SEMESTER-I

COURSE-1: INTRODUCTION TO MATHEMATICAL PHYSICS

Theory

Credits: 3 3 hr. /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.

SYLLABUS

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

Distinction between Ordinary and partial derivatives, 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.)

Vector and Scalar quantities in Physics, Matrices and Operations: Types, Addition and Multiplication, Identity and Inverse, Determinant (2x2 and 3x3), Trace, Transpose, Eigenvalues and Eigen Vectors, Calculation of Eigen values using characteristic equations. 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. Phasor representation: representation of voltage and current as phasors, Derivation of Impedance of a series LCR circuit.

UNIT – IV PROBABILITY (9. Hrs.)

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

UNIT V FOURIER ANALYSIS (9. Hrs.)

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

Reference books:

1. Mathematical methods for physics sciences (3rd edition) - Mary. L. Boas
2. First Chapter (Vector analysis) in Introduction to Electrodynamics (3rd edition) – David. J. Griffiths
3. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier

Student Activities:

- Problem-solving sessions using real-life physics applications (e.g., using vector calculus in electromagnetism).
- Group projects on solving physical systems using matrix methods and linear algebra tools.
- Mini-lab activity on phasor diagrams and impedance using circuit simulation software (like Ltspice or Tinkercad Circuits).
- Data collection and analysis task: Record physical measurements (e.g., decay times, counts) and apply statistical models (Poisson/Gaussian).

CO-PO MAPPING

COURSE -1

CO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CO1	3	2	–	–	–	–	–	–
CO2	3	2	–	–	2	–	–	–
CO3	3	2	–	–	–	–	–	–
CO4	–	3	–	–	2	–	–	–
CO5	3	2	–	–	3	–	–	–

SEMESTER I

COURSE 2: MECHANICS AND PROPERTIES OF MATTER

Credits: 3

3 hr. /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.

SYLLABUS

UNIT-I MECHANICS OF PARTICLES (9 hrs.)

Newton's Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, collisions in two and three dimensions, concept of impact parameter, scattering cross-section, Rutherford scattering-derivation

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, motion of satellites, 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, Poisson's ratio – Physical meaning, Bending of beams – Types, point and distributed load, Cantilever and uniform bending – Qualitative treatment, 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, simple derivation and applications (Venturimeter, airplane lift), Equation of continuity – Concept, Viscosity – Poiseuille's law (statement and qualitative explanation), Surface tension – Examples and qualitative ideas

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

REFERENCE BOOKS:

1. BSc Physics -Telugu Akademy, Hyderabad
2. Mechanics - D.S. Mathur, Sulthan Chand & Co, New Delhi
3. Mechanics - J.C. Upadhyaya, Ramprasad & Co., Agra
4. Properties of Matter - D.S. Mathur, S. Chand & Co, New Delhi ,11th Edn., 2000
5. Physics Vol. I - Resnick-Halliday-Krane ,Wiley, 2001
6. Properties of Matter – Brijlal & Subrmanyam, S. Chand & Co. 1982
7. Mechanics-EM Purcell, Mc Graw Hill
8. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
9. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House.
10. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.
11. Fluid Mechanics – Frank M. White, McGraw Hill.
12. Textbook of Fluid Dynamics – M. D. Raisinghania, S. Chand & Co.

CO-PO MAPPING

COURSE – 2

CO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CO1	3	3	–	–	–	–	–	–
CO2	3	2	–	–	–	–	–	–
CO3	3	2	–	–	–	–	–	–
CO4	2	2	–	–	–	–	–	–
CO5	3	2	–	–	–	–	–	–

SEMESTER-I

COURSE 1: AI FUNDAMENTALS

Theory **Credits:4** **4hrs/week**

Learning Objectives:

1. Understand the history and evolution of Artificial Intelligence and Identify major subfields of AI.
2. Investigate the role of AI in various industries like healthcare, agriculture, and education.
3. Examine concepts like bias, fairness, transparency, and accountability in AI systems.
4. Explore the integration of AI in scientific research and discuss future directions and evolving trends in AI.
5. Learn how prompt engineering is used in various sectors like education and content creation.

Course Outcomes:

Students will be able to

1. Describe the different subfields and their roles in AI applications.
2. Analyze the benefits and limitations of AI in diverse domains.
3. Evaluate AI systems in terms of inclusivity, privacy, and robustness.
4. Describe Generative AI and emerging technologies like ChatGPT.
5. Apply prompt engineering concepts to various real-world use cases.

Unit I. AI and its Subfields

Introduction to Artificial Intelligence, History, Definition, Artificial General Intelligence, Industry Applications of AI, Challenges in AI. Knowledge Engineering, Machine Learning, Computer Vision, Natural Language Processing, Robotics.

Unit 2. Applications of AI

Healthcare, Finance, Retail, Agriculture, Education, Transportation.

Unit 3. Bias and Fairness in AI Systems

Ethics in AI, Bias and Fairness in AI Systems, Transparency in AI Systems, Accountability, Security, Privacy, Inclusivity, Sustainability, Robustness, Reliability.

Unit 4. AI in Research, Generative AI and prompt engineering

AI in Experimentation and Multi-disciplinary research, Generative AI introduction, ChatGPT, Hugging Face, Gemini and other tools basics, Perplexity, Prompt engineering Definition and its importance, Role of Prompt Engineering in AI/ML Interaction, Emerging trends and Future Directions in AI.

Unit 5. Applications of Prompt engineering

Applications of Prompt Engineering: Education, Business & Commerce, Content Creation: AI for Creative Writing,AI for creative design, writing AI scripts for video, generating slides and slidesGPT usage, Designing thumbnails and channel branding with AI

Text Books:

1. AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI) by Saptarsi Goswami, Amit Kumar Das , Amlan Chakrabarti
2. Prompt Engineering for Beginners: by Kapila Arora, Geetu Garg, Gaurav Arora.

References:

1. Let’s Learn Artificial Intelligence: Base Module, Niti Ayog, Atal Innovation Mission.
2. Prompt Engineering for Generative AI: Future-proof inputs for Reliable AI-outputs by James Phoenix & Mike Taylor.
3. Generative AI Tutorial:https://www.w3schools.com/gen_ai/
4. Generative AI 360°: Practical Guide to ChatGPT, Midjourney & AI Tools to Boost Productivity & Creativity , For Professionals, Marketers & Entrepreneurs by Hitesh Motwani , ZebraLearn, 2025.
5. Generative AI: Prompt Engineering Basics:
6. Learn Generative AI Prompt Engineering for everyone. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone?action=enroll
7. Free Artificial Intelligence (AI) Tutorial - Hands-On Prompt Engineering for AI Beginners & Business User | Udemy,

https://www.udemy.com/course/prompt-engineering-for-ai-beginners-business-users

GOVERNENT COLLEGE (A), RAJAHMUNDRY
DEPARTMENT PF PHYSICS
SEMESTER-II
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.

SYLLABUS

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

Simple Harmonic Oscillator: Solution of differential equation, and physical characteristics, Lissajous figures. Damping, Damped Harmonic Oscillator: Solution of differential equation, Energy considerations, 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. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. 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, 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. Idea of elliptical and circular polarization

REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. BSc Physics Vol.2, Telugu Akademy, Hyderabad
3. Fundamentals of Physics. Halliday/Resnick/Walker, Wiley India Edition 2007.
4. Waves & Oscillations. S. Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
5. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
6. Optics – Ajoy Ghatak, Tata McGraw Hill
7. Fundamentals of Optics – Jenkins and White, McGraw Hill
8. Wave Optics and Vibrations – N. Subrahmanyam & Brijlal, S. Chand & Co.
9. Vibrations and Waves – H. J. Pain, Wiley

CO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CO1	3	2	–	–	–	–	–	–
CO2	2	1	–	–	–	–	–	–
CO3	3	2	–	–	–	–	–	–
CO4	3	2	–	–	–	–	–	–
CO5	3	2	–	–	–	–	–	–

GOVERNENT COLLEGE (A), RAJAHMUNDRY
DEPARTMENT PF PHYSICS
SEMESTER-II
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.

SYLLABUS

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

Kinetic Theory of gases- Introduction, Maxwell's law of distribution of molecular velocities, Lammert's toothed wheel method; 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; Change of entropy when ice changes into steam. 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 (qualitative), Refrigeration – Vapour compression machine.

