# B.Sc. Rem Syllabus 2024-25

| | Government College (Autonomous) Rajahmundry | Program & Semester I B.Sc., (I SEM) | | | |
|---|---|---|---|---|---|
| Course Code **124901** | **ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES** | | | | |
| Teaching | Hours Allocated: 60 (**Theory**) | L | T | P | C |
| Pre-requisites: | Trigonometric ratios, vector multiplication, Laws of motion, Basics of thermodynamics, kepler‟s laws, Inverse square law, Periodic table, classification matter | 3 | 0 | 2 | 4 |

| Year | Semester | Course | Title of the Course | No. of Hrs /Week | No. of Credits |
|---|---|---|---|---|---|
| I | **I** | 1 | Essentials and Applications of Mathematical, Physical and Chemical Sciences | 3+2 | 4 |
| | | 2 | Advances in Mathematical, Physical and Chemical Sciences | 3+2 | 4 |

## Course:

The objective of this course is to provide students with a comprehensive understanding of theessential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

## Learning outcomes:

| | On Completion of the course, the students will be able to- | Cognitive Domain |
|---|---|---|
| CO1 | Apply critical thinking skills to solve complex problems involving complexnumbers, trigonometric ratios, vectors, and statistical measures. | Understanding & Application |
| CO2 | To Explain thebasic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations | Application |
| CO3 | To Explain thebasic principles and concepts underlying a broad range of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life. | Understanding, Application |
| CO4 | Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts. | understanding , Applicatsion |

| | | |
|---|---|---|
| CO5 | To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures | Application |

SYLLABUS: **1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL,PHYSICAL ANDCHEMICAL SCIENCES**

**UNIT I: ESSENTIALS OF MATHEMATICS:**

**Complex Numbers:** Introduction of the new symbol i – General form of a complex number –Modulus-Amplitude form and conversions

**Trigonometric Ratios:** Trigonometric Ratios and their relations – Problems on calculation of angles

**Vectors:** Definition of vector addition – Cartesian form – Scalar and vector product andproblems

**Statistical Measures**: Mean, Median, Mode of a data and problems

**UNIT II: ESSENTIALS OF PHYSICS:**

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behavior of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

**UNIT III: ESSENTIALS OF CHEMISTRY::**

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

**UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:**

**Applications of Mathematics in Physics & Chemistry:** Calculus, Differential Equations & Complex Analysis

**Application of Physics in Industry and Technology**: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

**Application of Chemistry in Industry and Technology:** Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

**UNIT V: ESSENTIALS OF COMPUTER SCIENCE:**

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications.

**Ethical and social implications:** Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud

Techniques- Privacy and Data Protection

**Recommended books:**


1. Functions of one complex variable by John. B.Conway, Springer- Verlag.
2. Elementary Trigonometry by H.S.Hall and Striking
3. Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. Basic Statistics by B.L.Agarwal, New age international Publishers
5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman
6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker
7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.
8. Physics for Technology and Engineering" by John Bird
9. Chemistry in daily life by Kirpal Singh
10. Chemistry of bio molecules byS. P. Bhutan
11. Fundamentals of Computers by V. RajaRaman
12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson


**vv 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 | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 |

**STUDENT ACTIVITIES** **UNIT I: ESSENTIALS OF MATHEMATICS:**

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms.

They will plot the complex numbers on the complex plane and identify their properties

2: Trigonometric Ratios Problem Solving

Give students a set of problems that require the calculation of trigonometric ratios and theirrelations.

Students will solve the problems using the appropriate trigonometric functions (sine, cosine,tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications

Provide students with a set of vectors in Cartesian form.

Students will perform vector addition and subtraction operations to find the resultant

vectors.They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis

Give students a dataset containing numerical values.

Students will calculate the mean, median, and mode of the data, as well as other statisticalmeasures if appropriate (e.g., range, standard deviation).
They will interpret the results and analyze the central tendencies and distribution of the data.

**UNIT II: ESSENTIALS OF PHYSICS:**

1. Concept Mapping

Divide students into groups and assign each group one of the topics.

Students will create a concept map illustrating the key concepts, relationships, andapplications related to their assigned topic.

Encourage students to use visual elements, arrows, and labels to represent connections andinterdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects orelectric and magnetic fields.
Provide the necessary materials, instructions, and safety guidelines for conducting theexperiment.
Students will work in small groups to carry out the experiment, collect data, and analyze theresults.

After the experiment, students will write a lab report summarizing their findings,observations, and conclusions.

**UNIT III: ESSENTIALS OF CHEMISTRY**

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine, orenvironmental issues.
Students will research and create a presentation (e.g., PowerPoint, poster, or video) thatshowcases the importance of chemistry in their assigned aspect.

2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based ontheir properties.
They will identify and analyze trends in atomic structure, such as electronic configuration,atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids andbases or observing a combustion reaction.
Students will observe and describe the chemical changes that occur, including

changes incolor, temperature, or the formation of new substances.

4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates, proteins,fats, or vitamins.

Students will research and gather information about their assigned biomolecule category,including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

**UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY**

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies thatinvolve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the integrationof concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integratesmathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy,environmental conservation, or materials science.

3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate,analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

**UNIT V: ESSENTIALS OF COMPUTER SCIENCE:**

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth
2. your college network) and prepare a report covering network architecture.
3. Identify the types of malwares and required firewalls to provide security.
4. Latest Fraud techniques used by hackers.

| | Government College (Autonomous) Rajahmundry | Program & Semester I B.Sc.(I SEM) | | | |
|---|---|---|---|---|---|
| Course 2 **124902** | ADVANCES OF MATHEMATICAL, PHYSICALAND CHEMICAL SCIENCES | | | | |
| Teaching | Hours Allocated:60 (**Theory**) | L | T | P | C |
| Pre-requisites: | Basic knowledge of geometry, matrices, law of conservation of energy, Number system etc. | 3 | 0 | 2 | 4 |

**Course Objective:**

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in thesedisciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

**Learning outcomes:**

| | On Completion of the course, the students will be able to- | Cognitive Domain |
|---|---|---|
| CO1 | Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems. | Understanding & Application |
| CO2 | To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations. | Application |
| CO3 | Understand the different sources of renewable energy and their generation processes and advances in Nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials. | **Understanding , Application** |
| CO4 | Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of Nano sensors. Explore the effects of chemical pollutants on ecosystems and human health. | **understanding , Application** |
| CO5 | Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts. | **Application** |

SYLLABUS :

**UNIT I: ADVANCES IN BASICS MATHEMATICS**

**Straight Lines:** Different forms – Reduction of general equation into various forms – Pointof intersection of two straight lines

**Limits and Differentiation:** Standard limits – Derivative of a function –Problems on product rule and quotient rule

**Integration:** Integration as a reverse process of differentiation – Basic methods of integration

**Matrices:** Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose ofamatrix and determinants

**UNIT II: ADVANCES IN PHYSICS:**

**Renewable energy**: Generation, energy storage, and energy-efficient materials and devices. **Recent advances in the field of nanotechnology**: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

**UNIT III: ADVANCES IN CHEMISTRY:**

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

**UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY**

- **Mathematical Modelling applications in physics and chemistry**
- **Application of Renewable energy**: Grid Integration and Smart Grids,
- **Application of nanotechnology**: Nanomedicine,
- **Application of biophysics**: Biophysical Imaging, Biomechanics, Neurophysics,
- **Application of medical physics**: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

**UNIT V: Advanced Applications of computer Science**

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

**Recommended books:**


1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices byA.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah
11. Environmental Chemistry by Anil.K.D.E.
12. Digital Logic Design by Morris Mano
13. Data Communication & Networking by Bahrouz Forouzan.

