Government College (Autonomous), Rajahmundry
Department of Physics
I-B.Sc (Honours) RENEWABLE ENERGY MANAGEMENT
SEMESTER-I
Course I: Renewable Energy Resources -I
(w.e.f. 2025–26 batch)

Hrs : 3 per week **Credits: 03**

Course Objectives

1. **To introduce fundamental concepts of energy and power**, various units and conversions, and classification of different types of energy resources.
2. **To provide knowledge on solar energy**, including solar radiation characteristics, types and generations of solar cells, PV and thermal systems, and their applications.
3. **To familiarize students with wind energy systems**, their origin, site selection criteria, types of wind turbines, and their construction and operation.
4. **To develop understanding of ocean energy resources**, including tidal, wave, and ocean thermal energy conversion (OTEC) technologies.
5. **To impart knowledge on biomass energy**, including biomass resources, photosynthesis, usable forms of biomass, and biomass conversion technologies (wet and dry processes).

Course Learning Outcome Statement

CLO1	Define energy and power, explain their various units, classify energy resources (primary/secondary, renewable/non-renewable, conventional/non-conventional, green/clean) and describe BEE activities, star labelling and footprint concepts.
CLO2	Explain solar radiation parameters, types and generations of solar cells, describe PV system components (cell to array) and solar thermal systems, and discuss their applications.
CLO3	Describe the origin of winds, site selection criteria, types, construction and working of wind turbines, and assess their energy potential.
CLO4	Analyse the principles, technologies and conversion methods of ocean energy sources such as tidal, wave and ocean thermal energy systems.
CLO5	Discuss photosynthesis, biomass resources and classify biomass conversion technologies (wet and dry processes) with their applications.

SYLLABUS

UNIT-I **(09 Hrs)**

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 **(09 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

UNIT-III **(09 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 **(09 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). (B H Khan Ch.10,ShobhNathSingh Ch.11,12,13)

UNIT-V **(09 Hrs)**

Bio-Energy: Photo synthesis, 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,3rdEd,TataMcGrawHill (2017)
3. Nonconventional Energy Resources, Shobh Nath Singh, Pearson India (2017)

Government College (Autonomous), Rajahmundry
Department of Physics -2025-26
I-B.Sc (Honours) RENEWABLE ENERGY MANAGEMENT
SEMESTER-I
Course II: Mechanics & Properties of matter
(w.e.f. 2025–26 batch)

Hrs : 3 per week **Credits: 03**

COURSE OBJECTIVE:

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

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

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

UNIT-I MECHANICS OF PARTICLES (9 hrs.)

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

UNIT-II CENTRAL FORCES (9 hrs.)

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

Geo-stationary satellites

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

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

UNIT IV: FLUID MECHANICS (9 hrs)

Fluids – Properties and classification, Streamline vs turbulent flow, Reynolds number, Bernoulli's theorem – Statement, simple derivation and applications (Venturimeter, airplane lift), Equation of continuity – Concept, Viscosity – Poiseuille's law (statement and qualitative explanation), Surface tension – Examples and qualitative ideas

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

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

REFERENCE BOOKS:

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

SEMESTER-I

SKILL ENHANCEMENT COURSE 1: AI FUNDAMENTALS

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

Learning Objectives:

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

Course Outcomes:

Students will be able to

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

Unit I. AI and its Subfields

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

Unit 2. Applications of AI

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

Unit 3. Bias and Fairness in AI Systems

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

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

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

Unit 5. Applications of Prompt engineering

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

Text Books:

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

References:

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

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

Government College (Autonomous), Rajahmundry
Department of Physics
I.B.Sc (Honours) RENEWABLE ENERGY MANAGEMENT (w.e.f. 2025–26 batch)
SEMESTER-II
Course 3: Renewable energy resources-II

Course Learning Outcome

CLO1 Explain the global and Indian energy scenario, energy demand, trilemma index, and the role of NGT.

CLO2 Describe the origin, types, and extraction mechanisms of geothermal energy resources.

CLO3 Analyse the principles, components, classification, and site selection of hydropower systems.

CLO4 Explain the basic nuclear physics concepts and working of various nuclear reactors and power plants.

CLO5 Evaluate environmental effects of various energy production systems and their impact on ecosystems.

UNIT-I **(09 Hrs)**

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 **(09 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 **(09 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 **(09 Hrs)**

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.