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 pyro heliometer, Estimation of surface temperature of Sun.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Thermodynamics, R.C. Srivastava, S.K. Saha & Abhay K. Jain, Eastern Economy Edition.
3. Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath & Co. Ltd., Meerut
4. Fundamentals of Physics. Halliday/Resnick/Walker. C. Wiley India Edition, 2007
5. Heat and Thermodynamics - N BrijLal, P. Subrahmanyam, S. Chand & Co., 2012
6. Heat and Thermodynamics - MS Yadav, Anmol Publications Pvt. Ltd, 2000
7. University Physics, HD Young, MW Zemansky, FW Sears, Narosa Publishers, New Delhi

COURSE 4

CO / PLO	PLO1 Physics Knowledg	PLO2 Problem Solving	PLO3 Experimental Skills	PLO4 Instrumentation	PLO5 Computational Skills	PLO6 Communication	PLO7 Ethics	PLO8 Lifelong Learning
CO1	3	2	–	–	–	–	–	–
CO2	3	2	–	–	–	–	–	–
CO3	3	3	–	–	–	–	–	–
CO4	2	2	–	–	–	–	–	–
CO5	3	2	–	–	–	–	–	–

GOVERNENT COLLEGE (A), RAJAHMUNDRY
DEPARTMENT PF PHYSICS

APPLICABLE TO MATHEMATICS, PHYSICS, CHEMISTRY AND ANY OTHER MATHEMATICAL SCIENCES

SEMESTER-II

COURSE 1: APPLICATIONS OF ARTIFICIAL INTELLIGENCE

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

Course Objectives

1. Provide a foundational understanding of AI platforms, data pipelines, and their importance in the physical sciences.
2. Introduce real-world datasets and public repositories relevant to physics, chemistry, mathematics, and earth sciences.
3. Explain how AI is applied to solve scientific problems, discover patterns, and support research in physical sciences in a simple, non-coding manner.
4. Highlight ethical concerns, data challenges, and the future of AI-driven discoveries in physical sciences.

Course Outcomes

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

1. Explain the AI ecosystem (hardware, cloud, and edge devices) in relation to physical sciences applications.
2. Identify scientific data types and public repositories relevant to physics, chemistry, mathematics, and earth sciences.
3. Describe the process of preparing and managing scientific data pipelines.
4. Illustrate the role of AI in solving real-world scientific challenges in physics, chemistry, mathematics, and earth sciences.
5. Analyze ethical, environmental, and societal impacts of AI-driven scientific applications.

SYLLABUS

Unit 1. Infrastructure and Platforms for Building Applications using AI

Hardware used in building AI applications: Processors - CPU, GPU, TPU, NPU, Memory - RAM, VRAM, Storage - HDD, SSD. **Platforms for building applications using AI:** Online platforms (Example - Google AutoML, H2O.ai, Teachable Machine or similar platforms - for practice only); Desktop (No-code/Low- code) platforms (Orange Data Mining, KNIME, Weka, RapidMiner or similar tools - for practice only).

Edge AI: Concept; Applications in daily life in devices like Refrigerators, Led Bulbs, Surveillance Cameras, Micro Ovens, Smart Cars/Scooters; Edge AI in smart Appliances

Unit 2: Foundations of Data - Types,

Ethics and Utility in Building Applications using AI Importance of data in building AI applications: Data as the fuel for AI, Role of big data in training AI models.

Conceptual Foundations of Data: Data vs. Information vs. Knowledge.

Structure of Data: Structured, Semi-Structured, and Unstructured Data.

Modalities of Data: Text, Image, Audio, Video, Tabular, Time-Series, and Spatial Data. **Formats of Data**: Text Formats (CSV, JSON, XML), Image Formats (JPEG, GIF, PNG), Audio/Video (MP3, WAV, MP4, AVI).

Data Repositories: Definition of public Datasets; Definition of private Datasets; Importance of Public Datasets, Popular Public Dataset Repositories (Example - Kaggle, Hugging Face Datasets, UCI Machine Learning Repository, Google Dataset Search or similar ones - for demonstration only), Dataset licensing and usage rights.

Ethics, Privacy in Data Usage: Privacy concerns related to data usage; Regulations governing data usage - GDPR, HIPAA (Overview), Ethical use of data, Responsible AI data practices.

Unit 3. The AI Data Pipeline: From Collection to Model Readiness

The AI Data Pipeline: Stages and Components: Key Stages (Data Collection, Annotation, Preprocessing, Splitting, Feeding into AI Models

Core Components: Ingestion, Storage, Processing, Validation, Delivery

Data Collection Methods for AI: Manual Input (Surveys, forms, human-curated entries), Sensors & IoT Devices (Real-time data from physical environments), System Logs & Transactions, Web Scraping (Automated extraction from websites), APIs (Structured data access from external platforms)

Data Annotation and Labelling: Definition & Importance; Annotation Methods: Manual Annotation, Automated Annotation; Types of Annotation: Classification, Bounding Boxes, Segmentation, Transcription, Named Entity Recognition (NER)

Data Cleaning and Preprocessing: Importance of data cleaning; Understanding "Dirty" Data: Missing Values, Duplicates, Incorrect Formats, Outliers, Noise; Steps in Data Cleaning: Identify Issues, Handle Errors (Imputation, Removal), Validate Cleaned Data

Data Splitting: Splitting data into training set and test set.

Data Transformation Techniques: Normalization, Transformation, Feature Engineering (Conceptual)

Unit 4: AI in Physical Sciences (Physics & Chemistry Applications)

AI in Physics: AI for analyzing astronomical images (identifying galaxies, stars, exoplanets), CERN Datasets for Particle Physics.

AI in material science: discovering new superconductors and quantum materials

AI in energy: predicting power grid loads, optimizing solar and wind energy systems

AI in Chemistry: Protein structure prediction (AlphaFold). AI in drug discovery - virtual screening of compounds. AI in chemistry - reaction outcome & material property prediction**.**

Unit 5: AI in Mathematics and Earth Sciences

Pattern recognition in large datasets (fractals, chaos systems, number theory)

Automated theorem proving and symbolic mathematics

AI in optimization problems (transport, logistics, resource allocation)

(Explore the Wolfram Alpha Tool: https://www.wolframalpha.com/examples/mathematics)

Climate modeling: AI predicting weather patterns, cyclones, and long-term climate change Remote sensing: AI analyzing satellite images for deforestation, urbanization, and natural resource mapping

Earthquake and natural disaster prediction using sensor networks

AI in geology: identifying mineral deposits, oil, and groundwater reserves

	Government College (Autonomous) Rajahmundry	Program & Semester IIB.Sc. (IIISem)			
Course Code 324901	**OPTICS**				
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Wave equation solutions, Geometrical identities, Classification of theories of light, Image formation With mirrors and lenses, Properties of light.	3	-	-	3

Course Objectives:

1. 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.
2. Distinguish between Fresnel"s diffraction and FraunPhofer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.
3. Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.
4. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
5. Explain about the different aberrations in lenses and discuss the methods of minimizing them.
6. Understand the basic principles of fiber optic communication and explore the field of Holography and Nonlinear optics and their applications.

CourseOutcomes:

	On Completion of the course, the students will be able to-	Cognitive Domain
CO1	Students would learn about principle of superposition, coherence, Interference by division of wave front and amplitude, Fresnel's bi-prism, Lloyd's mirror, thin film interference, wedge shaped film interference, Newton's rings, Michelson's interferometer and their applications to sodium D lines and thickness of thin film.	Understanding & Application
CO2	Students would learn about Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction due to circular aperture, single slit, and double slit, N-slit, grating. They would also learn about Fresnel's half period zones, zone plate, phase reversal zone plates, comparison of zone plate & convex lens, interference & diffraction.	Application
CO3	Students would learn about methods of polarization, Brewster's law, Malus law, Nicol prism, Quarter wave plate, half wave plate, babinet's compensator and optical activity analysis by Laurent's half shade polarimeter.	Understanding , Application
CO4	Students would learn about various monochromatic and chromatic aberrations and theirremovaltechniques.Theywouldalsolearnaboutfiberopticstypesandapplications	understanding , Application
CO5	Students would learn about principles of LASER, He-Ne laser, Ruby laser, applications of laser, Principles of optical fiber communication, classification of optical fibers, applications of optical fibers, principles of holography, limitations of Gabor's hologram and applications of holography	Application

Course with focus on employability/entrepreneurship/Skill Development modules

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.

