Syllabus Documents

For the Papers offered during I, II, Semesters in Major System

(As Approved in the BOS meeting held on 30 Aug. 2023 for batch 2023-24)

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	Major1	Essentials and Applications of Mathematical, Physical and Chemical Sciences	3+2	4
		Major2	Advances in Mathematical, Physical and Chemical Sciences	3+2	4
	II	Major1	Fundamentals of Renewable Energy Resources	3	3
			PRACTICAL COURSE-1	2	1
		Major2	**Mechanics, Waves and Oscillations**	3	3
			PRACTICAL COURSE -2	2	1

Courses offered in B.Sc (REM) programme: Credits

Year	Semester	Title of the Course (Paper)	Max. Marks (SEE)	Marks in (CIA)	L	T	P	C
1	**I**	Essentials and applications of Mathematical, Physical and Chemical Sciences	**50**	**50**	**5**	**0**	**0**	**4**
	I	Advances in Mathematical, Physical and Chemical Sciences	**50**	**50**	**5**	**0**	**0**	**4**
	II	Renewable Energy Resources-1 (Minor-1)	**50**	**50**	**3**	**0**	**2**	**4**
	II	Renewable Energy Resources-2	**50**	**50**	**3**	**0**	**2**	**4**

COURSE STRUCTURE UNDER CBCS PATTERN (2020-2023)

RENEWABLE ENERGY SOURCES
(MATHEMATICS, PHYSICS & RENEWABLE ENERGY SOURCES)
UNDER CBCS PATTERN

SEMESTER	MODULE		SUBJECT	HRS.	CREDITS	IA	ES	TOTAL
		SECOND YEAR						
SEMESTER III	III	REM 114	ELECTRICAL AND ELECTRONIC INSTRUMENTATION	4	4	50	50	100
			PRACTICAL III	2	1	50	NIL	50
SEMESTER IV	IV	REM 115	RENEWABLE ENERGY HARVESTING SYSTEMS	4	4	50	50	100
			PRACTICAL IV	2	1	NIL	50	50
	V	REM 116	RENEWABLE ENERGY STORAGE SYSTEMS	4	4	50	50	100
			PRACTICAL IV	2	1	NIL	50	50
			INDUSTRIAL INTERNSHIP					100
		THIRD YEAR						
SEMESTER V	VI-A	REM 117	SOLAR PV, SOLAR THERMAL AND WIND ENERGY SYSTEMS	4	4	50	50	100
			PRACTICAL	2	1	50	NIL	50
	VI-B	REM118	ENERGY AUDITING AND MANAGEMENT	4	4	50	50	100
				2	1	50	NIL	50
SEMESTER VI			INDUSTRIAL INTERNSHIP/APPRENTICESHIP					200

I SEM MAJOR 1

	Government College (Autonomous) Rajahmundry	Program & Semester IB.Sc.(ISem)			
Course Code 1	**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

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential 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.

SYLLABUS

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 and problems **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- Behaviour 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 S.R.Knight
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 by S. P. Bhutan
11. Fundamentals of Computers by V. Raja Raman
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 their relations.

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 statistical measures 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, and applications related to their assigned topic.

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

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects or electric and magnetic fields.

Provide the necessary materials, instructions, and safety guidelines for conducting the experiment.

Students will work in small groups to carry out the experiment, collect data, and analyze the results.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,or environmental issues.
Students will research and create a presentation (e.g., PowerPoint, poster, or video) that showcases 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 on their 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 and bases or observing a combustion reaction.
Students will observe and describe the chemical changes that occur, including changes in color, 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 that involve the interdisciplinary application of mathematics, physics, and chemistry.

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

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integrates mathematics, 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 of
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**.**

I SEM MAJOR 2

	Government College (Autonomous) Rajahmundry	**Program & Semester** I B.Sc.(I Sem)			
Course 2	**ADVANCES OF MATHEMATICAL, PHYSICAL AND 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 these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

SYLLABUS :

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms – Point ofintersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product ruleand 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 ofa matrix 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 by A.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:

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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 analyzing rates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation and apply basic methods of 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, and matrix transpose.