UNIT-V **(09 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.(FrankRSpellman)

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)
4. Environmental Impacts of Renewable Energy Frank R. Spellman (2014)

GOVERNMENT COLLEGE (A), RAJAHMUNDRY
DEPARTMENT OF PHYSICS
I B.Sc PhysicsE (HONS)
SEMESTER-II (SYLLABUS)
COURSE-3: WAVES AND OPTICS

Theory Credits: 3 3 hrs. /week

COURSE OBJECTIVE:

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

LEARNING OUTCOMES:

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

- Describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed and utilize mathematical relationships related to wave characteristics.
- Distinguish between Longitudinal and Transverse waves.
- Understand the phenomenon of interference of light and its formation in Thin films and Newton's rings.
- Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating and to describe the construction and working of zone plate and make the comparison of zone plate with convex lens
- Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.

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

Simple Harmonic Oscillator: Solution of differential equation, and physical characteristics, Principle of superposition - Damping, Damped Harmonic Oscillator: Solution of differential equation, Energy considerations, Logarithmic decrement, relaxation time, quality factor - Forced Oscillations: Solution of differential equation.

UNIT-II VIBRATING STRINGS AND BARS (9 hrs)

Transverse wave propagation along a stretched string - Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

UNIT-III: INTERFERENCE (9 hrs)

Principle of superposition – coherence Conditions for interference of light - Fresnel's biprism: determination of wavelength of light – colors of thin films- Determination of diameter of wire - Newton's rings in reflected light: Determination of wavelength of monochromatic light using Newton's rings.

UNIT-IV: DIFFRACTION (9 hrs.)

Introduction - distinction between Fresnel and Fraunhoffer diffraction - Fraunhoffer diffraction: Diffraction due to single slit - Fresnel's half period zones - area of the half period zones - zone plate - Difference between interference and diffraction.

UNIT-V: POLARIZATION (9 hrs.)

Polarized light: methods of polarization by reflection, refraction, double refraction - Brewster's law - Mauls law - Nicol prism: polarizer and analyser - Quarter wave plate - Half wave plate.

REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.

2. BSc Physics Vol.2, Telugu Akademy, Hyderabad
3. Fundamentals of Physics. Halliday/Resnick/Walker, Wiley India Edition 2007.
4. Waves & Oscillations. S. Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
5. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
6. Optics – Ajoy Ghatak, Tata McGraw Hill

SEMESTER-II

COURSE 1: APPLICATIONS OF ARTIFICIAL INTELLIGENCE

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

Course Objectives

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

Course Outcomes

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

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

Unit 1. Infrastructure and Platforms for Building Applications using AI

Hardware used in building AI applications: Processors - CPU, GPU, TPU, NPU, Memory - RAM, VRAM, Storage - HDD, SSD

Platforms for building applications using AI: Online platforms (Example - Google AutoML, H2O.ai, Teachable Machine or similar platforms - for practice only); Desktop (No-code/Low-code) platforms (Orange Data Mining, KNIME, Weka, RapidMiner or similar tools - for practice only).

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

Unit 2: Foundations of Data - Types, Ethics and Utility in Building Applications using AI

Importance of data in building AI applications: Data as the fuel for AI, Role of big data in training AI models.

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

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

Modalities of Data: Text, Image, Audio, Video, Tabular, Time-Series, and Spatial Data.

Formats of Data: Text Formats (CSV, JSON, XML), Image Formats (JPEG, GIF, PNG), Audio/Video (MP3, WAV, MP4, AVI).

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

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

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

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

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

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

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

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

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

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

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

AI in Physics: AI for analyzing astronomical images (identifying galaxies, stars, exoplanets),

CERN Datasets for Particle Physics.

AI in material science: discovering new superconductors and quantum materials

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

AI in Chemistry:

Protein structure prediction (AlphaFold).

AI in drug discovery - virtual screening of compounds.

AI in chemistry - reaction outcome & material property prediction**.**

Unit 5: AI in Mathematics and Earth Sciences

AI in Mathematics:

Pattern recognition in large datasets (fractals, chaos systems, number theory) Automated theorem proving and symbolic mathematics AI in optimization problems (transport, logistics, resource allocation)

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

AI in Earth Sciences

Climate modeling: AI predicting weather patterns, cyclones, and long-term climate change

Remote sensing: AI analyzing satellite images for deforestation, urbanization, and natural resource mapping

Earthquake and natural disaster prediction using sensor network AI in geology: identifying mineral deposits, oil, and groundwater reserves

B.Sc. Physics – II Semester

Mandatory Audit Course

INDIAN KNOWLEDGE SYSTEMS FOR PHYSICAL SCIENCES

Course Type: Mandatory Audit Course
Credits: 0 (Audit)
Hours per Week: 2 **Total Teaching Hours:** 30

Course Outcomes

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

- **CO1 (Unit I):** Explain the scientific foundations of Indian Knowledge Systems including concepts of matter, cosmology and early atomic ideas.
- **CO2 (Unit II):** Describe major Indian contributions to astronomy and mathe- matics relevant to physical sciences.
- **CO3 (Unit III):** Analyze traditional Indian material technologies and logical sys- tems using modern scientific perspective.