**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 | 1 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | 2 |

STUDENT ACTIVITIES

**UNIT I: ADVANCES IN BASIC MATHEMATICS**

**1: Straight Lines Exploration**

Provide students with a set of equations representing straight lines in different forms, such as slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including their slopes, intercepts,and point of intersection.

**2: Limits and Differentiation Problem Solving**

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications, such as analyzingrates of change or optimizing functions.

**3: Integration Exploration**

Students will explore the concept of integration as a reverse process of differentiation and apply basic methodsof integration, such as the product rule, substitution method,or integration by parts.

Students can discuss the significance of integration in various fields, such as physics and chemistry

**4: Matrices Manipulation**

Students will perform operations on matrices, including scalar multiplication, matrix multiplication, andmatrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solving systems ofequations or representing transformations in geometry.

**UNIT II: ADVANCES IN PHYSICS:**

**1: Case Studies**

Provide students with real-world case studies related to renewable energy, nanotechnology, biophysics,medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, and proposeinnovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological

advancements.

**2: Experimental Design**

Assign students to design and conduct experiments related to one of the topics: renewable energy, nanotechnology, biophysics, medical physics, or shape memory materials.
They will identify a specific research question or problem to investigate and design an experimentaccordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based on their findings.They will discuss the implications of their experimental results in the context of recent advances in the field.

**3: Group Discussion and Debate**

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign students specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

**UNIT III: ADVANCES IN CHEMISTRY:**

**1. Experimental Design and Simulation**

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtual screeningexperiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity and selectivityof nano sensors in detecting specific analytes.
Chemical biology-related activities could involve designing experiments to study enzyme-substrateinteractions or molecular interactions in biological systems.
Students will perform their experiments or simulations, collect data, analyze the results, and drawconclusions based on their findings.

**2. Case Studies and Discussion**

Provide students with real-world case studies related to the impact of chemical pollutants once systemsand human health.
Students will analyze the case studies, identify the sources and effects of chemical pollutants, and proposemitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing withchemical pollutants.
For the dye removal using the catalysis method, students can explore case studies wherecatalytic processes are used to degrade or remove dyes from wastewater.

Students will discuss the principles of catalysis, the advantages and limitations of thecatalysis method, and its applications in environmental remediation.

**3: Group Project**

Assign students to work in groups to develop a project related to one of the topics.
The project could involve designing a computer-aided drug delivery system, developing a nano sensor for aspecific application, or proposing strategies to mitigate the impact of chemical pollutants on

ecosystems. Students will develop a detailed project plan, conduct experiments or simulations, analyze data,and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

**UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY**

**1: Mathematical Modelling Experiment**

Provide students with a mathematical modelling experiment related to one of the topics. For example, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.
Students will work in teams to design and conduct the experiment, collect data, and analyze the results using mathematical models and statistical techniques.
They will discuss the accuracy and limitations of their model, propose improvements, and interpret the implications of their findings in the context of renewable energy or the specific applicationarea.

**2: Case Studies and Group Discussions**

Assign students to analyze case studies related to the applications of mathematical modeling innanotechnology, biophysics, medical physics, solid waste management, environmental remediation, orwater treatment.
Students will discuss the mathematical models and computational methods used in the case studies,analyze the outcomes, and evaluate the effectiveness of the modelling approach.
Encourage group discussions on the challenges, ethical considerations, and potentialadvancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations ofmathematical modelling in solving complex problems in these areas.

**3. Group Project**

Assign students to work in groups to develop a group project that integrates mathematical modelling withone of the application areas: renewable energy, nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize waste management practices. Students will plan and execute their project, apply mathematical modelling techniques, analyze the results, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

**UNIT V: Advanced Applications of computer Science**

Students must be able to convert numbers from other number system to binary number systems

1. Identify the networking media used for your college network

Identify all the networking device

# SEM - II

| | Government College (Autonomous) Rajahmundry | Program & Semester | | | |
|---|---|---|---|---|---|
| Course 3 | Renewable Energy Resources-1 | I B.Sc.(II Sem) | | | |
| Teaching | Hours Allocated:60 (**Theory**) | L | T | P | C |
| Pre-requisites: | Renewable energy sources require land surface for production of energy, in contrast to oil and gas, which are conveniently stored underground by natural processes. In essence, oil and gas are fossil biofuels; the land production required already took place in the past. | 4 | - | - | 3 |

1. The energy has become an important and one of the basic infrastructures for the economic development of the country. It is imperative for the sustained growth of the economy.
2. This course envisages the new and renewable source of energy, available in nature and to expose the students on sources of energy crisis and the alternates available, also stress up on the application of non-conventional energy technologies.

**Course Outcomes:**

| | On Completion of the course, the students will be able to- | CognitiveDomain |
|---|---|---|
| CO1 | Understand the need of energy conversion and the various methods of energy storage. | Understanding & Application |
| CO2 | Explain the field applications of solar energy. | Application |
| CO3 | Identify Winds energy as alternate form of energy and to know how it can be tapped. | Understanding , Application |
| CO4 | Gain a better understanding of global issues. Identify current key issues that exist within the climate change problem. | understanding , Application |
| CO5 | Explain bio gas generation and its impact on environment. | Application |

# Renewable Energy Resources-1

## UNIT-I (12hrs)

**Introduction to Energy:** Definition and units of energy - Joule, Erg, Calorie, Ton of Coal Equivalent, Ton of oil equivalent, Ton of TNT, KWH, electron Volt, British Thermal Unit, Definition and Units of Power – Watt, Horse power, Ton of refrigeration, Ton of air cooling.(Wiki)

**Classification of energy resources**: Primary-Secondary, Commercial-Non commercial, Conventional-Nonconventional, Renewable-Non-renewable, Green energy, Clean energy(Definitions and examples),

Green Foot print, Carbon Foot print, Ecological Footprint Concepts.

Bureau of Energy Efficiency–Actions and Activities, BEE Star label, ISEER introduction.

**UNIT-II(14 hrs)**

Solar constant, Solar Radiation spectrum, Classification of Solar cells - First generation Second Generation, Third Generation. Key elements of Silicon Solar cell, PV Solar cell, Module, panel and array. Solar Thermal systems types, applications of Solar PV and Solar Thermal systems.