CO / PLO	PLO1 Physics Knowledge	PLO2 Problem Solving	PLO3 Experimental Skills	PLO4 Instrumentation	PLO5 Computational Skills	PLO6 Communication	PLO7 Ethics	PLO8 Lifelong Learning
CO1	3	2	–	–	–	–	–	–
CO2	3	2	–	–	–	–	–	–
CO3	3	2	–	–	–	–	–	–
CO4	3	2	–	–	–	–	–	–
CO5	3	2	–	1	–	–	–	1

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc (III Sem)			
Course Code 324902	**HEAT AND THERMODYNAMICS**				
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Drift, Diffusion, Laws of thermodynamics, Heat capacities, Gas laws, Heat transfer methods, Statistics (mean, mode, median, Standard deviation, errors)	3	0	-	3

CourseObjectives:

1. Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equi-partition 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.
3. Understand the working of Carnot"s ideal heat engine, Carnot cycle and its efficiency
4. Develop criticalunder standing of concept of Thermodynamic formulation of Maxwell"s equations and its applications.
5. Differentiate between principles and methods to produce low temperature and liquefy air and also understand the practical applications of substances at low temperatures.
6. Examine the nature of black body radiations and the basic theories.

CourseOutcomes:

CO	On completion of this course, student will be able to	Cognitive Domain (BT Level)
CO1	Explain the fundamental concepts of kinetic theory of gases, including Maxwell's distribution, mean free path, and transport phenomena	**Understand (BT2)**
CO2	Analyze thermodynamic systems using laws of thermodynamics, entropy, and evaluate the efficiency of heat engines	**Analyze (BT4)**
CO3	Apply thermodynamic potentials and Maxwell's relations to solve problems related to ideal and real gases	**Apply (BT3)**
CO4	Explain the principles of low temperature physics including Joule–Thomson effect and adiabatic demagnetization	**Understand (BT2)**
CO5	Analyze black body radiation using Planck's law and related laws such as Wien's and Rayleigh–Jeans laws	**Analyze (BT4)**

SEM III SYLLABUS: HEAT AND THERMODYNAMICS

UNIT-I: KINETIC THEORY OF GASES:

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:

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; change of entropy when ice changes into steam.

UNIT-III: THERMODYNAMIC POTENTIALS AND MAXWELL'S EQUATIONS:

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

UNIT-IV: LOW TEMPERATURE PHYSICS:

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

(qualitative).

UNIT-V: QUANTUM THEORY OF RADIATION: .

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 pyro heliometer, Estimation of surface temperature of Sun.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Thermodynamics, R.C.Srivastava, S.K.Saha & Abhay K.Jain, Eastern Economy Edition.
3. Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath & Co. Ltd., Meerut
4. Fundamentals of Physics. Halliday/Resnick/Walker. C. Wiley India Edition 2007
5. Heat and Thermodynamics -N BrijLal, P Subrahmanyam, S.Chand& Co.,2012
6. Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
7. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code 324903	**ELECTRONIC DEVICES AND CIRCUITS**	II B.Sc. (III Sem)			
Teaching	Hours Allocated: 3 hrs/week (THEORY)	L	T	P	C
Pre-requisites:	Voltmeter, Ammeter, Rheostat, steam generators, Thermometer types.	3	0	0	3

COURSE OBJECTIVE:

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

OnCompletion of thecourse, the students willbeable to-		Cognitive Domain
CO1	Understand the behavior of P-N junction diodes in forward and reverse bias conditions and analyze the impact of junction capacitance on diode characteristics.	Understanding &Remembrance
CO2	Analyze and compare the characteristics and operation of different BJT configurations (CB, CE, and CC) and demonstrate proficiency in biasing techniques.	Application
CO3	Comprehend the operation and characteristics of FETs, including JFETs and MOSFETs, and explain the working principles and characteristics of UJTs.	Analyzation
CO4	Describe the operation and applications of various photoelectric devices such as LEDs, photo diodes, phototransistors, and LDRs.	Application
CO5	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	Application

SYLLABUS: **ELECTRONIC DEVICES AND CIRCUITS**

UNIT I: PN JUNCTION DIODES

P-N junction Diode, Formation of depletion region, Forward and Reverse bias Ideal Diode, Diode equation – Reverse saturation current – Tunnel Diode- Construction, working, V-I characteristics and Applications, Zener diode – V I characteristics, Applications

UNIT –II: BIPOLAR JUNCTION TRANSISTOR AND ITS BIASING: (D.C)

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 CB and CE configurations. Hybrid parameters of a Transistor and equivalent circuit, BJT Transistor Biasing – Need for stabilization, Thermal runaway, Stability factor, Biasing methods - Voltage-Divider Bias.

UNIT-III: FIELD EFFECT TRANSISTORS & POWER ELECTRONIC DEVICES –

Difference between JFET and BJT, Construction and working of JFET, Drain and Transfer Characteristics, MOSFET - Depletion-type, and Enhancement-Type MOSFETs. FET Biasing: Voltage Divider Biasing. UJT- Construction, working, V-I characteristics. SCR – Construction, Working and Characteristics

UNIT IV: PHOTO ELECTRIC DEVICES:Light-Emitting Diodes (LEDs) - Construction, working, characteristics and Applications, IR Emitters, Photo diode - Construction, working characteristics and Applications, Phototransistors - Construction, working and characteristics, Applications, Structure and operation of LDR, Applications

UNIT-V: POWER SUPPLIES:

Rectifiers: Half wave, Full wave and bridge rectifiers - Efficiency (with derivations), ripple factor- Zener diode as Voltage Regulator, Filters- choke input (inductor), L-section, π-section filters. Three terminal fixed voltage IC-regulators (78XX and 79XX)

REFERENCE BOOKS:

1. Electronic Devices and Circuit Theory --- Robert L. Boylestad & Louis Nashelsky.
2. Electronic Devices and Circuits I – T.L.Floyd- PHI Fifth Edition
3. Integrated Electronics – Millmam & Halkias.
4. Electronic Devices & Circuits – Bogart.
5. Sedha R.S., A Text Book Of Applied Electronics, S.Chand & Company Ltd

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. (III Sem)			
Course Code 324904	ANALOG AND DIGITAL ELECTRONICS				
Teaching	Hours Allocated: 3 hrs/week (THEORY)	L	T	P	C
Pre-requisites:	Kirchhoff"s Laws, Ohm"s Law, number system	3	0	0	3

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:

OnCompletion of thecourse, the students willbeable to-		Cognitive Domain
CO1	Understand Principles and Working of Operational Amplifier	Understanding &Remembrance
CO2	To understand the Boolean algebra and simplification of Boolean expressions.	Application
CO3	knowledge on OP-Amp in different Applications	Analyzation
CO4	To understand the number systems, Binary codes and Complements.	Application
CO5	To analyze logic processes and implement logical operations using combinational logic circuits.	Application

SYLLABUS: **ANALOG AND DIGITAL ELECTRONICS**

UNIT-I: OPERATIONAL AMPLIFIERS

a) Concept of feedback in CE amplifier, negative and positive feedback, advantages and disadvantages of negative feedback, Basic concepts of differential amplifier, Block diagram of op amp and its equivalent circuit, IC Diagram (IC 741), Ideal voltage transfer curve, Open loop Op-Amp configurations- differential, inverting and non-inverting Op-Amps.

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

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: Linear Applications: Voltage Follower, Summing Amplifier, Subtracting Amplifier, Averaging Amplifier, Difference Amplifier, Integrator and Differentiator, Square Wave response of Integrator and Differentiator (Brief explanation only)

UNIT-III: NUMBER SYSTEMS, CODES AND LOGIC GATES

a) Number Systems and Codes: Decimal, Binary, Octal and Hexadecimal number systems, conversions, Binary addition, Binary subtraction using 1"s and 2"s complement methods, BCD code and Gray code –

Conversions

b) Logic Gates: Construction and truth tables of OR, AND, NOT gates, Universal gates – Basic construction and truth tables of NOR & NAND, Realization of logic gates using NAND and NOR, XOR and XNOR Logic gates symbol and their truth tables. De Morgan's Laws, Boolean Laws, Simplification of Boolean Expressions using Boolean Laws

UNIT-IV: ARITHMETIC CIRCUITS & DATA PROCESSING CIRCUITS

a) Half Adder and Full Adder: Explanation of truth tables and Circuits. Half Subtractor and Full Subtractor: Explanation of truth tables and Circuits, 4 - bit binary Adder/Subtractor.

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, Encoders: 4 to 2 Encoder, 8 to 3 Encoder, Applications of decoders and encoders

UNIT-V: SEQUENTIAL LOGIC CIRCUITS & CODE CONVERTERS

a) Combinational Logic vs Sequential Logic Circuits, Sequential Logic circuits: Flip-flops, Basic NAND, NOR Latches, Clocked SR Flip-flop, JK Flip-flop, D Flip-flop, Master-Slave Flip- flop, Conversion of Flip flops.