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

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

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

Students will analyze the case studies, identify the challenges or problems presented, and propose innovative 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 experiment accordingly.

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 screening experiment to identify potential drug candidates for a specific disease target.

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

2. Case Studies and Discussion

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

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

Students will discuss the principles of catalysis, the advantages and limitations of the catalysis 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 anano sensor for a specific 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 application area.

2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modelling in nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water 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 potential advancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations of mathematical 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 with one 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
2. Identify all the networking devices used in your college premises.

II SEM MAJOR 1

	Government College (Autonomous) Rajahmundry	**Program & Semester** I B.Sc.(II Sem)			
Course 3	Fundamentals of Renewable Energy Resources				
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.	3	0	2	4

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.

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-Nonrenewable, 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.

Activity Proposed: Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.

Suggest the areas where the non-conventional energy may be used 3 Identify the solar intensity and wind speed in your institute locality and calculate the intensity of Solar/Wind Power can be generated. 4 Visit to web site of ministry of renewable energy, Government of India: http://mnre.gov.in/ make a Study on 'Developmental Impact and Sustainable Governance aspects of Renewable Energy Projects

Evaluation Method: Presentation skills, Report etc.

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.

Activity Proposed: Visit solar power plant /wind power plant available in your locality/ nearer to your institute and understand different elements, working, and note the power generation by these plants

Evaluation Method: Report, presentation skills, critical thinking, problem solving etc.

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)

Activity Proposed:

1 Prepare a of monthly energy consumption of your institute and find the ways how it can be conserved.

2 Conduct an energy audit of your institute; suggest the ways how the conventional energy resources utilization can be minimized..

Evaluation Method: Knowledge retention, performance etc.

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)

Activity Proposed : Gain a better understanding of global issues.

Identify current key issues that exist within the climate change problem.

Evaluation Method: Quiz

UNIT-V(10 hrs)

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

Activity Proposed: Teacher and classroom bioenergy resources are a necessary component for exposing students to the benefits of renewable biomass and waste resources to develop low-carbon biofuels and bioproducts.

References books

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

	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				
Course 4	**LAB-1**	**Program & Semester** **I B.Sc. (II Sem)**			
Teaching	**Hours Allocated: 2hrs/week (Practicals)**	**L**	**T**	**P**	**C**
Pre-requisites:	**photo electric effect, diode characteristics.**	**0**	**0**	**2**	**1**

COURSE OBJECTIVE: **To familiarize the students with the concepts of generation of electrical energy from Solar Energy with emphasis on Solar thermal energy and Solar Photovoltaic and its application.**

LEARNING OUTCOMES:

. Learn the fundamental concept of generation of electricity from solar energy. 2. Will have knowledge of basics of solar PV cell fabrication technology. 3. Know about the dependence of I-V characteristics on the physical parameters such as Insolation and Temperature. 4. Acquaint themselves with various types of control algorithms for Maximum Power Point Tracking. 5. Will have knowledge of basics of standalone and grid connected solar PV topologies and basic components of a solar PV system

RENEWABLE ENERGY RESOURCES-1

List of Experiments/Syllabus:

Any six experiments out of the following.

1. **I-V Characteristics of Solar cell. fill factor.**
2. **P-V Characteristics of solar cell. Efficiency.**
3. **Spectral characteristics of solar cell**
4. **Intensity characteristics of solar cell**
5. **Area characteristics of solar cell**
6. **Effect of temperature on the efficiency of the solar cell.**
7. **Effect of tilt angle on the efficiency of the solar cell.**
8. **Determination of Planck's constant using photocell.**

II SEM MAJOR 2

	Government College (Autonomous) Rajahmundry	**Program**

Course Code REM-2	**MECHANICS,** **WAVES AND OSCILLATIONS**	**&** **Semester** I B.Sc. (II Sem)			
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Linear Kinematics, Vector Algebra, Center of mass, Coordinate systems, Second order differential equation solutions, Properties of sound waves.	3	0	2	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 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 with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