**UNIT-III(10 hrs)**

**Wind Energy**: Origin of winds, Wind turbine site selection (ShobhNath Singh 6.5), Wind Turbine Types And Their Construction(BHKhan 7.8)

**UNIT-IV (14 hrs)**

**Ocean Energy**: Origin and nature of tidal energy, Ocean tidal energy conversion schemes, Wave energy technology, Ocean thermal energy conversion technology (Open cycle, closed cycle and Hybrid cycle).(BHKhan Ch.10,ShobhNathSingh Ch.11,12,13)

**UNIT-V(10 hrs)**

Bio-Energy:Photosynthesis, Usable forms of Biomass, Biomass resources, Biomass conversion technologies –Wet processes, Dry processes.(BHKhan Ch.8, GDRoy)

**References books**


1. Non-Conventional Energy Sources, G.D.Rai, NewDelhi.
2. Nonconventional Energy Resources,B.H.Khan,3rd Ed,TataMcGrawHill (2017)
3. Nonconventional Energy Resources, Shobh Nath Singh, Pearson India (2017)

**(1: Slight [Low]; 2: Moderate[Medium]; 3: Substantial[High],**

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

| | Government College (Autonomous) Rajahmundry | Program & Semester I B.Sc. (II Sem) | | | |
|---|---|---|---|---|---|
| Course-4 Course Code: | **MECHANICS, WAVES AND OSCILLATIONS** | | | | |
| Teaching | Hours Allocated: 60 (**Theory**) | L | T | P | C |
| Pre-requisites: | Linear Kinematics, Vector Algebra, Centre of mass, Coordinate systems, Second order differential equation solutions, Properties of sound waves. | 4 | - | - | 4 |

## Course Outcomes:

| On Completion of the course, the students will be able to- | | Cognitive Domain |
|---|---|---|
| CO1 | Students would learn about motion of variable mass system, Collisions in two and three dimensions, Rutherford scattering problem. Students would learn about rotational kinematics of rigid body, Moment of inertia tensor, Euler equations, Precision of top, equinoxes and Gyroscope | Remembering & Understanding |
| CO2 | Students would learn about conservative forces, relation between conservative force and potential, equation of motion under central forces, Keppler's laws and Coriolis force. | Application |
| CO3 | Students would learn about Gallian-Lorentz frames of references, Lorentz transformations, Michelson-Morley experiment, Postulates of special theory of relativity, length contraction, time dilation, addition of masses, mass energy relation. | Analyzing |
| CO4 | Students would learn about physical properties of Simple Harmonic Motion (SHM), Lissajous figures. Students would also solve the differential equations for forced harmonic oscillator and damped harmonic oscillator and compare the results with simple harmonic oscillator. They would also learn about Coupled oscillators and their normal modes | Remembering & Application |
| CO5 | Students would solve the wave equation for vibrating strings and study various parameters like modes, overtones, energy transport, transverse impedance etc. They would also learn about basics of ultrasonics, production detection of ultrasonics, measurement of frequency sand velocity of ultrasonics and the applications of ultrasonics. | Application |

## Course-4

## MECHANICS,WAVES AND OSCILLATIONS

UNIT-I:

**1. Mechanics of Particles (5 hrs)**

Review of Newton's Laws of Motion, Motion of variable mass system, Motion of a rocket, Multistage rocket, Damping effect of air on rocket motion*, Concept of impact parameter, scattering cross-section, Rutherford scattering-Derivation. Scattering Formula*

**2. Mechanics of Rigid bodies (7 hrs)**

Rigid body, Equation of motion for a rotating body, Angular momentum and Moment of inertia tensor, **Energy stored in flywheel**, Euler equations, Precession of a spinning top, Gyroscope, Precession of the equinoxes

Additional Inputs: Precession of atom and nucleus in magnetic field

**Unit-II:**

**3. Motion in a Central Force Field (12hrs)**

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, central force as a negative gradient of potential energy*. Equation of motion under a central force, Kepler's laws of planetary motion- Proofs, Basic idea of Global Positioning System (GPS), **NAVIC**, weightlessness, Physiological effects of astronauts,

UNIT-III:

**4. Relativistic Mechanics (12hrs)**

Introduction to relativity, Frames of reference, Galilean transformations, absolute frames, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction, variation of mass with velocity, Einstein's mass-energy relation, **Addition of velocities***

**Additional Inputs**: Twin paradox

**Unit-IV:**

**5. Undamped, Damped and Forced oscillations: (07 hrs)**

Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor. Velocity Resonance and Electrical Oscillator*

Additional inputs: Simple harmonic oscillator and solution of the differential equation, Lissajous figures.

**6. Coupled oscillations: (05 hrs)**

Coupled oscillators-Introduction, Two coupled oscillators, Normal coordinates and Normal modes- N-coupled oscillators and wave equation

**Unit-V:**

**7. Vibrating Strings and Vibration of Bars: (07 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, Meldes strings, **Vibrating bars (Conceptual). Tuning Fork** *

**8. Ultrasonics: (05 hrs)**

Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics, **Experimental Determination of wavelength of Ultrasonics** Applications of ultrasonic waves, SONAR

**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 | 1 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | 2 |

**Proposed activities:**

**Skill development**: Practicals based on computational techniques in Mat Lab

**Employability** : visiting any industry related to energy conversion and utilization.

TEXT BOOKS:

- B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
- Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
- Unified Physics - Waves and Oscillations, Jai PrakashNath&Co.Ltd.
- Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman. Publications, Delhi
- Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
- Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.
- The Physics of Waves and Oscillations, N.K.Bajaj, Tata McGraw Hill
- Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

**Web Links:**

1. https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/syllabus/
2. https://ocw.aprende.org/courses/physics/8-01sc-physics-i-classical-mechanics-fall-2010/
3. https://onlinecourses.nptel.ac.in/noc21_ph32/preview
4. https://nptel.ac.in/courses/115/105/115105098/
5. https://ocw.mit.edu/courses/physics/8-03sc-physics-iii-vibrations-and-waves-fall-2016
6. https://nptel.ac.in/courses/115/106/115106119/
7. https://nptel.ac.in/courses/122/105/122105023/

| | Government College (Autonomous) Rajahmundry | Program & Semester I B.Sc. (II Sem) | | | |
|---|---|---|---|---|---|
| Course Code | **MECHANICS, WAVES AND OSCILLATIONS** | | | | |
| Teaching | Hours Allocated: 30 (**Practical**) | L | T | P | C |
| Pre-requisites: | Screw gauge, Vernier Callipers, Stop watch, Graph plotting basics, MATLAB | - | - | 2 | 1 |

**Minimum of 6 experiments to be done and recorded:**

1. Young‟s modulus of the material a bar (scale) by non- uniform bending
2. Bifilar suspension –Moment of inertia of a regular rectangular body.
3. Fly-wheel -Determination of moment of inertia
4. Rigidity modulus of material of a wire-Dynamic method (Torsional pendulum)
5. Determination of ‘g’ by Compound pendulum
6. Simple pendulum- normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
7. Coupled oscillators
8. Verification of laws of vibrations of stretched string –Sonometer
9. Determination of frequency of a bar –Melde‟s experiment.