UNIT I (10 Hours)

Scientific Foundations in Ancient India

- Sources of Indian scientific knowledge – Vedas, Vedangas and Gurukula system.
- Concept of matter – Panchabhuta theory.
- Paramanu theory and Vaisheshika school of atomism.
- Concepts of time, cosmology and cyclic universe.
- Early scientific thinkers and their contributions.

UNIT II (10 Hours)

Indian Astronomy and Mathematical Physics

- Development of astronomy in ancient India.
- Concept of Earth's rotation and planetary motion.
- Methods of eclipse calculations.
- Development of zero and place value system.
- Trigonometry in astronomical measurements.
- Infinite series and approximation methods (Kerala School).

UNIT III (10 Hours)

Indian Material Science, Engineering and Scientific Method

- Ancient Indian metallurgy – Wootz steel and zinc distillation.
- Corrosion resistance – Iron Pillar case study.
- Temple architecture and structural engineering principles.
- Water management and urban planning in Indus Valley Civilization.
- Nyaya system – Pramana and logical reasoning.

Reference Books

1. B.V. Subbarayappa, *Science in India: A Historical Perspective*.
2. Debiprasad Chattopadhyaya, *History of Science and Technology in Ancient India*.
3. Kapil Kapoor, *Indian Knowledge Systems*.
4. UGC, *Indian Knowledge Systems – Introductory Module*.

GOVERNENT COLLEGE (A), RAJAHMUNDRY
DEPARTMENT PF PHYSICS

Multidisciplinary Course
SEMESTER-II
INDIAN HISTORY
Credits: 2 2 hrs/week

Learning Outcomes:

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

- Students will have an overall understanding of Indian history and culture from ancient to modern India.
- Learn about the changes in society, economy, politics, and culture under various
- dynasties.
- Know mediaeval Indian history and culture.
- Understand the greatness of the Mughals and their administration.
- Visualise how the Europeans are settled and how the colonials introduce various economic policies and their impacts.

  Know the stages of the Indian Freedom Struggle and the roles of Gandhi and Subash Chandra Bose.

Syllabus:

Unit-I

Ancient Indian History and Culture: What is History-Evolution of Man-Science and Technology in Harappan Civilisation-Vedic Literature- Difference between Jainism and Buddhism Philosophy-Ashoka Dhamma Policy-Science and Technology in Guptha Period Chronology of Various Dynasties that ruled India (6th Century BC to 1206 CE)

Unit-II

History and Culture of Medieval India: Delhi Sultanate: Rulers (Brief), Alla-Ud Din Khilji and Muhammad-Bin-Tuglaq Reforms-Greater Mughals (Brief)-Mughal Administration-Akbar Religious Policy-Mughal Art and Architecture-Bhakti Saints

Unit-III

History of Modern India: European Settlements-British Revenue Policies-Economic Impact of British Rule-Socio-Religious Reform Movements-Causes for 1857 Revolt-Indian Freedom Struggle: Vandemataram, Home Rule Movement-Gandhi's Role: Non-Cooperation Movements, Salt Satya Graha and Quit India Movement-Subash Chandra Bose-Partition of India.

Curricular Activities:

 Map-pointing/Collection of Historical news paper cuttings.

 Prepare a chart on Ancient, Medieval Dynasties and their rulers.

 Prepare a list of Historical events in chronological order

 Unit Tests/Quiz/Debates/Workshops/Book Reviews/Seminars/Assignments.

 Collection of Articles and Books/Preparation of Videos/Charts

References:

1. E.H. Carr., What is History, Penguin, 1961
2. R.S.Sharma., Ancient India, New Delhi, 1996
3. D.N.Jha, Ancient India: In Historical Outline, Manohar Publishers, 1999.
4. R.C.Majumdar, K.K.Dutta &H.C.Roy Chowdhuri (ed.), An Advanced History of India, Macmillan, 1948.
5. Romila Thapar., Early India: From the origins to 1300, University of California Press, 2004.
6. Ranabir Chakravarthi., Exploring Early India, upto 1300 A.D, Primus Books, 2016.
7. Satish Chandra., History of Medieval India, 800-1700, Oriental Blackswan, 2007.
8. Satish Chandra., Medieval India: From Sultanate to the Mughals, Part-I & II, Har Anand Publications, 2005.
9. I.H.Qureshi., The Administration of the Sultanate of Delhi, Oriental Books, 1977.
10. Harbans Mukhia., The Mughals of India, Wiley Publishers, 2008.
11. JhanF.Richards., The Mughal Empire, All Volumes, Cambridge University Press, 2012.
12. Sumit Sarkar., Modern India, Pearson India, 2014.
13. Śekhara Bandyopādhyāẏa.,From Plessey to Partition: A History of Modern India, Oriental Blakswan, 2004
14. V.D.Mahajan., Modern Indian History, S.Chand and Company Limited, 2020.
15. Bipan Chnadra, A.Tripathi, Barunde., Freedom Struggle, National Book Trust, 1987.
16. R.C.Dutt., The Economic History of India Under Early British Rule, K.Paul, Trench, Trubner& Company Limited, 2008.