B) Code Converters: BCD to Decimal Converter, BCD to Gray Code Converter, BCD to 7 segment Decoders

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code 324901	**OPTICS**	II B.Sc. (III Sem)			
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Wave equation solutions, Geometrical identities, Classification of theories of light, Image formation With mirrors and lenses, Properties of light.	3	-	-	3

Course Objectives:

1. 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.
2. Distinguish between Fresnel's diffraction and Fraunhofer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.
3. Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.
4. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
5. Explain about the different aberrations in lenses and discuss the methods of minimizing them.
6. Understand the basic principles of fiber optic communication and explore the field of Holography and Nonlinear optics and their applications.

CourseOutcomes:

	On Completion of the course, the students will be able to-	Cognitive Domain
CO1	Students would learn about principle of superposition, coherence, Interference by division of wave front and amplitude, Fresnel's bi-prism, Lloyd's mirror, thin film interference, wedge shaped film interference, Newton's rings, Michelson's interferometer and their applications to sodium D lines and thickness of thin film.	Understanding & Application
CO2	Students would learn about Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction due to circular aperture, single slit, and double slit, N-slit, grating. They would also learn about Fresnel's half period zones, zone plate, phase reversal zone plates, comparison of zone plate & convex lens, interference & diffraction.	Application
CO3	Students would learn about methods of polarization, Brewster's law, Malus law, Nicol prism, Quarter wave plate, half wave plate, babinet's compensator and optical activity analysis by Laurent's half shade polarimeter.	Understanding , Application
CO4	Students would learn about various monochromatic and chromatic aberrations and theirremovaltechniques.Theywouldalsolearnaboutfiberopticstypesandapplications	understanding , Application
CO5	Students would learn about principles of LASER, He-Ne laser, Ruby laser, applications of laser, Principles of optical fiber communication, classification of optical fibers, applications of optical fibers, principles of holography, limitations of Gabor's hologram and applications of holography	Application

Course with focus on employability/entrepreneurship/Skill Development modules

SYLLABUS:

UNIT-I Aberrations

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

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‟s rings in reflected light. Determination of wavelength of monochromatic light using Newton‟s rings and Michelson Interferometer.

UNIT-III Diffraction

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

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

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.

REFERENCE BOOKS:

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

Web Links:

1. https://nptel.ac.in/courses/122/107/122107035/
2. https://nptel.ac.in/courses/115/105/115105083/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2014
4. https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2009
5. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/

CO-PO Mapping: (1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2	3	2	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1	3	3	3
CO3	3	2	2	3	2	3	2	2	2	3	2	2	3	2	2	2
CO4	3	3	3	2	2	1	2	3	1	1	3	1	2	2	2	3
CO5	3	2	3	2	2	2	3	2	2	1	3	1	2	3	2	2

	IV		Modern Physics Practical Course	2	1
		11	Introduction to Nuclear and Particle Physics	3	3
			Introduction to Nuclear and Particle Physics Practical Course	2	1
Minor Paper			Electricity and Magnetism	3	3
			Electricity and Magnetism Practical Course	2	1
			Modern Physics	3	3
			Modern Physics Practical Course	2	1
			On Job Training (OJT)	24	4

	Government College (Autonomous) Rajahmundry	**Program & Semester** II B.Sc. (IV Sem)			
Course Code 424901	**ELECTRICITY AND MAGNETISM**				
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Differentiation, line, surface and volume integration, Coulomb"s law, AC, DC, VC, RMS Value and Classification of materials based on electrical conductivity, Introduction to semiconductors.	3	0	-	3

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:

OnCompletion of thecourse, the students willbeable to-	Cognitive domain

CO1	Students would able to learn about the concepts of electric field and electric potential due to point charge, solid sphere, and cylinder. These concepts will enhance the student towards the problems come across in the real life. Students would also able to learn about the concept of dielectrics and its applications	Understanding & Remembrance
CO2	Students would able to learn about the concepts of Biotsavart's law,Faraday's law and it's applications.Students would also able to learn about Faradays laws and their applications in daily life like solenoid	Application
CO3	Students would able to learn about different combinations of Inductor, capacitance and resistor and also their performance characteristics. Students would also able to learn about mathematical description of Electromagnetic Waves ie Maxwell"s equations	Analysis
CO4	Students would able to learn about Semiconductor devices ie PN junction diode, Zener diode and transistors and their characteristics so that the student can able to use appropriately	Understanding
CO5	Develop an understanding on the unification of electric, and magnetic fields and Maxwell"s equations governing electromagnetic waves.	Application

Syllabus

ELECTRICITY AND MAGNETISM

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, Dielectric strength, 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 - sensitivity. Branch current method, Nodal Analysis, star to delta & delta to star conversions. 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, 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:

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:

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.

EFERENCE 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.

WebLinks:
1. https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007
2. http://physics.bu.edu/~duffy/classroom.html
3. https://nptel.ac.in/courses/115/106/115106122/

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code 424902	MODERN PHYSICS	II B.Sc. (IV Sem)			
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Atomic models, Types of spectra, Matrices, Types of forces in nature, Electrical conductivity.	3	0	-	3

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 Completion of the course, the students will be able to-		
CO1	Students would able to learn about the concepts of atomic models and their drawbacks. Students would also learn about Stern & Gerlach experiment Vector atom model, this model gives the existence of spin of an electron. Study of fine spectra and Zeeman effect on various elements.	KNOWLEDGE
CO2	Students would able to learn about the importance of Quantum mechanics, study the basic concepts involved in the origin of quantum mechanics like uncertainty principle, De-Broglie matter waves, and experiments that confirm wave nature of matter and particle nature of radiation.	KNOWLEDGE
CO3	Students would able to learn about the importance of Heisenberg"s uncertainty principle for position and momentum. Students would able to learn Schrodinger time independent and time dependent wave equations. Wave function properties Significance. Basic postulates of quantum mechanics. from these we can predict the position of a particle at future specific time	UNDERSTANDING
CO4	Students would learn about basic properties of nucleus, dipole & quadrupole moments, binding energy, nuclear forces and nuclear models. Elementary particles and counters	APLICATION
CO5	Students would learn about basics of nanomaterials, classification, properties. Students would also learn about Introduction to Superconductivity, types and applications.	APPLICATION

MODERN PHYSICS SYLLABUS
SYLLABUS

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 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

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:

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:

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:

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.)

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. (IV Sem)			
Course Code 424903	**INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS**				
Teaching	Hours Allocated: 3 hrs/week **(Theory)**	L	T	P	C
Pre-requisites:	Atomic models, Types of spectra, Matrices, Types of forces in nature, Electrical conductivity.	3	0	-	3

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:

On Completion of the course, the students will be able to-		COGNATIVE DOMAIN
CO1	know about high energy particles and their applications which prepares them for further study and research in elcitrap physics	**SKILL**
CO2	Students can explain important concepts on nucleon-nucleon interaction, such as its short-range, spin dependence, isospin, and tensors.	**UNDERSTANDING**
CO3	Students can show the potential shapes from nucleon nucleon interactions.	**APPLICTIONS**
CO4	can explain the single particle model, its strengths, and weaknesses	**PPLITIONS**
CO5	Students can explain magic numbers based on this model	**UNDERSTANDING**

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	3	3	3	2	2	2	3	2	3	2	3	2	2
CO2	3	2	2	3	2	3	3	1	3	3	2	2	1	2	2	3
CO3	2	2	2	3	2	2	3	2	3	3	2	2	2	3	1	2
CO4	3	2	3	2	2	2	3	3	1	2	3	3S	2	2	2	2
CO5	2	3	3	2	2	2	3	3	1	2	3	1	2	1	3	2

INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

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- Semi empirical mass formula, 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, Reaction energetic, Threshold energy, nuclear cross-section; Nuclear detectors: Geiger- Muller counter, Scintillation counter, Cloud chamber

