DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A+' Grade

CIRCULAR NO.SS/ Sci & Tech./ B.Voc /13 /2025.

It is hereby inform to all concerned that, on the recommendation of the Dean, Faculty of Sconce & Technology; **the Academic Council at its meeting held on 21 July, 2025 has been accepted *the "following Curriculum at UG Level* as per National Education Policy-2020" *for the implementation of all concerned affiliated colleges*** under the Faculty of Science & Technology.

Sr.No	Subject Name	Semester
1.	B.Voc in Plant Tissue Culture and Green House Technology (Pattern 2024)	I & II
2.	B.Voc in Renewable Energy Sources (Pattern 2024)	I & II
3.	B.Voc in Architectural Planning & Interior Design	III & IV
4.	IT Skills and Software Development	III & IV

This is effective from the Academic Year 2025-26 onwards under the Faculty of Science & Technology.

All concerned are requested to note the contents of the circular and bring notice to the students, teachers and staff for their information and necessary action.

University campus, 1420-22
Chhatrapati Sambhajinagar-431004.
Ref. No. S S/Sci & Tech/B.Voc./2025-26/
Date: 01/ 08/ 2025

Deputy Registrar,
Syllabus Section

****

Copy forwarded and Information to necessary action:-

1] **The Head, concerned Department,**
2] **The Director, Board of Examination & Evaluation,**
3] **The Director,** University Network & Information Centre, UNIC, with a **request to upload this circular on University Website.**
Dr. Babasaheb Ambedkar Marathwada University **Chhatrapati Sambhajinagar.**

Dr. Babasaheb Ambedkar Marathwada University,

Chhatrapati Sambhaji Nagar – 431001

Three Year

B. Voc. Degree Program

Course Structure

(Revised)

(AS PER NEP-2020)

Subject (Major):

Renewable Energy Sources

(Pattern 2024)

Effective from 2025-26

Preface

The National Education Policy (NEP) 2020 has introduced significant reforms aimed at transforming the education landscape in India. Here's how NEP 2020 intersects with skill education

1. Multidisciplinary Education: NEP 2020 emphasizes multidisciplinary education, encouraging students to pursue a broad range of subjects and skills. This approach promotes flexibility and enables students to develop diverse skill sets tailored to their interests and career goals.

2. Holistic Development: the policy advocates for holistic development, which includes not only academic learning but also social, emotional, and vocational skills, this holistic approach ensures that students are well-rounded individuals equipped to navigate various aspects of life and work.

3. Vocational Education and Internships: NEP 2020 places a strong emphasis on vocational education, integrating it into mainstream curriculum from an early age. The policy encourages hands-on learning experiences, internships, and apprenticeships to provide practical skills and real- world exposure to students.

4. Focus on Critical Thinking and Problem-Solving: NEP 2020 prioritizes the development of critical thinking, creativity, and problem-solving skills. These skills are essential for innovation and adaptability in a rapidly changing world and are integrated across all levels of education.

5. Flexible Learning Pathways: The policy promotes flexible learning pathways, allowing students to choose their own educational trajectories based on their interests, aptitudes, and aspirations. This flexibility enables students to explore diverse skill areas and tailor their education to suit their individual needs.

6. Teacher Training and Professional Development: NEP 2020 recognizes the importance of teacher training and professional development in enhancing the quality of education. The policy emphasizes continuous learning for teachers, equipping them with the knowledge and skills necessary to effectively nurture students' talents and abilities.

7. Digital Education and Technology Integration: The policy advocates for the integration of digital technology in education to enhance access, equity, and quality. Digital platforms and tools are leveraged to facilitate interactive learning experiences, skill development, and personalized instruction.

By aligning with the principles and objectives of NEP 2020, skill education in India is poised to undergo a transformative shift, fostering innovation, equity, inclusivity, and excellence in education. These contexts have remained as mainframe while developing this curriculum.

The University has adopted Outcome-based education (OBE) since 2017. OBE is widely adopted in educational systems globally due to student centric advantages. OBE provides clear and measurable learning objectives that help students focus and stay motivated. It emphasizes real- world skills, bridging the gap

between academia and the workforce. Customized learning paths are possible, accommodating different learning styles and promoting inclusivity. OBE focuses on mastery and competence rather than seat time, encouraging deeper learning and retention of knowledge. Continuous improvement is encouraged through ongoing assessment and feedback. OBE promotes accountability and transparency, allowing stakeholders to monitor progress and evaluate educational programs. It equips students with skills needed for the globalized economy, fostering critical thinking and collaboration. Lifelong learning skills like self-directed learning and adaptability are developed, creating a culture of continuous improvement. Overall, OBE offers a holistic approach to education, emphasizing relevant skills, competencies, and attitudes crucial for success in today's ever-changing world.