GOVERNENT COLLEGE (A), RAJAHMUNDRY

DEPARTMENT PF PHYSICS

Multidisciplinary Courses Offered for B.A./B.Com./BBA/BCA Majors

w.e.f. AY 2023-24

SEMESTER-II

PRINCIPLES OF PHYSICAL SCIENCES

Credits: 2 2 hrs/week

Course Objective:

The course "Principles of Physical Sciences " is designed to introduce arts students to fundamental concepts and principles of physical sciences, fostering a deeper understanding of the physical world and its interconnections with various disciplines.

Learning outcomes:

Upon completion of the course "Principles of Physical Sciences for Arts Students," students from arts backgrounds will be able to:

1. Understand the foundational principles of physical sciences: Students will develop a comprehensive understanding of the core principles and concepts in physical sciences.
2. Analyse and interpret scientific information: Students will acquire the ability to critically analyse scientific information and data related to physical sciences.
3. Apply physical science principles to real-world scenarios: Students will develop the skills to apply physical science principles to solve real-world problems and scenarios.

Syllabus:

Unit 1: Introduction to Physics

Nature of Physics: Overview of physics as a discipline, its scope, and its relationship to other sciences. Scientific Method in Physics: Introduction to the scientific method and its application in the study of physics. Measurement and Units: Understanding the principles of measurement, SI units, and the importance of accurate and precise measurements. Scalars and Vectors: Differentiating between scalars and vectors, understanding vector addition and subtraction.

Unit 2: Mechanics for Arts Students

Motion and Forces: Introduction to the principles of motion, including velocity, acceleration, and the laws of motion. Energy and Work: Understanding the concept of energy, different forms of energy, and the relationship between work and energy. Circular Motion: Exploring the principles of circular motion, centripetal force, and applications in real-world scenarios. Gravity: Introduction to the concept of gravity, Newton's law of universal gravitation, and its implications.

Unit 3: Waves and Optics for Arts Students

Waves: Understanding the properties and characteristics of waves, including wave types, wave motion, and wave interference. Sound Waves: Exploring the nature of sound waves, including properties of sound, sound propagation, and the Doppler effect. Light and Optics: Introduction to the behavior of light, reflection, refraction, and the formation of images by mirrors and lenses. Wave Optics: Understanding the principles of interference, diffraction, and polarization of light waves.

Reference Books:

1."Principles of Physics" by David Halliday, Robert Resnick, and Jearl Walker: This textbook covers the fundamental principles of physics, including mechanics, electromagnetism, thermodynamics, and modern physics. It provides a comprehensive introduction to the subject and includes numerous examples and exercises for practice.

2. "University Physics" by Hugh D. Young and Roger A. Freedman: This textbook is widely used in university-level physics courses. It covers a wide range of topics in classical physics, modern physics, and thermodynamics. It is known for its clear explanations and problem-solving approach.
3. "Concepts of Modern Physics" by Arthur Beiser: This book provides an introduction to the principles and concepts of modern physics, including quantum mechanics, atomic and nuclear physics, and relativity. It is suitable for students with a basic background in physics and mathematics.
4. "The Feynman Lectures on Physics" by Richard P. Feynman, Robert B. Leighton, and Matthew Sands: This three-volume set is based on the famous lectures given by physicist Richard Feynman. It covers a wide range of topics in physics, including mechanics, electromagnetism, quantum mechanics, and statistical mechanics. The lectures are known for their engaging style and intuitive explanations.
5. "Physical Science" by Bill Tillery: This textbook provides a comprehensive introduction to the principles of physical science, covering topics such as motion, forces, energy, waves, electricity, and magnetism. It is designed for introductory-level courses and includes numerous examples, illustrations, and practice problems.
6. "Fundamentals of Physics" by Jearl Walker, David Halliday, and Robert Resnick: This textbook is widely used in physics courses and covers the fundamental principles of classical physics. It includes a strong emphasis on problem-solving and conceptual understanding.