UNIT-IV: Nuclear Decays and Nuclear Accelerators

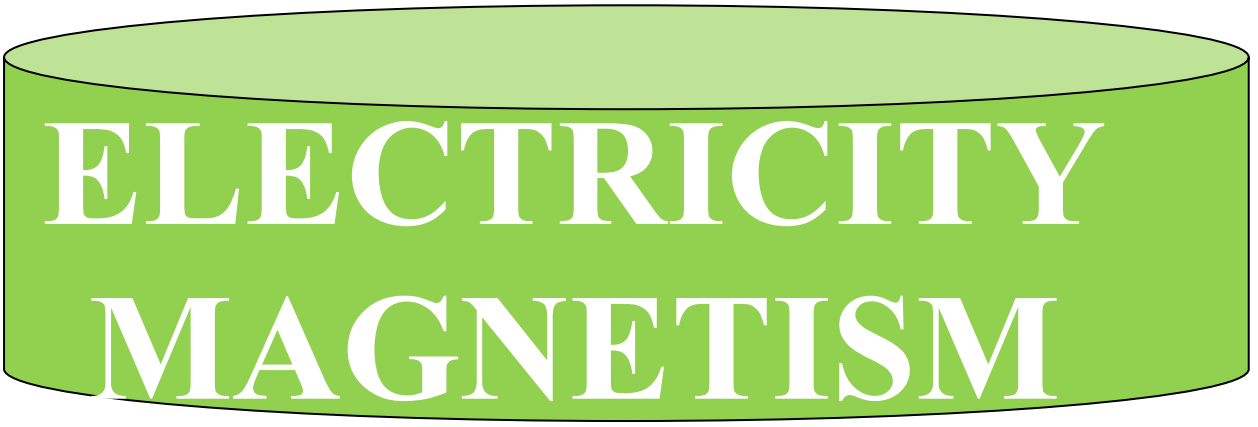
Nuclear Decays: Gamow"s theory of alpha decay, Fermi"s theory of Beta- decay, Energy release in Beta-decay, selection rules. Nuclear Accelerators: Types- Electrostatic and electrodynamics accelerators; Cyclotron-construction, working and applications; Synchrocyclotron-construction, working and applications.

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 Astro Physics

Reference Books:

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
4. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).
5. Atomic and Nuclear Physics, R.C. Sharma, K. Nath& Co., Meerut.
6. Nuclei and Particles, E. Segre.
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).


ELECTRICITY
MAGNETISM

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. (IV Sem)			
Course Code 424901	**ELECTRICITY AND MAGNETISM**				
Teaching	Hours Allocated: 3 hrs/week (**Theory**)	L	T	P	C
Pre-requisites:	Differentiation, line, surface and volume integration, Coulomb"s law, AC, DC, VC, RMS Value and Classification of materials based on electrical conductivity, Introduction to semiconductors.	3	0	-	3

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:

OnCompletion of thecourse, the students willbeable to-		Cognitive domain
CO1	Students would able to learn about the concepts of electric field and electric potential due to point charge, solid sphere, and cylinder. These concepts will enhance the student towards the problems come across in the real life. Students would also able to learn about the concept of dielectrics and its applications	Understanding & Remembrance
CO2	Students would able to learn about the concepts of Biotsavart's law,Faraday's law and it's applications.Students would also able to learn about Faradays laws and their applications in daily life like solenoid	Application
CO3	Students would able to learn about different combinations of Inductor, capacitance and resistor and also their performance characteristics. Students would also able to learn about mathematical description of Electromagnetic Waves ie Maxwell"s equations	Analysis
CO4	Students would able to learn about Semiconductor devices ie PN junction diode, Zener diode and transistors and their characteristics so that the student can able to use appropriately	Understanding
CO5	Develop an understanding on the unification of electric, and magnetic fields and Maxwell"s equations governing electromagnetic waves.	Application

	Government College (Autonomous) Rajahmundry	Program & Semester			
		II B.Sc. (IV Sem)			
Course Code 424902	**MODERN PHYSICS**	II B.Sc. (IV Sem)			
Teaching	Hours Allocated: 3 hrs/week (**PRACTICAL**)	L	T	P	C
Pre-requisites:	Atomic models, Types of spectra, Matrices, Types of forces in nature, Electrical conductivity.	3	0	…	3

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 Completion of the course, the students will be able to-		
CO1	Students would able to learn about the concepts of atomic models and their drawbacks. Students would also learn about Stern & Gerlach experiment Vector atom model, this model gives the existence of spin of an electron. Study of fine spectra and Zeeman effect on various elements.	KNOWLEDGE
CO2	Students would able to learn about the importance of Quantum mechanics, study the basic concepts involved in the origin of quantum mechanics like uncertainty principle, De-Broglie matter waves, and experiments that confirm wave nature of matter and particle nature of radiation.	KNOWLEDGE
CO3	Students would able to learn about the importance of Heisenberg"s uncertainty principle for position and momentum. Students would able to learn Schrodinger time independent and time dependent wave equations. Wave function properties Significance. Basic postulates of quantum mechanics. from these we can predict the position of a particle at future specific time	UNDERSTANDING
CO4	Students would learn about basic properties of nucleus, dipole & quadrupole moments, binding energy, nuclear forces and nuclear models. Elementary particles and counters	APLICATION
CO5	Students would learn about basics of nanomaterials, classification, properties. Students would also learn about Introduction to Superconductivity, types and applications.	APPLICATION

MODERN PHYSICS

SYLLABUS

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 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

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:

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:

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:

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.)

i.https://nptel.ac.in/courses/115/105/115105083/

ii.https://ocw.mit.edu/courses/physics/8-02t-electricity-and-magnetism-spring-2005

iii.https://nptel.ac.in/courses/115/103/115103108/

v. https://nptel.ac.in/courses/118/102/118102003/

vi. https://nptel.ac.in/courses/115/104/115104096/

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	3	3	1	2	2	3	2	3	2	3	2	2
CO2	2	2	2	3	2	3	3	1	3	3	2	2	1	2	2	3
CO3	2	2	2	3	2	2	2	2	2	3	2	2	2	3	1	2
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2	2	2	2
CO5	2	2	3	2	2	2	3	3	1	1	3	1	2	1	3	2

Govt. College (A), Rajahmundry

SEMESTER - IV

CYBER SECURITY

Credits: 2 2 hrs/week

Learning Outcomes:

Upon successful completion of the course, the students will be able to

- Develop an understanding of cybercrimes and various legal perspectives involved.
- Develop a security model to handle mobile, wireless devices and related security issues of an organization.
- Use the cybercrime tools and methods in solving real world problems

UNIT - I: 8hrs

Introduction to Cybercrime: Introduction, Cybercrime: Definition and origins of the word, Cybercrime and Information Security, who are cyber criminals? classifications of cybercrimes, cybercrime: the legal perspectives, an Indian perspective, cybercrime and the Indian IT Act 2000, a Global perspective on Cybercrimes.

UNIT-II: 12hrs

Cybercrime-Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Authentication Service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT-III: 10hrs

Tools and Methods Used in Cybercrime: Password Cracking, key loggers and Spywares, virus and worms, Trojan Horses and Backdoors, Steganography, attacks on wireless networks, Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Text Books:

1. Mark Rhodes, Ousley, Information Security, 1st Edition ,MGH, 2013.
2. Nina Godbole and SunitBelpure ¯ Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives , 1st Edition Publication Wiley, 2011.

Activities Planned:

1. Identify a user of internet, label him as a cybercriminal or not.
2. Checklist for reporting cybercrime at Cybercrime Police Station.
3. Checklist for reporting cybercrime online.
4. Reporting phishing emails.
5. Demonstration of email phishing attack and preventive measures.
6. Checklist for secure net banking.

FUNDAMENTALS OF ECONOMICS

Credits: 2 hrs/week

UNIT I- BASIC CONCEPTS (08 Hours)

Meaning of Economics, Nature and Scope of Economics, Micro & Macro Economics meaning and difference.

UNIT II- MICRO ECONOMIC CONCEPTS (10 Hours)

Theory of Demand and Supply, Meaning of utility, diminishing marginal utility; indifference curves analysis and consumers equilibrium; Production Function, Types of Costs and Revenue, Classification of Markets.

UNIT III- MACRO ECONOMIC CONCEPTS (12 Hours)

Meaning - Concepts and measurement of National Income ; Definition of Money-Types and Functions ; Evolution and Functions of Central Bank, Commercial Banks; Meaning of Inflation- causes and Anti-inflationary policies, Monetary and Fiscal Policy.

References:

Ahuja H. L. Principles of Micro economics, S. Chand Limited, Delhi.

Koutsoyiannis, A. (1990), Modern Microeconomics, Macmillian.

Gupta, S.B, Monetary Economics, S Chand & Co, New Delhi.

Dwivedi,D.N , Microeconomics-Theory & Applications‖, Pearson.

Stonier,A.W&Hague.Douglas.C ,A Text Book of Economic Theory, Pearson.

