.

UNIT-III: NUCLEAR REACTIONS AND NUCLEAR DETECTORS

Nuclear Reactions: Types of reactions, Conservation Laws in nuclear reactions, nuclear cross-section.

Nuclear detectors: Geiger- Muller counter, Scintillation counter, Cloud chamber.

UNIT-IV: NUCLEAR DECAYS AND NUCLEAR ACCELERATORS

Nuclear Decays: Gamow's theory of alpha decay, Fermi's theory of Beta decay. Nuclear Accelerators: electrostatic and electro dynamics accelerators, Cyclotron - construction, working and applications.

Synchrocyclotron- construction, working and applications.

UNIT-V: APPLICATIONS OF NUCLEAR AND PARTICLE PHYSICS

Medical Applications: Radiation therapy and imaging techniques. Nuclear energy: nuclear reactors and power generation. Particle physics in high-energy astrophysics.

COURSE11: INTRODUCTIONTO NUCLEARAND PARTICLEPHYSICS

Practical **Credits:1** **2hrs/week**

COURSEOBJECTIVE

1. **To familiarize students with experimental techniques and methodologies used in nuclear and particle physics.**
2. **To provide hands-on experience in conducting experiments related to nuclear and particle physics.**

LEARNING OUTCOMES

1. **Gain a solid understanding of fundamental concepts in nuclear and particle physics.**
2. **Acquire knowledge of experimental technique sand methodologies used in the field.**
3. **Understand the principles and operation of laboratory equipment and instruments specific to nuclear and particle physics experiments.**
4. **Develop proficiency in conducting experiments related to nuclear and particle physics.**
5. **Acquire skills in data acquisition, analysis, and interpretation using appropriate software and techniques.**
6. **Learn to design and perform experiments, including calibration, measurement, and control of variables.**

LIST OF EXPERIMENTS

1. **G.M. counter–Determination of dead time.**
2. **Study of characteristic curve of GM counter and estimation of its operating voltage.**
3. **Estimation of efficiency for a gamma source of the GM counter**
4. **To verify inverse square law using GM counter**
5. **Production and attenuation of bremsstrahlung**
6. **Estimation of efficiency for a beta source of the GM counter**
7. **7. Study of back scattering of beta particles**

SEMESTER-V

APPLICATIONS OF ELECTRICITY AND ELECTRONICS

COURSE OUTCOMES:

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

- **Explain the fundamental principles of electric and magnetic fields and their practical applications in everyday devices.**
- **Analyze the working principles of electrical components such as capacitors, inductors, transformers, and electric motors.**
- **Apply the concepts of electromagnetic induction and Maxwell's equations to understand electrical machines and power generation systems.**
- **Evaluate the role of electricity and magnetism in modern technologies such as communication systems, medical equipment, and electronic devices.**
- **Design and interpret simple electrical and magnetic circuits used in practical engineering and scientific applications.**
- **Develop problem-solving skills to analyze real-world cations involving electromagnetic phenomena .**

APPLICATIONS OF ELECTRICITY AND ELECTRONICS

Theory **Credits:3** **3hrs/week**

Applications of Electricity and Magnetism

Unit–1: Introduction to Passive Elements

a. Passive elements

Resistor – types of resistors, color coding, combination of resistors – series combination (voltage division), parallel combination (current division), Ohm's law and its limitation.

Inductor – principle, EMF induced in an inductor, energy stored in inductor, types of inductors.

Capacitor – principle, charging and discharging of a capacitor, types of capacitors.

b. Applications of Passive Elements

Applications of a resistor as a heating element in heaters and as a fuse element.

Applications of inductors, application of choke in a fan and in a radio tuning circuit, series resonance circuit as a radio tuning circuit.

Applications of capacitor in power supplies, motors (fans).

Unit–2: Power Sources Batteries

a. Power Sources

Types of power sources – DC & AC sources, different types of batteries, re-chargeable batteries, lead acid batteries, Li-ion batteries.

b. Network Theorems for DC Circuits

Thevenin's theorem, Norton's theorem, maximum power transfer theorem, applications of current sources & voltage sources, SMPS used in computers.