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

	Government College (Autonomous) Rajahmundry	**Program & Semester** I B.Sc. (I Sem)			
Course Code REM -2	**MECHANICS, WAVES AND OSCILLATIONS**				
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites:	Screw gauge, Vernier Calipers, Stop watch, Graph plotting basics, MATLAB	3	-	2	1

CourseOutcomes:

1.Perform experiments on Properties of matter such as the determination of moduli of elasticity *viz.*, Young‟s modulus, Rigidity modulus of certain materials, and Moment of inertia of some regular bodies by different methods and compare the experimental values with the standard values.
2.Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.
3.Notice the resonance using the sonometer experiments respectively.
4.Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration.
5.Demonstrate the formation of stationary waves on a string in Melde‟s string experiment.
6.Observe the motion of coupled oscillators and normal modes.

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/

III SEM MODULE 3

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code REM114	[ELECTRICAL AND ELECTRONIC INSTRUMENTATION	II B.Sc.M.P.Rem (III Sem)			
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:		4	0	-	4

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.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

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

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
MODULE-III
[ELECTRICAL AND ELECTRONIC INSTRUMENTATION]
SEMESTER III
(As Approved in the BOS meeting held on 02 AUG 2022 for 2022-23)

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).

Module4 (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.

Module5 (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

Web Links:

TOPICS INCLUDED UNDER AUTONOMOUS SET UP

CLASS : II B.Sc., MPREM
SEMESTER : III
COURSE : III
TITLE OF THE PAPER: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

ADDITIONAL/DELETED TOPICS	JUSTIFICATION
1. Automatic power factor correction (APFC) Panels. 2. Earth tester. 3. Megger & Earth tester, Calibrations of meters. 4. Electrolysis & its laws. 5. Laws of Illumination, Terminology used in Illumination, Types of Lamps, Lighting calculations.	These may be considered as an additional input

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	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc.MPRem (III Sem)			
Course Code REM114P	**ELECTRICAL AND ELECTRONIC INSTRUMENTATION 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. 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 (A):: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
RENEWABLE ENERGY MODULE -III
(THERMODYNAMICS AND HEAT TRANSFER)
(As Approved in the BOS meeting held on 11 APRIL 2021 for 2021-2022)

EVALUATION SCHEME

Examination	No. of Marks	Remarks
Semester end examination	50	Model of examination pattern furnished below
Internal examination	50 **Direct assessment - 20** **Indirect assessment - 30**	Mid examination –20 marks Attendance - 05 marks Assignment - 05 marks MCQ exam -10 marks Any TWO Pedagogy methods -10 marks (Quiz, classroom seminar, (2X5) Assignment or Case study, Test , puzzles, viva and few more innovative methods followed by individual lecturer)

IV SEM MODULE 4

	Government College (Autonomous) Rajahmundry	**Program & Semester** I B.Sc.M.P.Rem (IV Sem)			
Course Code REM115	**RENEWABLE ENERGY HARVESTING SYSTEMS**				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:		4	0	-	4

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 with focus on employability / entrepreneurship / Skill Development modules

Skill Development			Employability			Entrepreneurship	

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

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
MODULE-IV
[RENEWABLE ENERGY HARVESTING SYSTEMS]
SEMESTER IV
(As Approved in the BOS meeting held on 02 AUG 2022 for 2022-23)

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,

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 solarradiation into heat,Collectors used for solarthermalconversion: Flat plate collectors and Concentrating collectors, Solar cookers, Solar hot water systems, Solar greenhouses, Passive space heating and cooling concepts, Solar desalinator 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 REM114P	**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/

IV SEM MODULE 5

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code REM116	**RENEWABLE ENERGY STORAGE SYSTEMS**	II B.Sc.M.P.Rem (IV Sem)			
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.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

UNIT-I **(12 hr)**

1. 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)**

2. 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)**

3. 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)**

4. 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)**

5. 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.