Ackley.G , Macroeconomics: Theory And Policy, Macmillan, New York

Dwivedi,D.N , Macroeconomics: Theory and Policy , Tata McGraw Hill Education

Jhingan, M.L , Macroeconomics ,Vrinda Publications, New Delhi.

GOVERNMENT COLLEGE (A), RAJAHMUNDRY 2025-26 DEPARTMENT OF PHYSICS

Minor-5 - APPLICATIONS OF ELECTRICITY & MAGNETISM

SEMESTER-V

As per BoS approved on 15- Sep- 2025

SYLLABUS:

Unit-I: Introduction to Passive Elements (09Hrs)

A. Passive elements

Resistor - Types of Resistors, Color coding, Combination of Resistors – Series combination (Voltage division), Parallel combination (Current division), Ohms Law and its limitation. Inductor - Principle, EMF induced in an Inductor, Energy stored in Inductor, Phase relation between V and I, Combinations of Inductors, Types of Inductors. Capacitor - Principle, Charging and discharging of a Capacitor, Types of Capacitors, Color coding

B. Applications of Passive elements:

Applications of a Resistor as a heating element in heaters and as a fuse element. Open circuit, Short circuit, 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) etc.

Unit-II Power Sources (Batteries) **(**9Hrs)

A. Power sources:

Types of power sources-DC & AC sources, Different types of batteries, Rechargeable batteries –Lead acid batteries, Li-ion batteries Series, Parallel & Series-Parallel configuration of batteries,

B. Network Theorems for DC circuits

Thevenin"s theorem, Norton"s theorem, Maximum Power transfer theorem, Constant Voltage source- Constant Current Source-Applications of Current sources & Voltage sources, SMPS used in computers.

Unit-III (9Hrs)

Alternating & Direct Currents (A.C Generator, Construction and its working principle, Types of AC Generators, DC Generator, Construction and its working principle, advantages and disadvantages, Applications, Types of DC Generators, Losses associated with DC generators, Differences between DC and AC generators

Transformers- Construction and its working principle, EMF equation, Open circuit and short circuit tests, Types of Transformers - Step-down and Step-up Transformers, Relation between primary turns and secondary turns of the transformer with emf, Use of a Transformer in a regulated Power supplies, Single phase motor – working principle, Applications of motors (like water pump, fan etc).

Unit-IV Modulation Circuits (9Hrs)

A) Need for modulation, Types of modulation, Amplitude modulation, modulation index, Waveforms, Power relations, Demodulation, Diode detector, Frequency modulation, modulation index, Waveforms, Frequency modulation, modulation index.

Transmitters and Receivers: AM transmitter, AM Receiver, , FM Transmitter, FM Receiver

Unit-V Applications of EM Induction & Power Supplies (9Hrs)

A. DC motor – Construction and operating principle, Calculation of power, voltage and current in a DC motor, Design of a simple Motor (for example Fan) with suitable turns of coil
B. Design of a step-down (ex:220-12V) and step-up (ex:120-240V) transformers-Checking the output voltage of a battery eliminator using a Multimeter. (Trouble shooting), Design of a simple 5 volts DC charger.

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code PHY6A	**TITLE OF THE COURSE OPTICAL INSTRUMENTS AND OPTOMETRY (Skill Enhancement Course (Elective), Credits: 05)**	IV Year B. Sc.(Hons) – Semester – V			
Teaching	Hours Allocated: 50,Max.marks 100 (**Theory**)	L	T	P	C
Pre-requisite	Learn aberrations, basic principles of travelling microscope and Telescope	3	-	-	3

Course Objectives:

1. Need and Different types of microscopes
2. Construction and working of various types of microscopes
3. Types, working principle and applications of various Telescopes
4. Study of optical vision
5. Understanding of Ophthalmic techniques and optometry

Course Outcomes:

On Completion of the course, the students will be able to		cognitive domain
CO1	Understand the construction and working principles of various optical instruments used in daily life.	Understanding
CO2	Acquire a critical knowledge on the various defects of eye and their correcting methods with suitable lenses	Remembering
CO3	Demonstrate skills of using biological microscope through hands on experience	Applying
CO4	Understand the various techniques used in optometry and computer based eye testing	Understanding
CO5	Comprehend the various applications of microscopes and telescopes	Analyzing and Applying

Course with focus on Employability / Entrepreneurship / Skill Development modules

Syllabus:

UNIT-I OPTICAL MICROSCOPES (10hrs)

Introduction to Microscopes, Need of a Microscope, Different types of microscopes and their uses,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-II TELESCOPES (10hrs)

Introduction to Telescopes, Different types of Telescopes and their uses, Refracting Telescopes and Reflecting telescopes, Construction, working and magnifying power of Astronomical Telescope and Terrestrial Telescopes, Binoculars – working principle and applications.

UNIT-III APPLICATIONS OF OPTICAL INSTRUMENTS (10hrs)

Introductory ideas and applications of various microscopes viz., (i) Optical microscopes (Compound microscope, Stereo microscope, Confocal microscope) (ii) Electron microscopes (TEM, SEM), (iii) Scanning Probe microscope (iv) Scanning Acoustic microscope and (v) X-ray microscope. Introductory ideas and applications of various telescopes viz., (i) Optical telescopes (ii) Radio telescopes (iii) Solar telescopes (iv) Infrared telescope (v) Ultraviolet telescope (vi) X-ray telescope and (vii) Gamma ray telescope

UNIT-IV OPTICAL VISION (10hrs)

Introduction to optical Vision, Eye as an optical instrument, Formation of image in the eye and the camera, Ophthalmic lenses, Power of the lenses, Far point and near points, 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 (10hrs)

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, Checking the power of lenses, Principles of Computer based eye testing

Text books:

1. A Text Book of Optics by BrjLal and N.Subramanyam, S.Chand& Co.

Reference books:

1. Optics and Optical Instruments: An Introduction by B. K. Johnson, Dover Publications. 2. Modern Optical Instruments and their construction by or ford Henry-Publisher: Biblio Life, LLC.3. Practical Optics by MennNaftly, Elsevier Science Publishing.

Web links:

1. https://flexbooks.ck12.org . Applications of Optics in daily life | CK-12 Foundation

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2	3	2	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1	1	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3	3	2	2
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2	2	1	1

TITLE OF THE COURSE

ELECTRONIC INSTRUMENTATION

Skill Enhancement Course (Elective), Credits: 05)

Course Objectives:

1. Need and Different types of microscopes

Course Outcomes:

On Completion of the course, the students will be able to		cognitive domain
CO1	Identify various facilities required to set up a basic Instrumentation Laboratory.	Remembering
CO2	Acquire a critical knowledge of various Electrical Instruments used in the Laboratory	Understanding
CO3	Demonstrate skills of using instruments like CRO, Function Generator, Multimeter etc. through hands on experience.	Applying
CO4	Understand the Principle and operation of different display devices used in the display systems and different Transducers	Understanding
CO5	Comprehend the applications of various biomedical instruments in daily life like B.P. meter, ECG, Pulse oximeter etc. and know the handling procedures with safety and security..	Analysing

Course with focus on Employability / Entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

ELECTRONIC INSTRUMENTATION

Syllabus

UNIT-I INTRODUCTION TO INSTRUMENTS (10 hrs)

Types of electronic Instruments- Analog instruments & Digital Instruments, DC Voltmeter and AC Voltmeter, Construction and working of an Analog Multimeter and Digital Multimeter (Block diagram approach),Sensitivity, 3½display and 4½ display Digital multimeters, Basic ideas on Function generator

UNIT-II OSCILLOSCOPE (10 hrs)

Cathode Ray Oscilloscope-Introduction, Block diagram of basic CRO, Cathode ray tube, Electron gun assembly, Screen for CRT, Time base operation, Vertical deflection system, Horizontal deflection system, Use of CRO for the measurement of voltage (DC and DC), frequency, phase difference, Different types of oscilloscopes and their uses, Digital storage Oscilloscope

UNIT-III TRANSDUCERS (10 hrs)

Classification of transducers,Selection of transducers, Resistive, capacitive & inductive transducers, Resistive and capacitive touch screen transducer used in mobiles, Displacement transducer-LVDT, Piezoelectric transducer, Photo transducer, Digital transducer, Fibre optic sensors

UNIT-IVDISPLAY INSTRUMENTS (10 hrs)

Introduction to Display devices, LED Displays, Seven Segment Displays, Construction and operation (Display of numbers),Types of SSDs(Common Anode &Common Cathode type), Limitations of SSDs, Liquid Crystal Displays, Principle and working of 2x16 display and 4x16 LCD modules, Applications of LCD modules.