Student activities:

1. Conduct research on a famous physicist or a significant discovery in the field of physics. Write a short report highlighting the physicist's contributions or explaining the importance of the discovery. Include information about how the discovery impacted other scientific fields or technological advancements.
2. Watch videos or animations demonstrating circular motion, such as the motion of objects on a Ferris wheel or a car turning on a curved track. Identify the forces involved, including the centripetal force, and explain how they contribute to the object's circular motion. Discuss real-world examples where circular motion is significant, such as satellites orbiting the Earth.
3. Set up a wave demonstration using a rope or a slinky to visualize the properties of waves, such as wavelength, frequency, amplitude, and wave speed. Observe how these properties change when altering the parameters of the wave, such as tension or length.

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
COURSE—5 - RENEWABLE ENERGY RESOURCES-II
SEMESTER III
(As Approved in the BOS meeting held on 15 Sep- 2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT-I **(09 Hrs)**

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 **(09 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 **(09 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 **(09 Hrs)**

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 **(09 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.(FrankRSpellman)

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DEPARTMENT OF PHYSICS

II B.Sc., RENEWABLE ENERGYMANAGEMENT-

COURSE—6 - ELECTRICAL AND ELECTRONIC INSTRUMENTATION

SEMESTER-III

(As Approved in the BOS meeting held on 15 Sep-202–- 2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT 1 **(09hrs)**

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 **(09hrs)**

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 **(09hrs)**

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 **(09hrs)**

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**(09hrs)**

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: basic Electronics- Solid state; BL Thereja; 2005; S. Chand & Co.

1. Electrician Trade Theory 1st Semester; NIMI, Chennai (2018).

Reference books:

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

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DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY - SEMESTER III
COURSE—7: THERMODYNAMICS & FLUID MECHANICS

(As Approved in the BOS meeting held on 15 Aug 2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT-1

Thermodynamics introduction: (9Hrs)

Zeroth law of thermodynamics – Temperature scale, Thermodynamic properties – Extensive and Intensive, Thermodynamic systems – Isolated, closed, Open systems and thermodynamic potentials (Definitions only), First law of thermodynamics, Thermodynamic processes - Isothermal, Adiabatic, Isochoric, Isobaric. Heat capacity of solids, Ratio of heat capacities and relation with degrees of freedom.

UNIT-2 (9Hrs)

Second law and phase diagrams:

Second law of thermodynamics, Entropy changes in various processes, Reversible and irreversible processes, Carnot's engine, Phase, Phase change and Phase change diagrams for pure substances T-V, P-V, P-T and P-V-T diagrams. (Ref-2: Ch. 3)

UNIT-3 (9Hrs)

Thermodynamic cycles:

Rankine cycle (Steam engine) - Energy analysis, Deviations from ideal cycle, Improving efficiency of Rankine cycle, Otto cycle – 4 stroke spark ignition engine, 2 stroke spark ignition engine, Energy analysis, Diesel cycle - Energy analysis, Brayton Cycle (Gas engine) – Energy analysis, Deviations from ideal cycle, Improving the efficiency of Bryton cycle, Ideal Jet propulsion cycle – Modifications to turbojet engine. (Ref-1: Ch. 9, 10)

UNIT-4 (9Hrs)

Fluid Mechanics:

Definition of fluid, Fluid properties, Newtonian – Non Newtonian fluids (Conceptual), Pascal's law, Classification of flows, Euler Equation, Bernoulli's Equation, Limitations of Bernoulli's equation, Applications – Venturi meter, Siphon, Mechanical energy and efficiency. (Ref. 4, Ch. 11, 12, 13; Ref. 5

UNIT-5 (9Hrs)

Some applications to Renewable energy systems:

Efficiency of Wind mill, Tidal range power, Power in waves, T-S diagrams for various geothermal systems, Simple steam power plant, gas turbine, Chemical thermodynamics – Organic fuels, Fuel modeling, Heat of formation, Heat of reaction, Explosion pressure.

Additional Inputs: Steam tables,

1. Engineering Thermodynamics, S.K. Gupta, S. Chand Publishing - (2013)
2. Thermodynamics An Engineering Approach by Yunus A. Cengel, Michael A. Boles,
3. Fundamentals of Thermal-Fluid Sciences Yunus A. Çengel, Robert H. Turner - (2004)

4. Engineering Thermodynamics and Fluid Mechanics P. K. Nag_ Sukumar Pati – 5th Ed. WBUT–2016 McGraw-Hill Education (2016)
5. Fluid Mechanics_ Fundamentals and Applications, Yunus A. Cengel Dr., John M. Cimbala, McGraw-Hill Education - (2017)
6. Modern Engineering Thermodynamics, Robert T. Balmer - , Academic Press (2010)
7. https://home.uni-leipzig.de/energy/energy-fundamentals/15.htm
8. https://en.wikipedia.org/wiki/Siphon

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DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY

SEMESTER III

COURSE-8 - WAVE OPTICS

(As Approved in the BOS meeting held on 15 Aug 2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT-I Interference of light: (09Hrs)

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

UNIT-II Diffraction of light (09Hrs)

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*

UNIT-III Polarisation of light (09Hrs)

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

UNIT-IV Aberrations and Fibre Optics: (09Hrs)

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.