The Authorities of Dr. Babasaheb Ambedkar Marathwada University, CHHATRAPATI SAMBHAJI NAGAR (M.S.), remaining aligned to accreditation standards of National Assessment and Accreditation Council, decided to opt for National Education and Policy and Outcomes Based Education (OBE). As part of the decision, different meetings, workshops and presentations were held at the campus of the university.

This document is the outcome of such meetings and workshops held at University level and department level. The detailed document is designed and the existing curriculum of the department has been meticulously analysed from the standpoint of the immediate and long-time requirements of manufacturing and process industries, and transformed in to the framework of NEP with OBE. This is the first step towards the implementation of NEP with OBE in the university departments and affiliated colleges. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the Graduates/Post-graduates of the university departments and affiliated colleges.

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Vocation (B. VOC.) the curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century. At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Vocation (B. VOC.) the curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight. Furthermore, the curriculum is designed to promote experiential learning, research, and hands- on exploration, recognizing the importance of Lab Course

engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in Lab Course settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery. Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Vocation (B. Voc.) the curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Vocation (B. Voc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world. As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Vocation (B. Voc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

In light of aforesaid, Dr. Babasaheb Ambedkar Marathwada University hereby proposes to offer a three years Bachelor of Vocation program (B. Voc.) in Renewable Energy Sources. The curriculum design of this program is undertaken with following considerations

The Bachelor of Vocation (B.Voc.) in Renewable Energy Sources is a dynamic and forward-thinking program designed to equip students with the skills and knowledge needed to excel in the growing field of renewable energy. As the world shifts toward sustainable energy solutions, this course focuses on harnessing natural resources like solar, wind, and biomass to create cleaner, more efficient power sources. Through a blend of theoretical learning and hands-on experience, students will gain expertise in renewable technologies, energy management, and environmental sustainability, preparing them for a successful career in the green energy sector. The Bachelor of Vocation (B.Voc.) in Renewable Energy Sources is a dynamic and forward- thinking program designed to equip students with the skills and knowledge needed to excel in the growing field of renewable energy. As the world shifts toward sustainable energy solutions, this course focuses on harnessing natural resources like solar, wind, and biomass to create cleaner, more efficient power sources. Through a blend of theoretical learning and hands-on experience, students will gain expertise in renewable technologies, energy management, and environmental sustainability, preparing them for a successful career in the green energy sector.

3 years degree Course in
B. VOC Renewable Energy Sources
SYLLABUS
Scheme of the course
Duration: 03 years

RES B VOC SEM-I

Course Type	Course code	Course Name	Contact Hours per week		Credit assigned		Total Credit	Total contact hours for the course
			Th.	Pr.	Th.	Pr.		
Major (core)M1 Mandatory	RES/DSC/ T/100	Energy Resources	2	0	2	-	2+2=4	30
	RES/DSC/P/126	practical on RES/DSC/ T/100	0	4	-	2		60
Major (core)M2 Mandatory	RES/DSC/T/101	Solar Energy Applications	2	0	2	-	2+2=4	30
	RES/DSC/P/127	practical on RES/DSC/ T/101	0	4	-	2		60
Major (core)M3 Mandatory	RES/DSC/T/102	Fundamentals of Electronics	2	0	2	-	2+2=4	30
	RES/DSC/P/128	practical on RES/DSC/ T/102	0	4	-	2		60
Generic open elective (choose any one pool of courses) other than Major	RES /GE/OE/T/ 100	Computer Hardware	2	0	2	-	2	30
SEC (choose any one pool of courses)	RES/SEC/T/100	Fundamentals of Instrumentation	1	0	1	-	1+1=2	15
	RES/SEC/P/126	practical Based on RES/SEC/T/100	0	2	-	1		30
	RES/SEC/T/101	Physics of Energy Sources						15
	RES/SEC/P/127	practical Based on RES/SEC/T/101						30
AEC, VEC, IKS	RES/AEC/T/100	English (Common for all the faculty)	2	-	2	-	2+2=4	
	RES/IKS/T/101	Choose any one from pool of courses	2	-	2	-		
OJT/FP/CEP/CC/RP	RES/CC/P/126	Health and Wellness (Common for all the faculty)	-	4	-	2	2	
Total			13	18	13	09	22	