Unit–3: Alternating & Direct Currents

a. A.C. generator – construction and its working principle, types of AC generators, DC generators, construction and its working principle, advantages and disadvantages, applications, difference between DC and AC generators.

b. Transformers – construction and its working principle, EMF equation, types of transformers – step-down and step-up transformers, relation between primary turns and secondary turns of the transformer with e.m.f., use of a transformer in a regulated power supply.

Unit–4: Modulation Circuits

a. Need for modulation, types of modulation, amplitude modulation, modulation index, wave forms, power relations, demodulation, diode detector, frequency modulation.

b. Transmitters and Receivers

AM transmitter, AM receiver, FM transmitter, FM receiver.

Unit–5: Applications of EM Induction & Power Supplies

a. DC motor – construction and operating principle, calculation of power, voltage and current in a DC motor.

b. Working of a DC regulated power supply, construction of a 5 volts regulated power supply, checking the output voltage of a battery eliminator using a multimeter (trouble shooting), design of a simple 5 volts DC charger, power supply for computers (SMPS).

ELECTRONIC INSTRUMENTATIONS

COURSE OUTCOMES:

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

- **Understand basic concepts of electronic instrumentation, measurement systems, and performance characteristics such as accuracy, precision, sensitivity, and resolution.**
- **Explain the working principles of transducers and sensors used for measuring physical quantities like temperature, pressure, displacement, and flow.**
- **Analyze signal conditioning circuits including amplifiers, filters, and converters used in instrumentation systems.**
- **Describe the operation of measuring instruments such as oscilloscopes, digital voltmeters, and signal generators.**
- **Apply data acquisition techniques and understand analog-to-digital and digitaltoanalog conversion in measurement systems.**
- **Design and evaluate basic electronic instrumentation is for practical measurement and control applications.**

Electronic Instrumentation

THEORY

Unit–1: Introduction to Instruments

a. Basics of measurements: classification of instruments, analog instruments & digital instruments, construction and working of an analog multimeter and digital multimeter (block diagram approach), DC voltmeter and AC voltmeter, specifications of multimeter and their significance.

b. Balancing and damping, moving iron instruments & PMMC instruments.

Unit–2: Oscilloscope

a. Cathode ray oscilloscope – principle and block diagram of CRO, cathode ray tube – functioning, various controls.

b. Applications of CRO: measurement of voltage (DC and AC), frequency & time period, different types of oscilloscopes and their uses.

Unit–3: Transducers and Bridges

a. Linear Variable Differential Transformer (LVDT), resistive, capacitive & inductive transducers, piezo-electric transducer.

b. DC bridge – Wheatstone's bridge, AC bridge – measurement of inductance and capacitance – Maxwell's bridge, Schering bridge, measurement of frequency – Wien's bridge

Unit–4: ADC and DAC & Display Instruments

a. A/D & D/A converters – Binary ladder, A/D converters.

b. Introduction to display devices, LED displays, seven segment displays, construction and operation (display of numbers), types of SSDs (common anode & common cathode type), liquid crystal displays, principle and working, applications of LCD modules.

Unit–5: Amplifiers, Oscillators & Biomedical Instruments

a. Amplifiers – classification of amplifiers, coupling amplifiers – RC coupled amplifier, frequency response characteristics (no derivation), feedback in electronic circuits –

positive and negative feedback, expressions for gains, advantages of negative feedback, Barkhausen criteria, RC phase shift oscillator.

b. Basic operating principles and uses of:

i) ECG machine

ii) Ultrasound

iii) Ventilator

iv) Pulse oximeter

OPTICAL INSTRUMENTS AND OPTOMETRY

COURSE OUTCOMES:

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

- **Understand the basic principles of optics used in optical instruments and optometric devices.**
- **Explain the construction and working of common optical instruments such as microscopes, telescopes, spectrometers, and optical sensors.**
- **Describe the structure and function of the human eye and understand common vision defects such as myopia, hypermetropia, astigmatism, and presbyopia.**
- **Analyze different optometric techniques used for vision testing and correction of eye defects.**
- **Demonstrate knowledge of corrective lenses and optical devices used in optometry, including spectacles and contact lenses.**
- **Apply optical principles in the design, calibration, and use of optical instruments for scientific and medical applications.**

Optical Instruments and Optometry

THEORY

Unit–1: Optical Microscopes

Simple microscope – construction, magnifying power, normal adjustment; compound microscope – construction, magnifying power, normal adjustment; phase contrast microscope – operating principle; travelling microscope – construction, working and uses.