Additional inputs:

10. Verification of Kepler’s third law for planets in solar system
11. Plotting Kepler orbits for various eccentricities.
12. Plotting Rocket velocity/displacement as a function of time
13. Plotting Lissajous figures

**Virtual Lab Links:**

1. https://vlab.amrita.edu/
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html
3. https://www.myphysicslab.com/

| | Government College (Autonomous) Rajahmundry | Program & Semester IIB.Sc. (IIISem) | | | |
|---|---|---|---|---|---|
| Course 5 Course code: | **Renewable energy sources-II** | | | | |
| Teaching | Hours Allocated (**Theory**) | L | T | P | C |
| Pre-requisites: | Renewable energy is energy produced from sources like the sun and wind that are naturally replenished and do not run out. Renewable energy can be used for electricity generation, space and water heating and cooling, and transportation. | 4 | - | - | 3 |

Course Objective:

1. Various renewable energy resources available in the country, their potential, exploitation/achievements etc.,
2. 1.To introduce basic concepts of Geothermal Energy.
   2. To explain and show finding and obtaining of Geothermal Energy sources.
   3. To teach using of Geothermal Energy in useful way.
   4. To teach applications of Geothermal Energy.
3. To study occurrence movement and distribution of water that is a prime resource for development of a civilization..
4. To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology. To know the basic principles and movement of ground water and properties of ground water flow.
5. To be able to recall and explain the structure and properties of the atom. To be able to recall the three main types of radiation. To be able to explain the structure and properties of the three main forms of radiation.

## CourseOutcomes:

| | On Completion of the course, the students will be able to- | CognitiveDomain |
|---|---|---|
| CO1 | To acquire the knowledge of modern energy conversion technologies. | Understanding & Application |
| CO2 | Successfully completing this course, students will be able to: 1. To have information about Geothermal Energy. 2. To learn Geothermal Energy Conversion systems. 3. To learn Geothermal Energy sources and probing methods | Application |
| CO3 | Illustrate hydro and ocean power generation systems, Model hydro power extraction from oceans. | Understanding , Application |
| CO4 | know what radioactivity is and how it arises. know about radioactivity in nature and why it is there. know about fundamental concepts e.g. half-life, radioactive series and isotope generators | **understanding , Application** |
| CO5 | 1. Understand the importance and dimension of a healthy environment, become environmentally conscious, skilled and responsible in all their actions with a concern for sustainable development.<br>2. Comprehend the significance and issues related to ecosystems, natural resources and biodiversity and become aware of the need and ways to protect/ preserve them. | **Application** |

## Course-5
## Renewable energy sources-II

**UNIT-I(12hrs)**

**Global Energy Scenario:** Energy demand and Energy Trilemma index**.**
**Indian Energy Scenario:** Energy resource es available in India, Governance of energy sector in India, National Green Tribunal (NGT)act, NGT activities

**UNIT-II (12 hrs)**

**Geothermal energy:** Origin of geothermal energy, Types of geothermal resources and basic extraction mechanisms-Hydrothermal Resources, Geo-pressured resources, Hot dry rock resources, Magma resources.

**UNIT-III (12 hrs)**

**Introduction to Hydropower, Hydrology** – descriptive hydrology, hydrograph, mass curve, storage, dams. Classification of Hydropower Plants, Small Hydropower, Systems: Overview of micro, mini and small hydro systems Status of Hydropower Worldwide Advantages and Disadvantages of Hydropower, Selection of site for hydroelectric plant, Hydrological cycle, Essential elements of a hydroelectric power plant.

**UNIT-IV(12hrs)**

**Radioactivity;** Mass defect and binding energy; Chain reaction; Materials used in nuclear plants; Classifications of nuclear reactors, Construction and working of conventional nuclear reactor, pressurized water reactor, boiling water reactor, supercritical water reactor, Fast breeder reactor-types, Gas cooled reactor-types, Nuclear fusion reactor schematic, Nuclear power plant.

**https://sci-hub.ru/10.1016/b978-0-08-098330-1.00017-x and Wikipedia**
**https://libgen.rs/scimag/?q=nuclear+power+paul+breeze**

**UNIT-V (12 hrs)**

**Environmental Effects:** Environmental degradation due to energy production and utilization ,air and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Environmental effects of thermal power station, nuclear power generation, hydroelectric power, Geothermal power, Ocean energy harvesting. Wind energy harvesting, Solar energy harvesting, Bioenergy.(Frank Spellman)

**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 | 1 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 2 |

| | Government College(Autonomous) Rajahmundry | Program & Semester II B.Sc. (III Sem) | | | |
|---|---|---|---|---|---|
| Course 4 | **LAB-3** | | | | |
| Teaching | Hours Allocated: 2hrs/week(**Practicals**) | L | T | P | C |
| Pre-requisites: | Wind energy, Origin of winds, Wind turbine site selection | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVE:**

he long-term objective of wind farms is to help reduce the greenhouse gas emissions contributing to climate change.

LEARNING OUTCOMES:

Wind turbines may also reduce electricity generation from fossil fuels, which results in lower total air pollution and carbon dioxide emissions. An individual wind turbine has a relatively small physical footprint

**CORE COURSE-5- - [RENEWABLE ENERGY RESOURCES-2 LAB]**

**(As Approved in the BOS meeting held on 12/07/2024 for 2024-25)**

**No. of Hours perweek:02** **Total Lectures: 30**

**Any six experiments out of the following**

1. Effect of wind speed on windmill efficiency.

2. Study of hydroelectric power through a laboratory model

3. Effect of water source height on turbine power generation.

4.Wind-rose analysis

https://www.climate.gov/maps-data/dataset/wind-roses-charts-and-tabular-data

https://www.wikihow.com/Read-a-Wind-Rose

5. Spectral analysis of intensities on selective absorbers in solar cookers.

6.Biomass conversion analysis https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9160279/

| | Government College (Autonomous) Rajahmundry | Program & Semester | | | |
|---|---|---|---|---|---|
| Course-6 Course Code | **ELECTRICAL AND ELECTRONIC INSTRUMENTATION** | II B.Sc..REM (III Sem) | | | |
| Teaching | Hours Allocated: 60 (**Theory**) | L | T | P | C |
| Pre-requisites: | | 4 | 0 | - | 3 |

**Course-Objectives**

1. To understand Basic Terminology of Alternating current
2. To explain the important basic components home electrical appliances and their fixing.
3. To explain the semiconductor devices like diodes and transistors.

**Course Outcomes**

| On Completion of the course, the students will be able to- | |
|---|---|
| CO1 | Students can able to understand the Basics Alternating current and different network connections, power factor and it's related issues. |
| CO2 | Students can able to do wiring and fixing of electrical appliances in the houses as well as industries. |
| CO3 | Students can able to understand the basics of Semiconductor devices like diodes and transistors |
| CO4 | Students can able to understand the cells , batteries , different types of batteries and working of UPS |
| CO5 | Students can able to understand the domestic service line rules and electrical safety rules. |

**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 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | 1 | 3 | 1 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 |

DEPARTMENT OF PHYSICS
SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
COURSE--VI- SEMESTER III

**ELECTRICAL AND ELECTRONIC INSTRUMENTATION**

**(As Approved in the BOS meeting held on 12 JULY 2024 for 2024-25)**

No. of Hours per week: 04 Total Lectures: 60

**UNIT 1(12hrs)**

**Alternating currents & Circuit theory:** RMS Value of current, Current through L, C, R, Phasor analysis of RLC circuit –series & parallel resonance, Star & Delta connections, Three phase three wires & three phase four wires system, Three phase Power. Active& Reactive Power, Power factor, Causes & effects of low power factor, Methods of Improving power factor, Automatic power factor correction (APFC) Panels.