UNIT-V Lasers and Holography: (09Hrs)

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*

SEMESTER-IV

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY

SEMESTER IV

COURSE—9 –ENERGY HARVESTING SYSTEMS

(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT 1 **(9hrs)**

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 **(9hrs)**

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 **(9hrs)**

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 **(9hrs)**

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 **(9hrs)**

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)

SEMESTER-IV

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS

II B.Sc., RENEWABLE ENERGY -SEMESTER IV
COURSE—10 –ENERGY STORAGE SYSTEMS
(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

SYLLABUS

UNIT-I **(9 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 **(9 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 **(9 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 **(9 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 **(9 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.
1. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

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DEPARTMENT OF PHYSICS

II B.Sc., RENEWABLE ENERGY -SEMESTER IV
COURSE—11 –ELECTRICITY & MAGNTISM
(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

SYLLABUS

UNIT I: Electrostatics 9Hrs

Electric charge and charge distributions. Coulomb's law and superposition principle. Electric field and electric flux. Gauss's law and applications to systems with spherical, cylindrical and planar symmetries. Electric potential and potential energy. Relation between electric field and electric potential. Electric field and potential due to continuous charge distributions.

UNIT II: Dielectric Properties 9Hrs

Dielectric properties: dielectric constant, electronic, ionic and orientational polarization, D,E,P Relation, Clausius–Mossotti equation. Dielectric loss, dielectric breakdown and dielectric strength.

UNIT III: Magnetic Properties 9Hrs

Magnetic properties of materials: magnetic dipole moment, magnetization, magnetic susceptibility and permeability. Atomic origin of magnetism and Bohr magneton. Classification of magnetic materials — diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic and ferrimagnetic materials. Domain theory of ferromagnetism and domain walls (qualitative). Hysteresis, soft and hard magnetic materials. Determination of paramagnetic susceptibility using Quincke's tube method.

UNIT IV: Maxwell's Equations and Electromagnetic Waves 9Hrs

Displacement current and its physical significance. Maxwell's equations in integral and differential forms. Wave equation for electromagnetic fields. Plane electromagnetic waves in free space and linear media. Poynting vector, Poynting's theorem and energy of electromagnetic fields. Reflection and refraction of electromagnetic waves at a dielectric interface (normal incidence only). Transmission and reflection coefficients.

UNIT V: Charged Particles in External Fields 9Hrs

Lorentz force law. Motion of charged particles in uniform electric and magnetic fields. Motion in crossed electric and magnetic fields - Circular and helical motion of charged particles. Hall effect: Hall voltage, Hall coefficient, experimental determination and applications. Mass

Spectrometer and cyclotron.

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DEPARTMENT OF PHYSICS

SYLLABUS FOR III B.Sc., RENEWABLE ENERGY

SEMESTER V

COURSE—12 -Modern physics

(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

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

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

UNIT-II: Molecular Structure and Spectroscopy (9Hrs)

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

UNIT-III: Matter waves & Uncertainty Principle: (9Hrs)

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

UNIT-IV: Quantum Mechanics: (9Hrs)

Basic postulates of quantum mechanics, Schrodinger time independent and time dependent wave equations- Derivations, Physical interpretation of wave function, Eigen functions, Eigen values, Application of Schrodinger wave equation to

(one-dimensional potential box of infinite height (Infinite Potential Well)

UNIT V: Superconductivity: (9Hrs)

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

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DEPARTMENT OF PHYSICS

SYLLABUS FOR III B.Sc., RENEWABLE ENERGY
COURSE—13 - SEMESTER V
Energy Management & auditing
(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

Unit- I **(9Hrs)**

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 **(9Hrs)**

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 **(9Hrs)**

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 **(9hrs)**

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 **(9hrs)**

ENERGY AUDIT: Introduction, Types of energy audit, Steps for conducting energy Audit, Data collection hints, Case study - Tata Energy.

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DEPARTMENT OF PHYSICS

SYLLABUS FOR III B.Sc., RENEWABLE ENERGY
COURSE—14-A - Renewable Energy resources-III
Semester-V
(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

UNIT -1 **(09Hrs)**

Solar collectors: Liquid Flat Plate Collector- Efficiency of flat plate collectors-Flat plate air heating collectors, flat plate collectors with intermittent output.