Unit–2: Telescopes

Refracting telescopes and reflecting telescopes, construction, working and magnifying power of astronomical telescope and terrestrial telescopes. Binoculars – working principle and applications.

Unit–3: Application of Optical Instruments

Introductory ideas and applications of various microscopes viz.,

(i) Electron microscopes (TEM, SEM)

(ii) Scanning probe microscope

(iii) Scanning acoustic microscope

(iv) X-ray microscope

Introductory ideas and applications of various telescopes viz.,

(i) Optical telescopes

(ii) Radio telescopes

(iii) Infrared telescope

(iv) Ultraviolet telescope

Unit – IV : Optical Vision

Introduction to optical vision, eye as an optical instrument, formation of image in the eye and the camera, ophthalmic lenses, myopia and hypermetropia defects, removal of defects in vision using ophthalmic lenses, contact lenses – working principle, different types of contact lenses.

Unit – V : Ophthalmic Techniques and Optometry

Ophthalmoscope and keratometer and their working principles, evaluation of eye disorders, guidelines for standardized eye chart preparation, simple phoropter and its working principle and its uses, principles of computer based eye testing.

SOLAR ENERGY AND ITS APPLICATIONS

COURSE OUTCOMES:

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

- **Understand the basic concepts of solar radiation, solar energy potential, and the importance of renewable energy resources.**
- **Explain the principles and working of different solar energy technologies such as solar thermal systems and photovoltaic systems.**
- **Analyze the design and performance of solar energy devices including solar collectors, solar cells, and solar panels.**
- **Apply solar energy technologies for various applications such as solar water heating, solar cooking, solar drying, and solar power generation.**
- **Evaluate the advantages, limitations, and economic aspects of solar energy systems for sustainable development.**
- **Develop awareness of recent advancements and practical applications of solar energy in domestic, industrial, and agricultural sectors.**

Solar Energy and its Applications

THEORY

Unit – 1 : Basic concepts of Solar Energy

Spectral distribution of solar radiation, solar constant, zenith angle and air-mass, standard time, local apparent time, equation of time, direct, diffuse and total radiations, pyrheliometer – working principle, direct radiation measurement, pyranometer – working principle, diffuse radiation measurement. Distinction between the two meters.

Unit – 2 : Solar Thermal Collectors

Solar thermal collectors, types of thermal collectors, flat plate collector, liquid heating type, energy balance equation and efficiency, testing of flat-plate collector – solar water heating system, natural and forced circulation types – concentrating collectors – solar cookers – solar dryers – solar desalinizators.

Unit – 3 : Fundamentals of Solar Cells

Semiconductor interface, types, homo junction, hetero junction and Schottky barrier, advantages and drawbacks, photovoltaic cell, equivalent circuit, output parameters, conversion efficiency, quantum efficiency, measurement of I-V characteristics, series and shunt resistance, their effect on efficiency, effect of light intensity, inclination and temperature on efficiency.

Unit – 4 : Types of Solar Cells and Modules

Types of solar cells, crystalline silicon solar cells, I-V characteristics, poly-Si cells, amorphous silicon cells, thin film solar cells – CdTe/CdS cell configurations, advantages and limitations, module fabrication steps, modules in series and parallel, bypass and blocking diodes

Unit – 5 : Solar Photovoltaic Systems

Energy storage in PV systems – on grid, off-grid and stand-alone, batteries – primary and secondary, electrochemical storage – lead acid battery, solid-state battery – Li-ion battery, mechanical storage – flywheel, electrical storage – supercapacitor.