**UNIT 2**(12hrs)

**Electrical Instrumentation:** PVC wires, Conductors & cables, Wire joints, Soldering, National Electrical Code, SWG, common electrical Accessories – MCB, ELCB, MCCB, RCCB etc, Comparison between different types of wirings, Installation, Testing methods – Wiring estimations & cost, Earthing, types, methods, improving earth resistance, Earth tester. Types -PMMC,MI Meters, Principle and construction, Digital meters (Multimeter, Voltmeter, Ammeter, Ohm meter, Watt meter), Megger & Earth tester, Calibrations of meters.

UNIT-3 **(12hrs)**

**Semiconductor diode and transistors:** Semiconductor diode-V-I Characteristics, half wave rectifiers and full wave rectifiers (Centre tap and bridge), nature of rectifier output-ripple factor- Comparison of rectifiers- filter circuits- types of filter circuits - Voltage stabilization – Zener diode- Zener diode as voltage stabilizer.

Transistors-Bipolar junction transistors- Transistor as an amplifier DC and AC Load line concepts, Transistor as Switch, Oscillator and multi-vibrator (Conceptual).

UNIT-4 (12hrs)

**Power Electronics:** Electrolysis & its laws, Cells and Batteries- Primary & secondary cells, their construction & working, Lead Acid battery in detail, Hybrid cell, Alkaline cell, Charging Methods, Care & Maintenance of Battery. Inverter, Battery Charger, UPS-Principle of working. IC Voltage regulator, Voltage dimmer using DIAC and TRIAC.

UNIT-5 **(12hrs)**

**Power Transmission and Distribution:** Types of substation, Layout and components, Advantages of DC transmission and High voltage transmission, Domestic service line rules and Bus bar system, Line protectors: Circuit breakers, Relays, Laws of Illumination, Terminology used in Illumination, Types of Lamps, Lighting calculations.

National Policy on Safety, Health and Environment at Workplace (NPSHEW), Major OSH Laws & Regulations, Electrical Safety, Electrical safety Rules, Simple First Aid, General safety of tools and equipment PPEs , Fire extinguishers.

**Text books:**


1. Basic Electronics- Solid state; BL Thereja; 2005; S. Chand & Co.
2. Electrician Trade Theory 1st Semester; NIMI, Chennai (2018).


**Reference books:**


1. Electrician Trade Theory 4th Semester; NIMI, Chennai (2018).
2. Principles of Electronics; V. K. Mehta; 2006; Tenth Edition; S. Chand & Co

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc.Rem (III Sem) | | | |
|---|---|---|---|---|---|
| Course Code | **ELECTRICAL AND ELECTRONIC INSTRUMENTATION Practical's** | | | | |
| Teaching | Hours Allocated: 30 (**Lab**) | L | T | P | C |
| Pre-requisites: | | 0 | 0 | 2 | 1 |

**Any six experiments out of the following**

1. Familiarization with multi meter
2. Network theorems.
3. LCR Circuits
4. Soldering and wire joints
5. Rectifiers Full wave and half wave
6. Filters Low pass, High pass and band pass
7. Constant and variable IC voltage regulators
8. Voltage dimmer
9. Digital logic gates, Demorgan Laws, Half adder and Full adder.
10. Flip-flops and counters
11. Analysis of Household power demand.

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc (III Sem) | | | |
|---|---|---|---|---|---|
| Course Code COURSE-VII | **HEAT AND THERMODYNAMICS** | | | | |
| Teaching | Hours Allocated: 60 (**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) | 4 | 0 | - | 3 |

**Course Objectives:**

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 critical understanding of concept of Thermodynamic potentials, the 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.*

**Course Outcomes:**

| On Completion of the course, the students will be able to- | | Cognitive Domain |
|---|---|---|
| CO1 | Students would learn about Kinetic Theory of gases, Maxwell's law of distribution of molecular velocities and its experimental verification, Mean free path, Degrees of freedom, Transport phenomenon viscosity, Thermal conductivity and diffusion of gases | Understanding & Remembrance |
| CO2 | Students would learn about Various thermodynamic processes, entropy changes in various processes and heat engines. | Application |
| CO3 | Students would learn about various thermodynamic potentials and joule kelvin cooling concepts using thermodynamic potentials. | Analyzation |
| CO4 | Students would learn about various methods for producing very low temperatures and theory of Joule Kelvin effect. | Application |
| CO5 | Students would learn about Blackbody and its spectral energy distribution of black body radiation, Various theories of Black body radiation, usage of various radiation measuring instruments. | Application |

**SYLLABUS**
**COURSE-VII**
**HEAT & THERMODYNAMICS**

**UNIT-I**

**Kinetic Theory of gases: (12 hrs)** Kinetic Theory of gases - Introduction, Maxwell's law of distribution of molecular velocities (qualitative treatment only) and its experimental verification **(Toothed wheel),** Mean free path, **derivations of $C_{avg}$, $C_{rms}$, $C_p$,** Transport phenomenon in ideal gases: viscosity, thermal conductivity and diffusion of gases.

**UNIT-II**

**Thermodynamics: (12hrs)** Introduction- Isothermal and Adiabatic processes, Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, **Introduction about Heat engines,** Second law of thermodynamics: Kelvin's and Clausius statements, Principle of refrigeration, Entropy, Physical significance, Change in entropy in reversible and irreversible processes; Entropy and disorder-Entropy of Universe; Temperature-Entropy (T-S) diagram and its uses; change of entropy when ice changes into steam.

**UNIT-III**

**Thermodynamic Potentials and Maxwell's equations: (12hrs)** 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, Value of CP- CV, Value of CP/CV .

**UNIT-IV**

**Low temperature Physics: (12hrs)** Methods for producing very low temperatures - Joule Kelvin effect (Porous plug experiment), **,** Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Liquefaction of **Helium** by **Kapitza's** method, Production of low temperatures by adiabatic demagnetization (qualitative), Practical applications of substances at low temperatures.

Additional Inputs: Joule expansion

**UNIT-V**

**Quantum theory of radiation: (12 hrs)** Blackbody and its spectral energy distribution of black body radiation, Kirchoff's law, Wein's displacement law, Stefan-Boltzmann's law and Rayleigh-Jean's law (No derivations), Planck's law of black body radiation (Derivation), Deduction of Wein's law and Rayleigh- Jean's law from Planck's law, Solar constant and its determination using Angstrom pyrheliometer, Estimation of surface temperature of Sun.