Solar Concentrating Collectors: Parameters characterizing solar concentrators-Classification of solar concentrators- Thermodynamic limits to concentration- Point focusing solar concentrators- application of solar concentrators.Ref:1

UNIT-2 **(09Hrs)**

Flat-Plate Collectors: Performance and Testing Introduction-Testing of Collector-Heat Transfer Coefficients-Optimization of Heat Losses,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.

UNIT-3 **(09Hrs)**

Solar Cell characteristics: I-V Characteristics of solar cell, solar cell parameters- open circuit voltage, short

circuit current, fill factor, efficiency- effect of variation of insolation and temperature- Energy Payback Period(EPP), Classification of solar cells. Solar photovoltaic (PV) module, panel and array construction Solar PV modules- solar PV modules from solar cells, series and parallel connection, 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.Ref:1,3&4

UNIT-4 **(09Hrs)**

Basics of Wind Energy Conversion-

Wind Energy in India- Power available in the wind- Wind Turbine power and torque characteristics-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. Ref:5

UNIT-5 **(09Hrs)**

Aerodynamics of wind turbine: Airfoil, lift and drag characteristics- Aerodynamic theories-Axial momentum theory- Blade element theory- Power coefficient and tip speed ratio characteristics-

Rotor design and Performance analysis, life cycle of wind turbine. Wind energy conversion systems:

Wind pumps- Wind driven piston pumps, limitations and performance analysis.
Environmental benefits and problems of wind energy.

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DEPARTMENT OF PHYSICS
SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
SEMESTER V
COURSE—14(B)- GREEN BULDING
(As Approved in the BOS meeting held on 15-SEP-2025-26)

CREDITS:3 **Hrs per week: 3**

Module-1 **(09 Hrs)**

Introduction to the concept of cost effective construction – Uses of different types of materials and their availability – Stone and Laterite blocks – Burned Bricks – Concrete Blocks – Stabilized Mud Blocks – LimePozzolana Cement – Gypsum Board – Light Weight Beams – Fiber Reinforced Cement Components – Fiber Reinforced Polymer Composite – Bamboo – Availability of different materials – Recycling of building materials – Brick – Concrete – Steel – Plastics – Environmental issues related to quarrying of building materials.

Module-2 **(09 Hrs)**

Environment friendly and cost effective Building Technologies – Different substitute for wall construction Flemish Bond – Rat Trap Bond – Arches – Panels – Cavity Wall – Ferro Cement and Ferro Concrete constructions – Different pre cast members using these materials – Wall and Roof Panels – Beams – Columns – Door and Window frames – Water tanks – Septic Tanks – Alternative roofing systems – Filler Slab – Composite Beam and Panel Roof – Pre-engineered and ready to use building elements – Wood products – Steel and plastic – Contributions of agencies – Costford – Nirmiti Kendra – Habitat.**Module-3 (09 Hrs)**

Global Warming – Definition – Causes and Effects – Contribution of Buildings towards Global Warming – Carbon Footprint – Global Efforts to reduce carbon emissions. Green Building – Definition – Features – Necessity – Environmental benefit – Economical benefits – Health and Social benefits – Major energy efficient areas for buildings – Embodied Energy in Materials – Green Materials – Comparison of Initial cost of Green Vs Conventional Building – Life cycle cost of Buildings.

Module-4 **(09 Hrs)**

Green Building Rating Systems – BREEAM – LEED – GREEN STAR – GRIHA (Green Rating for Integrated Habitat Assessment) for new buildings – Purpose – Key highlights – Point System – Differential weightage – Green Design – Definition – Principles of sustainable development – Green Building Design – Characteristics of Sustainable Buildings – Sustainably managed Materials – Integrated Lifecycle design of Materials and Structures (Concepts only).

Module-5 **(09 Hrs)**

Utility of Solar Energy in Buildings – Utility of Solar energy in buildings, concepts of Solar Passive Cooling and Heating of Buildings. Solar Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

Green Composites for Buildings – Concepts of Green Composites. Water Utilisation in Buildings. Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
COURSE—15 -A – Power Electronics SEMESTER V
(As Approved in the BOS meeting held on 15-SEP-2025-26)

No. of Hours per week: 03 Total Lectures: 45

Unit1 **(09hrs)**

Field-Effect Transistors (FET)

Types of FET- Junction FET (JFET)- Formation of depletion region-Operation-Characteristics-Drain characteristics-Transfer characteristics-JFET parameters-MOSFETs- Types-Depletion type-Enhancement type-CMOS

Reference

A Text book of Applied Electronics; R.S. Sedha; 2005; S. Chand and Co.