RES B VOC SEM-II

Course Type	Course code	Course Name	Contact Hours per week		Credit assigned		Total Credit	Total contact hours for the course
			Th.	Pr.	Th.	Pr.		
Major (core)M1 Mandatory	RES/DSC/T/150	Energy Conversion systems	2	0	2	-	2+2=4	30
	RES DSC/P/176	Practical on RES/DSC/T/150	0	4	-	2		60
Major (core)M2 Mandatory	RES /DSC/T/151	Applications of wind energy	2	0	2	-	2+2=4	30
	RES /DSC/P/177	Practical on IA/DSC/T/151	0	4	-	2		60
Major (core)M3 Mandatory	RES /DSC/T/152	Energy and Environment	2	0	2	-	2+2=4	30
	RES /DSC/P/178	Practical on IA/DSC/T/152	0	4	-	2		60
Generic open elective (choose any one pool of courses) other than Major	RES /GE/OE/T/150	Computer science (Fundamentals of Information technology)	2	0	2	-	2	30
VSC vocational skill course (choose any one pool of courses)	RES /VSC/T/150	Fundamentals of Electricity	1	0	1	-	1+1=2	15
	RES /VSC/T/176	Practical Based on RES /VSC/T/150	0	2	-	1		30
	RES/VSC/T/151	Basics of Thermodynamics	1	0	1	-	1+1=2	15
	RES/VSC/P/177	Practical Based on RES/VSC/T/151	0	2	-	1		30
AEC, VEC, IKS	RES/AEC/T/150	Modern Indian Language (MIL-1) (Choose any one from pool of language courses)	2	-	2	-	2+2=4	
	RES/AEC/T/151	Constitution of India (Common for all the faculty)	2	-	2	-		
OJT/FP/CEP/CC/RP	RES/CC/P/176	Yoga Education / Sports and Fitness (Common for all the faculty)	-	4	-	2	2	
Total			13	18	13	09	22	

Programme Educational Objectives (PEOs):

Programme Educational Objectives (PEOs) for the Bachelor of Vocation Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Vocation program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Vocation curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Program Outcomes (PO):

Vocational Education is education that prepares the students for specific trades, crafts and careers at various levels and scopes. Scope of modern fabric of vocational education builds Human resource from a trade/ craftsmanship, technician or professional position in R & D organizations.

The Program Outcomes are the skills and knowledge which the students have at each exit level/at the time of graduation. These Outcomes are generic and are common to all exit levels mentioned in the programme structure. Graduates of the B.Voc program are expected to -

PO1. Apply broad based fundamental knowledge of the specific skill-based trade for the solution of target skill sector.

PO2. Identify industry domain related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of domain sectors and technical literature.

PO3. Design / develop solutions for broad based problems in the target skill-based trade to address changing challenges put forward by market demand/ stakeholder

PO4. Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions

PO5. Use the techniques, skills and modern tools necessary skill-based trade to practice with clear understanding of limitations.

PO6. Apply broad understanding of ethical and professional skill-based trade practice in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

PO7. Apply broad understanding of impact of skill-based trade in a global, economic, environmental and societal context.

PO8. Apply ability to develop practical solutions for skill trade problems within positive professional and ethical boundaries.

PO9. Function effectively as a leader and as well as team member in diverse/multidisciplinary environments.

PO10. Communicate effectively in oral and written format addressing specific professional/social demands.

PO11. Demonstrate knowledge and understanding of the first principles of skill trade and apply these to one's own work as a member and leader in a team, to complete project in any environment.

PO12. Recognize the need for and have the ability to acquire advance knowledge for addressing the changing technological demands of the target skill trade.