**TEXT BOOKS:**

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- Heat and Thermodynamics -N BrijLal, P Subrahmanyam, S.Chand & Co.,2012
- Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath & Co. Ltd., Meerut

**REFERENCE BOOKS:**

- Thermodynamics, R.C.Srivastava, S.K.Saha & Abhay K.Jain, Eastern Economy Edition.
- University Physics, HD Young, MW Zemansky, FW Sears, Narosa Publishers, New Delhi
- Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
- Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000

**Web Links:**

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-00-thermodynamics-of-materials-fall-2002
2. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008
3. https://onlinecourses.nptel.ac.in/noc20_me51/preview
4. https://nptel.ac.in/courses/112/108/112108148/

**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 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 3 | 1 |

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc. (III Sem) | | | |
|---|---|---|---|---|---|
| Course Code<br><br>COURSE | **Heat and Thermodynamics** | | | | |
| Teaching | Hours Allocated:<br>30 (**Practical**) | L | T | P | C |
| Pre-requisites: | Voltmeter, Ammeter, Rheostat, steam generators, Thermometer types. | 0 | 0 | 2 | 1 |

**Minimum of 6 experiments to be done and recorded**

1. Specific heat of a liquid –Joule's calorimeter
2. Thermal conductivity of bad conductor-Lee's method
3. Verification of Stefan's law.
4. Specific heat of a liquid by applying Newton's law of cooling correction**.**
5. Heating efficiency of electrical kettle with varying voltages.
6. Thermal behavior of an electric bulb (filament/torch light bulb)
7. Thermo couple and Seebeck Effect.
8. Study of variation of resistance with temperature - Thermistor.

**Virtual Lab Links:**

1. https://vlab.amrita.edu/
2. http://physics.bu.edu/~duffy/classroom.html
3. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html&sort=alpha&view=grid
4. **Study of Phase change of ice, naphthalene**.

| | Government college(A), rajahmundry | Program & Semester | | | |
|---|---|---|---|---|---|
| Course-8<br>Course Code | **WAVE OPTICS** | II B.Sc (III Sem) | | | |
| Teaching | Hours Allocated:<br>60 (**Theory**) | L | T | P | C |
| Pre-requisites: | Aberrations, interference , diffraction, polarization ,Aberrations **and Fibre Optics, Lasers and Holography** | 4 | 0 | - | 3 |

***Course objective***

*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.*

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

**Course Outcomes:**

| | 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 wavefront 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 their removal techniques. They would also learn about fiber optics types and applications | 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 fiers, principles of holography, limitations of Gabor's hologram and applications of holography | Application |

**Syllabus**

**Course-8- Wave Optics**

**UNIT-I Interference of light: (12hrs)**

Introduction, Conditions for interference of light, Interference of light by division of wave front and amplitude, Phase change on reflection- Stokes‟ treatment, Lloyds single mirror, Interference in thin films: Plane parallel and wedge- shaped films, colours in thin films, Newton's rings in reflected light-Theory and experiment, Determination of wavelength of monochromatic light, Michelson interferometer and determination of wavelength, **Fabrey Perot Interferometer***

**UNIT-II Diffraction of light:(12hrs)**

Introduction, Types of diffraction: Fresnel and Fraunhoffer diffractions, Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit, Plane diffraction grating, Determination of wavelength of light using diffraction grating, Resolving power of grating, Fresnel's half period zones, Explanation of rectilinear propagation of light, Zone plate, comparison of zone plate with convex lens. Diffraction grating interferometer*

Additional Inputs: **XRD**

**UNIT-III Polarisation of light:(12hrs)**

Polarized light: Methods of production of plane polarized light, Double refraction, Brewster's law, Malus law, Nicol prism, Nicol prism as polarizer and analyser, Quarter wave plate, Half wave plate, Optical activity, Laurent's half shade polarimeter, determination of specific rotation, Basic principle of LCDs, **Fiber optics sensors***

**Additional Inputs:** Plane, Circularly and Elliptically polarized light-Production and detection, Principle of antiglare glasses.

**UNIT-IV Aberrations and Fibre Optics: (12hrs)**

Monochromatic aberrations, Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; chromatism for two lenses (i) in contact and (ii) separated by a distance. Principles of fiber communication (qualitative treatment only), Advantages **and Applications*** of fiber optic communication.

Additional Inputs: Attenuation in optical fibres.

**UNIT-V Lasers and Holography: (12hrs)**

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, Applications of holography, Semiconductor lasers*

**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 | 2 | 3 | 1 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 1 | 3 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 3 | 1 |

TEXT BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
- Unified Physics Vol.IIOptics, Jai PrakashNath&Co.Ltd., Meerut

REFERENCE BOOKS:

- Optics-Murugeshan, S.Chand& Co.
- Optics,F.A. Jenkins and H.G.White, McGraw-Hill
- Optics, AjoyGhatak,TataMcGraw-Hill.
- Introduction of Lasers – Avadhanulu, S.Chand& Co.
- 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

| | Government college(A), rajahmundry | Program & Semester II B.Sc (III Sem) | | | |
|---|---|---|---|---|---|
| Course-8 Course Code | **WAVE OPTICS** | | | | |
| Teaching | Hours Allocated: 30 (**Practical**) | L | T | PPP | C |
| Pre-requisites: | Aberrations, interference , diffraction, polarization, Aberrations **and Fibre Optics, Lasers and Holography** | - | 0 | 2 - | 1 |

**Minimum of 6 experiments to be done and recorded**

1. Determination of radius of curvature of a given convex lens-Newton's rings.
2. Resolving power of grating.
3. Dispersive power of a prism.
4. Determination of wavelength of light using diffraction grating-minimum deviation method.
5. Determination of wavelength of light using diffraction grating-normal incidence method.
6. Refractive index of a liquid-hollow prism
7. Determination of thickness of a thin wire by wedge method
8. Determination of refractive index of liquid-Boy's method.
9. Determination of thickness of wire using laser diffraction.
10. Reflection grating – determination of grating element width on metal scale.
11. Determination of wave length of laser.

**Virtual Lab Links:**

1. https://ocw.mit.edu/resources/res-6-006-video-demonstrations-in-lasers-and-optics-spring-2008/
2. https://nptel.ac.in/courses/115/105/115105120/
3. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/engg_physics/labs/exp1/simulation/simulator.html
4. https://micro.magnet.fsu.edu/optics/lightandcolor/java.html

| | Government college(A), rajahmundry | Program & Semester II B.Sc (IV Sem) | | | |
|---|---|---|---|---|---|
| Course-9 Course Code | **ELECTRICITY, MAGNETISM AND ELECTRONICS** | | | | |
| Teaching | Hours Allocated: 60 (**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. | 4 | 0 | - - | 3 |

**Course Objectives:**

*Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.*

1. *Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.*
2. *Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.*
3. *Develop an understanding on the unification of electric and magnetic fields and Maxwell's equations governing electromagnetic waves.*
4. *Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits.*
5. *Describe the operation of p-n junction diodes, zener diodes, light emitting diodes and transistors*
6. *Understand the operation of basic logic gates and universal gates and their truth tables.*

**Course Outcomes:**

| On Completion of the course, the students will be able 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 Biot savart'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 | Students would able to learn about number system ,Boolean algebra, basic logic gates which are more useful in digital world | Application |

**Syllabus**
**Course-9 Electricity, Magnetism & Electronics**
**II B.Sc-REM- SEm-IV**

**UNIT-I (9 hr)**

**1. Electrostatics:** Gauss's law-Statement and its proof, **Differential form of Gauss law,** Electric field intensity due to (i) uniformly charged solid sphere and (ii) an infinite conducting sheet of charge, Deduction of Coulomb's law from Gauss law, Electrical potential–Equipotential surfaces, Potential due to a uniformly charged sphere

**2. Dielectrics:** Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, **Applications of Dielectrics** - Capacitance of a parallel plate condenser with dielectric slab between the plates, Electric displacement D, electric polarization P, Relation between D, E and P, Dielectric constant and electric susceptibility.