SRI V.S.SIVALINGAM CHETTIAR GOVERNMENT DEGREE COLLEGE

SULLURPET,TIRUPATI DISTRICT,ANDHRA PRADESH

PROGRAMME OUTCOMES

On successful completion of the Physics program, students will be able to:

PO1 – Fundamental Knowledge of Physics
Demonstrate a strong understanding of fundamental concepts in physics including mechanics, waves, optics, thermodynamics, electricity, magnetism, electronics, modern physics, and nuclear physics.

PO2 – Mathematical and Analytical Skills
Apply mathematical tools such as calculus, differential equations, vector algebra, and linear algebra to analyze and solve physical problems.

PO3 – Scientific Problem Solving
Identify, formulate, and solve theoretical and practical physics problems using logical reasoning, analytical thinking, and appropriate physical principles.

PO4 – Experimental and Laboratory Skills
Design and perform physics experiments, analyze experimental data, and interpret results using appropriate laboratory techniques and scientific methods.

PO5 – Application of Physics in Technology
Apply principles of physics in the understanding and design of technological systems such as electronic circuits, electrical machines, optical instruments, and renewable energy devices.

PO6 – Use of Modern Scientific Tools
Utilize modern scientific instruments, electronic devices, and computational tools for measurement, data analysis, and scientific investigations.

PO7 – Interdisciplinary Knowledge
Integrate concepts from physics, electronics, mathematics, and engineering to address interdisciplinary scientific and technological problems.

PO8 – Environmental and Energy Awareness
Understand the importance of sustainable energy resources and apply knowledge of renewable energy technologies such as solar energy for environmental sustainability.

PO9 – Communication and Scientific Reporting
Communicate scientific ideas, experimental results, and technical information effectively through written reports, presentations, and discussions.

PO10 – Lifelong Learning and Professional Development
Develop the ability for independent learning, critical thinking, and continuous professional development in the fields of physics, technology, and research.

PO11 – Ethical and Social Responsibility
Understand the ethical responsibilities of scientists and apply physics knowledge for the benefit of society and technological advancement.

PO12 – Career and Research Readiness
Demonstrate preparedness for higher studies, research, teaching, or careers in physics, electronics, instrumentation, renewable energy, and related scientific fields.

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PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the **Physics Program**, students will be able to:

PSO1 – Core Physics Knowledge
Apply fundamental principles of classical mechanics, thermodynamics, optics, electricity and magnetism, modern physics, and electronics to understand physical phenomena.

PSO2 – Experimental and Instrumentation Skills
Perform physics experiments using laboratory instruments, electronic devices, optical instruments, and measurement systems to analyze physical parameters accurately.

PSO3 – Application of Physics in Technology
Use concepts of electronics, instrumentation, optics, and renewable energy to understand and develop practical applications in modern technology and industry.

PSO4 – Research and Analytical Ability
Use mathematical methods, data analysis, and scientific reasoning to solve complex physical problems and pursue higher studies or research in physics and related fields.

COURSE OUTCOME – PROGRAM OUTCOME (CO–PO) MAPPING TABLE

(Scale generally used)

- **3 – High correlation**
- **2 – Medium correlation**
- **1 – Low correlation**
- **– No correlation**

SEMESTER I

INTRODUCTION TO MATHEMATICAL PHYSICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	–	–	–	1	–	–	1
CO2	2	3	3	–	–	–	1	–	–	1
CO3	3	3	2	–	–	–	1	–	–	–
CO4	2	3	2	–	–	–	1	–	–	–

MECHANICS AND PROPERTIES OF MATTER

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	–	1	–	–	–	–	1
CO2	3	2	3	–	1	–	–	–	–	–
CO3	3	2	2	–	1	–	–	–	–	–
CO4	2	2	3	–	1	–	–	–	–	1

SEMESTER II

WAVES AND OPTICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	–	–	–	–	–	–
CO2	3	3	2	1	–	–	–	–	–	–
CO3	2	3	3	1	–	–	–	–	–	–
CO4	3	2	2	1	–	–	–	–	–	–