V/VI SEM MODULE 6

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

SYLLABUS FOR III B.Sc(REM), RENEWABLE ENERGY

[Solar Thermal, Photo Voltaic and Wind energy Systems]

SEMESTER V/VI

(As Approved in the BOS meeting held on 30 AUG 2023 for 2023-24)

Module -1 **(15 Hrs)**

Solar collectors:

Liquid Flat Plate Collector- Materials for flat plate collector- Efficiency of flat plate collectors-Flat plate air heating collectors--Flat plate collector testing: series connected test, flat plate collector with intermittent output.

Solar Concentrating Collectors: Parameters characterizing solar concentrators- Classification of solar concentrators- Thermodynamic limits to concentration- Solar concentrator mountings-Performance analysis of cylindrical parabolic collector- Compound parabolic collector- Point focusing solar concentrators- application of solar concentrators.

Reference

Solar Energy: Fundamentals and Applications; H. P. Garg& J. Prakash; 2000; Tata McGraw-Hill.

Module-2 **(15 Hrs)**

Flat-Plate Collectors: Performance and Testing

Introduction-Testing of Collector-Heat Transfer Coefficients-Optimization of Heat Losses-Determination of Fin Efficiency-Thermal Analysis of Flat-Plate Collectors-Configuration of flat plate collector connection- Effect of Heat Capacity in Flat-Plate Collector--Effect of Dust in Flat-Plate Collector.

Evacuated solar collector

Introduction-Evacuated-Tube Cover Collector-working and efficiency of Evacuated-Tubular Collector - Evacuated Tube Collector with Heat Pipe.

Reference

Solar Energy: Fundamentals, Design, Modeling and Applications; G. N. Tiwari; 2002; Alpha Science.

Module-3 **(15 Hrs)**

Solar Cell characteristics

I-V characteristics-dark and illumination characteristics of solar cell, solar cell parameters- open circuit voltage, short circuit current, fill factor, efficiency- effect of variation of insolation and temperature-energy losses and efficiency- maximizing the performances- Energy Payback Period(EPP).

Reference

1. Solar Photovoltaics: Fundamental, Technologies and Applications; C.S. Solanki; 2011; Prentice Hall ofIndia.

2. Solar Energy: Fundamentals and Applications; H. P. Garg& J. Prakash; 2000; TataMcGraw-Hill.
3. Handbook of Photovoltaic Science and Engineering; Antonio Luque, Steven Hegedus; 2003; John Wiley andSons.

Classification of Solar Cells

On the basis of thickness of active material- On the basis of Junction structure- On the basis of type of active material- single crystal silicon solar cell- multi crystalline silicon solar cell- gallium arsenide solar cell- amorphous silicon solar cell- copper sulfide, cadmium telluride and copper indium selenide based solar cell- Dye Sensitised Solar Cells (DSSCs)

Solar photovoltaic (PV) module, panel and array construction

Solar PV modules- solar PV modules from solar cells, series and parallel connection, mismatch in cell/module, design and structure of PV modules, number of cells in a module, hot spots of the module, Wattage of modules, rating of PV modules- construction of solar PV panels and arrays from modules.

Reference

1. Solar Photovoltaics: Fundamental, Technologies and Applications; C.S. Solanki; 2011; Prentice Hall ofIndia.
2. Solar Energy: Fundamentals and Applications; H. P. Garg& J. Prakash; 2000; TataMcGraw-Hill.
3. Handbook of Photovoltaic Science and Engineering; Antonio Luque, Steven Hegedus; 2003; John Wiley and Sons.

Module-4 **(15 Hrs)**

Basics of Wind Energy Conversion-

Wind Energy in India- Power available in the wind- Wind Turbine power and torque characteristics- Types of rotors: Horizontal and Vertical axis wind turbine- , Advantages of vertical axis wind turbines over the horizontal axis wind turbines, Characteristics of wind rotor-Analysis of wind regimes- Local effects, wind shear, Turbulence and acceleration effects- Measurement of wind: Ecological indicator, Anemometers-wind direction-Wind speed statistics: Time and Frequency distribution, Mean wind speed and-distribution of wind velocity.