**Additional Input: Dielectric strength,**

**UNIT-II (9 hr)**

**3. Magnetostatics:** Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Divergence and curl of magnetic field, Ampere's Circuital Law and its application to Solenoid, Hall effect, determination of Hall coefficient and applications.

**4. Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, Self-induction and Mutual induction, Self-inductance of a long solenoid, Mutual inductance of two coils, Energy stored in magnetic field, **Principle and working of Transformer**, Eddy currents and Electromagnetic damping

**UNIT-III (9 hr)**

**5. Alternating currents:** Alternating current - Relation between current and voltage in LR and CR circuits, Phase and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

**6. Electromagnetic waves-Maxwell's equations:** Idea of displacement current, Maxwell's equations-Derivation, Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof)

**UNIT-IV (9 hr)**

**Basic Electronic devices:** PN junction diode, Zener diode and Light Emitting Diode (LED) and their I-V characteristics, Zener diode as a voltage regulator- Transistors and its operation, CB, CE and CC configurations, Input and output characteristics of a transistor in CE mode, Relation between alpha, beta and gamma; Hybrid parameters, Determination of hybrid parameters from transistor characteristics**;** Transistor as an amplifier.

**UNIT-V (9 hr)**

**Digital Electronics:** Number systems, Conversion of binary to decimal system and vice versa, Binary addition & Binary subtraction (1's and 2's complement methods), Laws of Boolean algebra, De-Morgan's laws-Statements and Proofs, Basic logic gates, NAND and NOR as universal gates, Exclusive-OR gate, Half adder and Full adder circuits.

**Additional Input**

**Power Sources (Batteries):** Types of power sources - DC & AC sources - Different types of batteries - Rechargeable batteries – Lead acid batteries - Li-ion batteries - Li-PO batteries - Series, Parallel & Series-Parallel configuration of batteries - Constant Voltage source - Constant Current Source - Applications of Current sources & Voltage sources - SMPS used in computers.

**TEXT BOOKS**

- BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
- Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
- Unified Physics Vol.3, ELECTRICITY, MAGNETISM AND ELECTRONICS, Jai Prakash Nath & Co. Ltd., Meerut

**REFERENCE BOOKS:**

- Electricity and Magnetism, B.D.Duggal and C.L.Chhabra. Shobanlal & Co.
- Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand & Co.,
- Electricity and Magnetism, R.Murugeshan, S. Chand & Co.
- Principles of Electronics, V.K. Mehta, S.Chand & Co.,
- Digital Principles and Applications, A.P. Malvino and D.P.Leach, McGrawHill edition.

**Web Links:**

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/

**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 | 2 | 1 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 1 | 3 | 2 |

| | Government college(A), rajahmundry | Program & Semester II B.Sc (III Sem) | | | |
|---|---|---|---|---|---|
| Course-9 Course Code | **ELECTRICITY, MAGNETISM AND ELECTRONICS** | | | | |
| Teaching | Hours Allocated: 30 (**Practical's)** | 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. | - | 0 | 2 - | 1 |

**Minimum of 6 experiments to be done and recorded**

1. LCR circuit series/parallel resonance, Q factor.
2. Determination of ac-frequency –Sonometer.
3. Verification of Kirchoff's laws and Maximum Power Transfer theorem.
4. Stewart Gee's Experiment.
5. Zener Diode –V-I Characteristics
6. Transistor CE Characteristics
7. Logic Gates- OR, AND, NOT and NAND gates- Verification of Truth Tables.
8. Verification of De Morgan's Theorems.
9. Half adder and Full adders-Verification of truth tables.
10. Dielectric constant of a material.

**Virtual Lab Links:**

1. https://vlab.amrita.edu/
2. http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedtour/GuidedTour.htm
3. http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedtour/GuidedTour.htm
4. http://physics.bu.edu/~duffy/classroom.html
5. Barkhausen Effect.
6. Temperature coefficient of resistance.
7. Hysteresis.

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc.REM (IVSem) | | | |
|---|---|---|---|---|---|
| Course-10 Course Code | **ENERGY HARVESTING SYSTEMS** | | | | |
| Teaching | Hours Allocated: 60 (**Theory**) | L | T | P | C |
| Pre-requisites: | | 4 | 0 | - | 3 |

**Course Objectives:**

1. To understand Basic Terminology of Solar Energy
2. To understand the basics of PV systems and it's installation.
3. To understand the wind, bio and ocean energies and production ofBiofuels.

**Course Outcomes:**

| On Completion of the course, the students will be able to- | |
|---|---|
| CO1 | Students can able to understand the Basic terminology of Solar energy |
| CO2 | Students can able to understand the Solar Thermal systems and different components used in the solar thermal energy conversion process. |
| CO3 | Students can able to understand the basics of solar PV cell , its fabrication ,solar module assembly. |
| CO4 | Students can able to understand the basics of Wind energy and different wind turbine technologies. |
| CO5 | Students can able to understand the Bio and Ocean energies and learn the production process of Biofuels. |

**Course 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 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 1 | 3 | 1 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 3 | 1 |
| CO5 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 3 | 1 |

**DEPARTMENT OF PHYSICS**
**SYLLABUS FOR II B.Sc., RENEWABLE ENERGY MANAGEMENT**
**COURSE-9-RENEWABLE ENERGY HARVESTING SYSTEMS**
**SEMESTER IV**
**(As Approved in the BOS meeting held on 12 JULY 2024 for 2024-25)**

No. of Hours per week: 04 Total Lectures: 60

**UNIT 1 (12hrs)**

**Basics of Solar Radiation:** Structure of Sun, Spectral distribution of extra terrestrial radiation, Solar constant, Concept of Zenith angle and air mass, Definition of declination, hour angle,solar azimuthal angle,

Direct, diffuse and total solar radiation, Solar intensity measurement – Thermoelectric pyranometer and Pyrheliometer, Using a sun path diagram on Shade analysis.

**UNIT-II (12 hrs)**

**Solar Thermal Systems:** Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion: Flat plate collectors and Concentrating collectors, Solar cookers, Solar hot water systems, Solar greenhouses, Passive space heating and cooling concepts, Solar desalination and drier, Solar thermal power generation.