UNIT-V BIOMEDICAL INSTRUMENTS (10 hrs)

Basic operating principles and uses of (i) Clinical thermometer (ii) Stethescope (iii) Sphygmomanometer (iv) ECG machine (v) Radiography (vi) Ophthalmoscope (vii) Ultrasound scanning (viii) Ventilator (ix) Pulse oxymeter (x) Glucometer, Basic ideas of CT scan and MRI scan

Textbooks:

1. Electronic Instrumentation by H.S.Kalsi , TMH Publishers
2. Electronic Instrument Hand Book by Clyde F. Coombs , McGraw Hill

REFERENCE BOOKS

1. Introduction to Biomedical Instrumentation by Mandeep Singh, PHI Learning.
2. Biomedical Instrumentation and Measurements by Leslie Cromwell ,Prentice Hall India.
3. Electronic Measurements and Instrumentation by Kishor, K Lal, Pearson, New Delhi
4. Electrical and Electronic Measurements by Sahan, A.K., DhanpatRai, New Delhi

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code PHY6B	TITLE OF THE COURSE LOW TEMPERATURE PHYSICS & REFRIGERATION (Skill Enhancement Course (Elective), Credits: 05)	III B. Sc. Semester – V			
Teaching	Hours Allocated: 50 (**Theory**)	L	T	P	C
Pre-requisites	Thermo Dynamic Laws, fluid mechanics, Condensation States of matter, Phase diagram of material,	3	-	-	3

Course Objectives:

1. Different methods of liquefaction
2. Learning various types of thermometers
3. knowledge on refrigeration and air conditioning
4. Learning various applications of low temperature & refrigeration

Course Outcomes:

On Completion of the course, the students will be able to		cognitive domain
CO1	Identify various methods and techniques used to produce low temperatures in the Laboratory.	Remembering
CO2	Acquire a critical knowledge on refrigeration and air conditioning	Understanding
CO3	Demonstrate skills of Refrigerators through hands on experience and learns about refrigeration components and their accessories	Applying
CO4	Understand the classification, properties of refrigerants and their effects on environment	Understanding
CO5	Comprehend the applications of Low Temperature Physics and refrigeration	Analyzing

Course with focus on Employability / Entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

LOW TEMPERATURE PHYSICS & REFRIGERATION
SEMISTER - V/VI
Syllabus:

UNIT-I PRODUCTION OF LOW TEMPERATURE (10 hrs)

Production of low temperatures-Introduction, Freezing mixtures, Joule-Thomson effect, Regenerative cooling, Different methods of liquefaction of gases, liquefaction of air, Production of liquid hydrogen and nitrogen, Adiabatic demagnetization, Properties of materials at low temperatures, Superconductivity

UNIT-II MEASUREMENT OF LOW TEMPERATURE (10 hrs)

Gas thermometer and its correction and calibration, Secondary thermometers, resistance thermometers, thermocouples, Vapour pressure thermometers, Magnetic thermometers, Advantages and drawbacks of each type of thermometer.

UNIT-III PRINCIPLES OF REFRIGERATION (10 hrs)

Introduction to Refrigeration- Natural and artificial refrigeration , Stages of refrigeration, Types of refrigeration - Vapor compression and vapor absorption refrigeration systems, Refrigeration cycle and explanation with a block diagram, Introductory ideas on air-conditioning.Refrigerants-Introduction, Ideal refrigerant, Properties of refrigerant, Classification of refrigerants, commonly used refrigerants, Eco-friendly refrigerants

UNIT-IV COMPONENTS OF REFIGERATOR (10 hrs)

Refrigerator and its working, Block diagram, Coefficient of Performance (COP), Tons of refrigeration (TR) and Energy Efficiency Ratio (EER), Refrigerator components: Types of compressors, evaporators and condensers and their functional aspects, defrosting in a refrigerator, Refrigerant leakage and detection

UNIT-V APPLICATIONS OF LOW TEMPERATURE & REFRIGERATION (10 hrs) Applications of Low temperatures: Preservation of biological material, Food freezing, liquid nitrogen and liquid hydrogen in medical field, Superconducting magnets in MRI- Tissue ablation (cryosurgery) - Cryogenic rocket propulsion system. Applications of refrigeration: Domestic refrigerators, Water coolers, Cold storages, Ice plants, Food preservation methods, Chemical and Process industries, Cold treatment of metals, Construction field, Desalination of water, Data centers.

GOVERNMENT COLLEGE (A), RAJAHMUNDRY 2025-26 DEPARTMENT OF PHYSICS
Minor-5 - APPLICATIONS OF ELECTRICITY & MAGNETISM
SEMESTER-V- MINOR PAPER
As per BoS approved on 15- Sep- 2025

SYLLABUS:

Unit-I: Introduction to Passive Elements (09Hrs)

A. Passive elements

Resistor - Types of Resistors, Color coding, Combination of Resistors – Series combination (Voltage division), Parallel combination (Current division), Ohms Law and its limitation. Inductor - Principle, EMF induced in an Inductor, Energy stored in Inductor, Phase relation between V and I, Combinations of Inductors, Types of Inductors. Capacitor - Principle, Charging and discharging of a Capacitor, Types of Capacitors, Color coding

B. Applications of Passive elements:

Applications of a Resistor as a heating element in heaters and as a fuse element. Open circuit, Short circuit, 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) etc.

Unit-II Power Sources (Batteries) **(**9Hrs)

C. Power sources:

Types of power sources-DC & AC sources, Different types of batteries, Rechargeable batteries –Lead acid batteries, Li-ion batteries Series, Parallel & Series-Parallel configuration of batteries,

D. Network Theorems for DC circuits

Thevenin"s theorem, Norton"s theorem, Maximum Power transfer theorem, Constant Voltage source-Constant Current Source-Applications of Current sources & Voltage sources, SMPS used in computers.

Unit-III (9Hrs)

Alternating & Direct Currents

(A.C Generator, Construction and its working principle, Types of AC Generators, DC Generator, Construction and its working principle, advantages and disadvantages,

Applications, Types of DC Generators, Losses associated with DC generators, Differences between DC and AC generators

A. Transformers- Construction and its working principle, EMF equation, Open circuit and short circuit tests, Types of Transformers - Step-down and Step-up Transformers, Relation between primary turns and secondary turns of the transformer with emf, Use of a Transformer in a regulated Power supplies, Single phase motor – working principle, Applications of motors (like water pump, fan etc).

Unit-IV Modulation Circuits (9Hrs)

A) Need for modulation, Types of modulation, Amplitude modulation, modulation index, Waveforms, Power relations, Demodulation, Diode detector, Frequency modulation, modulation index, Waveforms, Frequency modulation, modulation index.Transmitters and Receivers:AM transmitter, AM Receiver, , FM Transmitter, FM Receiver

Unit-V Applications of EM Induction & Power Supplies (9Hrs)

C. DC motor – Construction and operating principle, Calculation of power, voltage and current in a DC motor, Design of a simple Motor (for example Fan) with suitable turns of coil
D. Design of a step-down (ex:220-12V) and step-up (ex:120-240V) transformers- Checking the output voltage of a battery eliminator using a Multimeter. (Trouble shooting), Design of a simple 5 volts DC charger.

MINOR-6 ELECTRONIC INSTRUMENTATION SYLLABUS

UNIT-I: Introduction to Instruments (9 hrs)

- Fundamentals of measurement: accuracy, precision, sensitivity, resolution, error types.
- Classification: Analog and Digital instruments.
- Working principles of Analog Multimeter and Digital Multimeter (Block diagram only).
- DC and AC voltmeters: construction, operation, and applications.
- Introduction to Function Generator: types, frequency range, applications.
- Instrument calibration and error minimization techniques (basic overview).

UNIT-II: Signal Visualization and Oscilloscopes (9 hrs)

- Introduction to Signal Visualization: Importance of observing electrical signals in time
- and frequency domains.
- Block Diagram and Working Principle of Oscilloscopes: Overview applicable to both
- analog and digital oscilloscopes.
- Digital Storage Oscilloscope (DSO): Architecture and advantages over analog CROs.
- Measurement of voltage (DC & AC), frequency, time period, phase difference.
- Oscilloscope Controls: Time/div, volts/div, triggering, and cursors for automated
- measurements.
- Application Examples: Signal tracing in circuits, frequency response, waveform
- comparison, glitch detection.