Reference

Wind Energy: Fundamentals, Resource Analysis and Economics; Mathew Sathyajith; 2006; Springer

Module-5 **(15 Hrs)**

Aerodynamics of wind turbine:

Airfoil, lift and drag characteristics- Aerodynamic theories- Axial momentum theory- Blade element theory- Strip theory- Power coefficient and tip speed ratio characteristics-Rotor design and Performance analysis, life cycle of wind turbine.

Wind energy conversion systems:

Wind electric generators- Tower, rotor, gearbox, power regulation, and safety mechanisms- Generator: Induction and synchronous generator-Grid integration- Wind pumps- Wind driven piston pumps, limitations and performance analysis. Environmental benefits and problems of wind energy

Reference

Wind Energy: Fundamentals, Resource Analysis and Economics; Mathew Sathyajith; 2006; Springer

Additional reading

1. Johnson GL. Wind Energy Systems, (Electronic Edition), Prentice Hall Inc,2006
2. Burton T. Sharpe D. Jenkins N. Bossanyi E. Wind Energy Handbook. John Wiley,2001
3. Jha AR. Wind Turbine Technology, CRC Press, Taylor & Francis,2011
4. Jain P. Wind Energy Engineering. McGraw-Hill2011

	Government College (Autonomous) Rajahmundry	**Program & Semester** III B.Sc.MPRem (V Sem)			
Course Code REM114P	**Solar Thermal, Photo Voltaic and Wind energy Systems Practicals**				
Teaching	Hours Allocated: 30 (**Lab**)	L	T	P	C
Pre-requisites:		0	0	2	1

Objectives:

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

Any six experiments out of the following

1. Determination of Efficiency of Solar cell in Series Combination
2. Determination of Efficiency of Solar cell in Parallel Combination
3. Effect of Temperature on Solar cell efficiency
4. Effect of wind direction on output of a wind turbine
5. Study of wind energy distribution
6. Illumination Characteristics of solar cell
7. Spectral Characteristics of Solar cell
8. Determination of Intensity of light using pyranometer

IV SEM MODULE 7

DEPARTMENT OF PHYSICS
SYLLABUS FOR III B.Sc., RENEWABLE ENERGY
[ENERGY MANAGEMENT AND AUDITING]
SEMESTER V/VI
(As Approved in the BOS meeting held on 02 AUG 2022 for 2022-23)

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

UNIT-I

ENERGY SCENARIO: Indian Energy Scenario, Long term energy goals, Energy security, Energy conservation and its importance, Energy strategy for future, Energy conservation act 2001 and its features, Bureau of energy efficiency (BEE), Electricity act 2003, Integrated energy policy.

Energy conservation and Management – Dr. Akshay, A. Pujara, BIP (2013) pp: 1.11-1.44

UNIT-II

THERMAL ENERGYMANAGEMENT: boilers – Types and Classification of boilers, Performance Evaluation of boilers, Parameters for selection of boilers; Furnaces – Types and classification of furnaces, Performance analysis of typical furnace system, Furnace waste heat recovery.

Energy Conservation – S. C. Bhatia, Sarvesh Devaraj, WPI (2016)

Unit-III

ELECTRICAL ENERGY MANAGEMENT: Transformers energy conservation techniques, Energy conservation in transmission line, Energy conservation in distribution line, Energy conservation in lighting system, monitoring motors, Energy-efficiency improvement opportunities in electric motors, Fans and Blowers.

Energy Conservation – S. C. Bhatia, Sarvesh Devaraj, WPI (2016)

UNIT- IV

Building energy management and Instruments: Factors effecting climate, EC-Act-2021 Building code, Energy conservation measures, Commercial, Industrial buildings, Residential buildings. Energy auditing instruments – Wattmeter, Luxmeter, Pyranometer, Anemometer, IR Thermometer.

Energy management – Anil kumar et. Al. CRC Press (2020)

UNIT-V (12 hrs)

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