**UNIT-III (12 hrs)**

**Solar PV systems:** Photovoltaic Effect, Solar photovoltaic cell and its working principle, Solar cell module assembly – Fabrication of solar module, Module performance, shading effect on I- V characteristics, – use of Bypass and Blocking diodes, SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems.

**UNIT-IV (12 hrs)**

**Wind energy:** Types of wind turbine, Lift and drag forces on wind turbine, Generator types, Blade design, Tower design, Yield Enhancement techniques, Grid connection, Building integration concept, Offshore floating wind turbine technologies and challenges.

**UNIT-V (12 hrs)**

**Bio energy and Ocean energy:** Anaerobic digestion, Liquid biofuels – Biodiesel, Ethanol, Methanol, Hydrogen generation,

**Text books:**


1. (Earthscan expert series) Chris Laughton - Solar Domestic Water Heating_ The Earthscan Expert Handbook for Planning, Design and Installation -Earthscan (2009)
2. (Earthscan expert series) Mark Hankins - Stand-alone solar electric systems _ the Earthscan expert handbook for planning, design and installation-Earthscan (2010)
3. (Planning and Installing Series) Deutsche GesellshaftFürSonnenenergie - Planning and Installing Photovoltaic Systems_ A Guide for Installers, Architects and Engineers - Earthscan Publications Ltd. (2008)


**Reference books:**


1. Geoff Stapleton, Susan Neill - Grid-connected Solar Electric Systems_ The Earthscan Expert Handbook for Planning, Design and Installation-Routledge (2012)
2. Goswami, D. Yogi - Principles of Solar Engineering, Third Edition-CRC Press (2015)
3. Sinisa Stankovic, Neil Campbell, Alan Harries - Urban Wind Energy-Earthscan Publications Ltd. (2009)
4. IEA-RETD (Organization) - Offshore renewable energy _ accelerating the deployment of offshore wind, tidal, and wave technologies-Earthscan (2012)
5. German Solar Energy Society (DGS), Ecofys - Planning and installing bioenergy systems_ a guide for installers, architects, and engineers-Earthscan Publications Ltd. (2005)


Web Links:

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc.MPRem (IV Sem) | | | |
|---|---|---|---|---|---|
| Course Code<br><br>Course-10 | **RENEWABLE ENERGY HARVESTING SYSTEMS Practicals** | | | | |
| Teaching | Hours Allocated: 30 (**Lab**) | L | T | P | C |
| Pre-requisites: | | 0 | 0 | 2 | 1 |

**Objectives:**

1. Students can able to enrich the working knowledge of the theoretical concepts.

**Any six experiments out of the following**

1. Preparation of copper oxide selective surface by chemical conversion method.
2. Effect of Tilt angle on solar cell IV Characteristics.
3. Spectral characteristics of solar cell.
4. Sun path diagram analysis
5. Effect of tilt angle and air mass index on average annual power generated by solar panel
6. Area properties of solar cell (Shadow effects).
7. Effect of tilt angle on the wind mill power generation.
8. Biomass production and analysis

WEB LINKS

https://biomanufacturing.org/uploads/files/916125159861202706-biofuels-lab-manual.pdf
https://drajmarsh.bitbucket.io/sunpath2d.html
https://archive.manylabs.org/lesson/124/solarPanelSimulation/

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc.Rem (IV Sem) | | | |
|---|---|---|---|---|---|
| Course Code<br><br>Course-11 | **RENEWABLE ENERGY STORAGE DEVICES** | | | | |
| Teaching | Hours Allocated: 60 (**Theory**) | L | T | P | C |
| Pre-requisites: | | 4 | 0 | - | 4 |

**Course Objectives:**

1. To understand the Basic concepts of energy storage systems.
2. To understand the Different forms of energy storage systems.
3. To understand the concept of Fuel cell and different types of fuel cells.

**Course Outcomes:**

| On Completion of the course, the students will be able to- | |
|---|---|
| CO1 | Students can able to understand the Basic terminology of Energy, Different Forms of Renewable Energy and Indian Energy Scenario. |
| CO2 | Students can able to understand the basics of solar energy& wind energy, construction and working of PV solar cell, wind turbine construction. |
| CO3 | Students can able to understand the basics of Geothermal energy & Hydro energy and their energy extraction mechanisms |
| CO4 | Students can able to understand the basics of Ocean energy, wave energy technology & Bio energy. |
| CO5 | Students can able to understand the hazardous effects of non renewable energy sources on the environment and the importance of renewable energy sources. |

## Syllabus:

COURSE-11- **ENERGY STORAGE DEVICES**

**UNIT-I (12 hr)**

**Energy Storage:** Need of energy storage; Different modes of energy storage, Flywheel storage, Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

**UNIT-II (12 hrs)**

**Electrochemical Energy Storage Systems:** Batteries: Primary, Secondary, Lithium, Solid- state and molten solvent batteries; Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes in electrodes.

**UNIT-III (12 hrs)**

**Magnetic and Electric Energy Storage Systems:** Superconducting Magnet Energy Storage(SMES) systems; Capacitor and battery: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application.

**UNIT-IV (12 hrs)**

**Fuel Cell:** Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics, efficiency, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages.

**UNIT-V (12 hrs)**

**Types of Fuel Cells:** Alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell; solid oxide fuel cell, proton exchange membrane fuel cell, problems with fuel cells, applications of fuel cells.

**Text books:**


1. J. Jensen and B.Squrensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
2. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.
3. P.D.Dunn, Renewable Energies, Peter Peregrinus Ltd, London, 1986.


**Reference books:**


1. . B.Viswanathan and M. A.Scibioh, Fuel Cells-Principles and Applications, University Press, 2006.
2. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

| | Government College (Autonomous) Rajahmundry | Program & Semester II B.Sc.Rem (IV Sem) | | | |
|---|---|---|---|---|---|
| Course Code | ENERGY STORAGE SYSTEMS Practicals | | | | |
| Teaching | Hours Allocated: 45 (**Lab**) | L | T | P | C |
| Pre-requisites: | | 0 | 0 | 2 | 3 |

**Objectives:**

1. Students can able to enrich the working knowledge of the theoretical concepts.

**Any six experiments out of the following**

Charging and discharging time constants of RC Circuit.

1. Measurement of dielectric constant of a material.
2. Energy storage – Fly wheel
3. Energy storage – Capacitor
4. Energy storage – Inductor
5. Study of charging and discharging cycles of Li-ion battery
6. Study of conversion efficiency of solar water heating system.
7. Study the performance of PWM Charge controller for parallel and series configurations and DC Load
8. Study of performance of MPPT charge controller for parallel and series configurations and DC Load

**Virtual Lab Links:**

**https://www.avit.ac.in/research_centre/renewable_energy/download/lab_manual.pdf**
**https://jru.edu.in/studentcorner/lab-manual/btech/ME/8th-sem/NonconventionalEnergySourcesLab.pdf**
**https://vlab.amrita.edu/?sub=77&brch=270 Amrita VLabs Energy Storage Labs**
**https://www.fuelcellstore.com/manuals/tutorial-set-manual-and-schematics.pdf**