UNIT-III: Transducers and Bridges (9 hrs)

- Transducers: Introduction, classification – active vs passive, analog vs digital.
- LVDT, Piezoelectric, Thermistor, Photo, and Capacitive transducers – principle and
- applications.
- Bridge circuits for measurement: Wheatstone bridge (Resistance), Wien bridge
- (Frequency).
- Calibration and error analysis in bridge measurements (basic concepts).

UNIT-IV: Display Instruments (9 hrs)

- Introduction to electronic displays: Types and uses.
- LED Displays and 7-segment displays: construction and working.
- Principles and advantages of LCDs and SSDs.
- Common Anode and Common Cathode configurations.
- Applications in voltmeters, counters, digital clocks, etc.
- Introduction to OLED and TFT displays (basic ideas only).

UNIT-V: Biomedical Instruments (9 hrs)

- Clinical thermometer and stethoscope: working principles.
- ECG machine: block diagram, signal interpretation basics.
- Pulse oximeter and BP monitor: principle and safe usage.
- Radiography (X-rays) and Ultrasound Scanning – overview.
- Basic concept of CT and MRI scans (non-mathematical).

Introduction to ventilators and glucometers.Textbooks:

1. Electronic Instrumentation by H.S.Kalsi , TMH Publishers
2. Electronic Instrument Hand Book by Clyde F. Coombs , McGraw Hill

REFERENCE BOOKS

1. Introduction to Biomedical Instrumentation by Mandeep Singh, PHI Learning.
2. Biomedical Instrumentation and Measurements by Leslie Cromwell ,Prentice Hall India.
3. Electronic Measurements and Instrumentation by Kishor, K Lal, Pearson, New Delhi

4. Electrical and Electronic Measurements by Sahan, A.K., DhanpatRai, New Delhi
5. Electronic Instruments and Measurement Techniques by Cooper, W.D. Halfrick, A.B., PHI Learning, New Delhi

SEMESTER-V

COURSE 13: ELECTRONIC INSTRUMENTATION

Practical Credits: 1 2 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Electronic Instrumentation is to provide students with hands-on experience in using electronic instruments for measurement, data acquisition, and control applications. The course aims to develop students' practical skills in operating, calibrating, and troubleshooting electronic instruments commonly used in scientific, engineering, and industrial settings.

LEARNING OUTCOMES:

1. Familiarize students with a range of electronic instruments, including multimeters,

SKILL PAPER

GOVERNMENT COLLEGE(A), RAJAHMUNDRY
DEPARTMENT OF CHEMISTRY
COMMON VALUE-ADDED COURSE

ENVIRONMENTAL EDUCATION

Credits: 2 2 hrs/week

Course objective: A Generic Course intended to create awareness that the life of human beings is an integral part of environment and to inculcate the skills required to protect environment from all sides.

Learning outcomes: On completion of this course the students will be able to …..

1. Understand the nature, components of an ecosystem and that humans are an integral part of nature.
2. Realize the importance of environment, the goods and services of a healthy biodiversity, dependence of humans on environment.
3. Evaluate the ways and ill effects of destruction of environment, population explosion on ecosystems and global problems consequent to anthropogenic activities.
4. Discuss the laws/ acts made by government to prevent pollution, to protect biodiversity and environment as a whole.
5. Acquaint with international agreements and national movements, and realize citizen's role in protecting environment and nature.

Unit 1: Environment andNatural Resources 06 Hrs.

1. Multidisciplinary nature of environmental education; scope and importance.
2. Man as an integral product and part of the Nature.
3. A brief account of land, forest and waterresources in India and their importance.
4. Biodiversity : Definition; importance of Biodiversity - ecological,consumptive, productive, social, ethical and moral, aesthetic, and option value.
5. Levels of Biodiversity: genetic, species and ecosystem diversity.

Unit-2: Environmental degradation and impacts 10Hrs

1. Human population growth and its impacts on environment; land use change, land degradation, soil erosion and desertification.
2. Use and over-exploitation of surface and ground water, construction of dams, floods, conflicts over water (within India).
3. Deforestation: Causes and effects due to expansion of agriculture, firewood, mining, forest fires and building of new habitats.
4. Non-renewable energy resources, their utilization and influences.
5. A brief account of air, water, soil and noise pollutions; Biological, industrial and solid wastes in urban areas. Human health and economic risks.
6. Green house effect - global warming; ocean acidification, ozone layer depletion, acid rains and impacts on human communities and agriculture.
7. Threats to biodiversity: Natural calamities, habitat destruction and fragmentation, over exploitation, hunting and poaching, introduction of exotic species, pollution, predator and pest control.

Unit 3: Conservation of Environment 10 Hrs

1. Concept of sustainability and sustainable development with judicious use of land, water and forest resources; afforestation.
2. Control measures for various types of pollution; use of renewable and alternate sources of energy.
3. Solid waste management: Control measures of urban and industrial waste.
4. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.
5. Environment Laws: Environment Protection Act; Act; Wildlife Protection Act; Forest Conservation Act.
6. International agreements: Montreal and Kyoto protocols; Environmental movements: Bishnois of Rajasthan, Chipko, Silent valley.

Suggested activities to learner: (4 hours)

1. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc

2. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural site.
3. Study of common plants, insects, birds and basic principles of identification.
4. Study of simple ecosystems-forest, tank, pond, lake,mangroves etc.
5. Case study of a Forest ecosystem or a pond ecosystem.

Suggested text book :

- ErachBarucha (2004) *Text book of Environmental Studies for Undergraduate courses* (Prepared for University Grants Commmission) Universities Press.
- PurnimaSmarath (2018) *Environmental studies* Kalyani Publishers, Ludhiana

Reference books :

- Odum, E.P., Odum, H.T. & Andrews, J. (1971) *Fundamentals of Ecology*. Philadelphia:Saunders.
- Pepper, I.L., Gerba, C.P. &Brusseau, M.L. (2011). *Environmental and Pollution Science*.Academic Press.
- Raven, P.H., Hassenzahl, D.M. & Berg, L.R. (2012) *Environment. 8th edition*. JohnWiley & Sons.
- Singh, J.S., Singh, S.P. and Gupta, S.R. (2014) *Ecology, Environmental Science and Conservation.* S. Chand Publishing, New Delhi.
- Sengupta, R. (2003) Ecology and economics: An approach to sustainable development.OUP.
- Wilson, E. O. (2006) *The Creation: An appeal to save life on earth.* New York: Norton.
- Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll (2006) *Principles of Conservation Biology.* Sunderland: Sinauer Associates,

ENVIRONMENTAL EDUCATION
QUESTION BANK

Unit – 1: Environment and Natural Resources

10 Marks Questions

1. Write an essay on scope, and importance of environmental education.
2. Describe various levels of biodiversity with suitable examples.
3. Explain the role of man as an integral part and product of nature.
4. Discuss the importance of natural resources like land, forest, and water in India.

5 Marks Questions

1. Define biodiversity and write its different levels.

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM DEPARTMENT OF PHYSICS

SYLLABUS FOR CERTIFICATE COURSE

HOUSEHOLD ELECTRICAL WIRING

(As Approved in the BOS meeting held on 15-09-2025)

UNIT- I

DOMESTIC WIRING (15hr)

Various types of house wiring and basic requirement of various utilities, estimate and format of estimation, Materials and accessories used in domestic wiring and their cost, types of loads and sub circuits, Types of service mains Design of number of sub circuits and distribution boards ,preparation of wiring installation plan layout with light load, power load and control point.

UNIT- II

MAIN MAINTENANCE (10Hr)

Selection of main switch cable, based on the load in circuit/sub circuits. Calculation of length of wiring cable and labor charges. Preparation of detailed estimates in standard Proforma. Estimation of wiring of small residential buildings, offices and Commercial establishments like shops, sales counter, stores.

UNIT- III

POWER WIRING (10hr)

Discussion on various loads and wiring methods circuits and in small industries agriculture etc., materials and accessories used in motor installation and their cost. Designing of distribution boards, cable, motor control panel.

UNIT- IV

WIRE INSTALLATION (10Hr)

Preparation of wiring installation plan and single line diagram, calculation of length of wiring cable and labor charges detailed estimate in the standard Proforma Related problems on installation of motors for small workshops and irrigation pump sets.

Text Books:

1. *Electrical Technology, chand publishers,New Dehli- B.L.Theraja.*
2. *Electrical Technology, ELBS Publications - Edward.*
3. *D.C Fundamentals, Delman Publications - Loper*
4. *A.C Fundamentals, Delman Publications - Loper*