HEAT AND THERMODYNAMICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	–	–	–	–	–	–	–
CO2	3	2	3	–	1	–	–	–	–	–
CO3	3	2	3	–	1	–	–	–	–	–
CO4	2	2	3	–	1	–	–	–	–	–

SEMESTER III

ELECTRONIC DEVICES AND CIRCUITS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	3	2	–	–	–	–
CO2	2	2	3	1	3	2	–	–	–	–
CO3	2	2	3	1	3	2	–	–	–	–
CO4	2	2	3	1	3	2	–	–	–	–

ANALOG AND DIGITAL ELECTRONICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	1	3	3	–	–	–	–
CO2	2	2	3	1	3	3	–	–	–	–
CO3	2	2	3	1	3	3	–	–	–	–
CO4	2	2	3	1	3	3	–	–	–	–

SEMESTER IV

ELECTRICITY AND MAGNETISM

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	–	2	–	–	–	–	–
CO2	3	2	3	–	2	–	–	–	–	–
CO3	3	2	3	–	2	–	–	–	–	–
CO4	3	2	2	–	2	–	–	–	–	–

MODERN PHYSICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	–	–	–	–	–	–	–
CO2	3	2	3	–	–	–	–	–	–	–
CO3	3	2	3	–	–	–	–	–	–	–
CO4	2	2	3	–	–	–	–	–	–	–

SEMESTER V

APPLICATIONS OF ELECTRICITY AND ELECTRONICS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	–	3	2	–	–	–	–
CO2	2	2	3	–	3	2	–	–	–	–
CO3	2	2	3	–	3	2	–	–	–	–

ELECTRONIC INSTRUMENTATION

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	3	3	–	–	–	–
CO2	2	2	3	2	3	3	–	–	–	–
CO3	2	2	3	2	3	3	–	–	–	–

SOLAR ENERGY AND ITS APPLICATIONS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	–	3	2	–	3	–	–
CO2	2	2	3	–	3	2	–	3	–	–
CO3	2	2	3	–	3	2	–	3	–	–

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SULLURPET, TIRUPATI DISTRICT, ANDHRAPRADESH

B.Sc., Mathematics, Physics, Chemistry

Understand and use atomic and molecular structural concepts to predict chemical characteristics and reactivity.

Perform, plan, analyze, and document laboratory experiments using critical dinking and scientific inquiry at a level appropriate for success in a chemistry graduate programme or an entry-level career in the chemical industry,

Be able to analyze and use results provided by instrumental chemical studies, as well as understand theoretical ideas of equipment typically employed in most chemistry specialties.

Know how to apply biological sciences to apiculture, aquaculture, and agriculture, and how to do it effectively

How Study the diversity of Archegoniate as well as plant morphology, taxonomy, and Embryology to gain a better understanding of the origin of life, evolution, and microbiological diversity

Research plant metabolism, physiological principles, genetics, and plant breeding strategies and learn about ecological and photo geographic studies

Be familiar with the fundamentals of plant tissue culture, biotechnology, and plant diversity.

Know the fundamentals of ethnobotany and medicinal botany, as well as pharmacognosy and phytochemistry.

Identify and classify the primary groups of life using a phylogenetic framework

Perform procedures in the areas of biochemistry, bioinformatics, taxonomy, economic zoology, and ecology according to laboratory standards.

Know how to apply biological sciences to apiculture, aquaculture, agriculture, and medicine, and how to do it effectively.

Develop expertise in the experimental methodologies and analysis methods suited to their field of biology specialty.

Understand and use atomic and molecular structural concepts to predict chemical characteristics and reactivity.

Perform, plan, analyse, and document laboratory experiments using critical thinking and scientific inquiry at a level appropriate for success ma chemistry graduate programing or an entry-level career in the chemical industry.

Be able to analyse and use results provided by instrumental chemical studies, as well as understand theoretical ideas of equipment typically employed in most chemistry specialties

Know how to apply biological sciences to apiculture, aquaculture, and agriculture. and how to do it effectively.