Unit2 **(09hrs)**

Thyristors, SCR, DIAC, TRIAC

Basic ideas and Types of Thyristors-Silicon Controlled Rectifier (SCR)-biasing-operation- equivalent circuit-Characteristics-SCR ratings-Series and parallel combination of SCR- Applications- Basic construction of Diac- V-I characteristic-Applications-TRIAC- Operation- V-I characteristics-TRIAC ratings-Applications

Reference

A Text book of Applied Electronics; R.S. Sedha; 2005; S. Chand and Co.

Unit3 **(09hrs)**

UJT and SCS

Uni Junction Transistor (UJT)-construction-equivalent circuit-intrinsic standoff ratio-Operation- V-I characteristics-Applications- Basic ideas of Silicon Controlled Switch (SCS)- operation-SCS application-Silicon Unilateral Switch (SUS)-Silicon Bilateral Switch (SBS) – Silicon Asymmetrical Switch (SAS).

Reference

A Text book of Applied Electronics; R.S. Sedha; 2005; S. Chand and Co.

Unit4 **(09hrs)**

Controlled Rectifiers

Introduction-SCR – Power control using SCR – SCR half wave rectifier – Average values of load voltage and current - 90°Variable Half Wave Rectifier - 180º Variable Half Wave Rectifier – SCR Full Wave Rectifier – UJT Triggered SCR phase control – TRIAC power control – DIAC-TRIAC Phase Control Circuit – General ideas of Inverters- Single phase inverter and Three phase inverters.Reference

A Text book of Applied Electronics; R.S. Sedha; 2005; S. Chand and

Co. Question Bank

Unit 5 **(09 hrs)**

Power Electronics in Renewable Energy Systems

Need of power electronics in renewable energy systems, Power conditioning for solar photovoltaic systems: DC–DC converters, solar inverters

Power electronics for wind energy systems: AC–DC–AC conversion, grid integration, variable speed operation

Role of power electronics in battery charging, energy storage systems, and electric vehicles; Power quality issues and protection in renewable energy converters; Introduction to smart grids and role of power electronics in grid integration

Reference

M.H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

SYLLABUS FOR II B.Sc., RENEWABLE ENERGY
COURSE—15 -B – OCEAN ENERGY
AND BIO ENERGY
SYSTEMS SEMESTER V

(As Approved in the BOS meeting held on 15-SEP-2025-26)

credits: 3 **Weekly 3Hrs**

UNIT – I : INTRODUCTION TO OCEAN ENERGY SYSTEMS (9 Hours)

Overview of renewable energy resources with emphasis on ocean energy. Ocean energy potential and global status. Oceanographic basics – tides, waves, currents, thermal gradients and salinity gradients. Energy availability, site selection criteria and resource assessment methods. Advantages and limitations of ocean energy systems. Environmental, social and economic aspects of ocean energy utilization. Role of ocean energy in sustainable and diversified energy mix.

UNIT – II : TIDAL AND WAVE ENERGY CONVERSION SYSTEMS (9Hours)

Tidal energy principles – tidal range and tidal stream. Types of tidal power plants – single basin, double basin and tidal stream systems. Components and working of tidal power plants. Wave energy characteristics and power estimation. Wave energy conversion devices – point absorbers, attenuators, oscillating water columns, overtopping devices. Grid integration issues and techno-economic challenges. Case studies of tidal and wave energy projects.

UNIT – III : OCEAN THERMAL AND SALINITY GRADIENT ENERGY (9 Hrs)

Ocean Thermal Energy Conversion (OTEC) – principle and thermodynamic cycles. Types of OTEC systems – open cycle, closed cycle and hybrid cycle. Components, working and performance analysis of OTEC plants. Salinity gradient energy – concept and potential. Methods of salinity gradient power generation – pressure retarded osmosis and reverse electrodialysis. Environmental impacts and feasibility of OTEC and salinity gradient systems. Future prospects of ocean thermal and salinity-based energy systems.

UNIT – IV : BIOENERGY RESOURCES AND BIOMASS CONVERSION TECHNOLOGIES (9 Hours)

Introduction to bioenergy and biomass resources. Classification of biomass – agricultural residues, forest residues, energy crops, aquatic biomass and waste

biomass. Biomass characteristics and energy potential. Biomass collection, transportation and storage issues. Thermochemical conversion processes – combustion, gasification and pyrolysis. Biochemical conversion processes – anaerobic digestion and fermentation. Comparative analysis of bioenergy conversion technologies.

UNIT – V : BIOFUELS, BIOENERGY SYSTEMS AND SUSTAINABILITY

(9 Hours)

Biogas plants – types, design considerations and applications. Liquid biofuels – bioethanol, biodiesel and advanced biofuels. Algae-based bioenergy systems. Bioenergy power plants and cogeneration systems. Integration of bioenergy with other renewable energy systems. Environmental impacts, life cycle assessment and carbon neutrality of bioenergy. Policies, economics and future trends in bioenergy systems.