Program Specific Outcomes (PSO):

Graduates of the B.Voc (Renewable energy sources) program are expected to –

1. Apply fundamental concepts of renewable energy technologies, including solar, wind, biomass, hydro, and geothermal, to assess their efficiency, feasibility, and environmental impact.
2. Develop, model, and analyze renewable energy systems for sustainable power generation, incorporating energy storage and grid integration strategies.
3. Evaluate energy policies, regulations, and economic factors affecting renewable energy deployment while promoting sustainability and energy conservation.
4. Apply engineering principles, simulation tools, and optimization techniques to design and improve renewable energy systems for real-world applications.
5. Assess the social, economic, and environmental impact of renewable energy projects to develop solutions that promote clean energy transition and mitigate climate change.

Eligibility:

10+2 / MCVC/ ITI (two years) with relevant/equivalent trade from any recognized Board/Institution are eligible for registration/ admission to first year (Semester I) of B.Voc Industrial Automation Degree program.

Exit Options:

The programme allows exit of a student in an intermediate stage, on successful employment. Scopes will be there for further continuation of study. The other wise exit options will be as follows-

Exit Point	*Duration*	*Diploma / Degree to be Offered*
First exit	After 1 yr.	Certificate in Vocation
Second exit	After 2 yrs.	Diploma in Vocation
Third exit	After 3 yrs.	Bachelor in Vocation (B. Voc.)

Sources

Learning Objectives of the course:-

- Provide an understanding of different **energy resources**, their classification, availability, and sustainability.
- Explain the **importance of renewable energy** in addressing environmental and economic challenges.
- Introduce the **fundamentals of solar energy**, including solar radiation, photovoltaic systems, and thermal applications.

Course Outcomes (COs): -On completion of this course, students should be able to -

- Differentiate between **renewable and non-renewable** energy resources and understand their global and national significance.
- Analyze the **principles and applications** of solar energy, including photovoltaic and solar thermal systems.
- Explain the **working and efficiency** of wind energy conversion systems and identify suitable locations for wind farms.
- Evaluate different **bioenergy technologies** and their role in sustainable energy production.

RES/DSC/T/100- Energy Resources

Marks:-50 **Total Contact Hours:-30**

Unit 1: Introduction to Renewable Energy **(6 Hours)**
- Overview of energy resources: Renewable vs Non-renewable
- Need for renewable energy: Environmental and economic considerations
- Global and national energy scenario
- Principles of sustainability

Unit 2: Solar Energy **(6 Hours)**
- Solar radiation and measurement
- Solar thermal systems: Water heating, space heating, and cooling
- Photovoltaic systems: Principles, components, and applications
- Challenges and future trends in solar energy

Unit 3: Wind Energy **(4 Hours)**
- Wind energy principles and conversion systems
- Types of wind turbines and their applications
- Site selection and wind resource assessment
- Challenges and developments in wind energy

Unit 4: Bioenergy **(4 Hours)**
- Biomass resources: Types and availability
- Bioenergy conversion technologies: Combustion, gasification, and biogas production
- Applications and environmental benefits of bioenergy
- Issues related to biomass utilization

Unit 5: Hydropower and Other Emerging Technologies **(6 Hours)**

- Hydropower: Small, medium, and large-scale systems
- Ocean energy: Tidal, wave, and ocean thermal energy conversion (OTEC)
- Geothermal energy: Principles, applications, and limitations
- Emerging technologies: Hydrogen energy and fuel cells

Reference Books:-

1. Renewable Energy: Power for a Sustainable Future by Godfrey Boyle
2. Energy and the Environment by James A. Fay and Dan S. Golomb
3. Renewable Energy Sources and Emerging Technologies by D.P. Kothari, K.C. Singal, and Rakesh Ranjan

RES/DSC/P/126- Practical on Energy Resources

Marks:-50 **Total contact Hours:-60**

Learning Objectives of the course:-

- Develop hands-on skills in **measuring solar radiation** and analyzing its effect on energy generation.
- Understand the **design, working principles, and efficiency** of solar energy systems such as photovoltaic (PV) panels and solar water heaters.
- Evaluate the **power output of solar PV panels** under different sunlight conditions.
- Demonstrate the functionality of **solar-powered lighting systems**, including battery charging and load performance.

Course Outcomes (COs): -On successfully completing this practical course, students should be able to

- Measure and analyze **solar radiation** at different tilt angles to optimize solar panel performance.
- Understand and evaluate the **efficiency of a solar water heating system** through practical assessment.
- Determine the **power output of a solar PV panel** under varying sunlight conditions and assess its effectiveness.
- Demonstrate the operation of a **solar-powered lighting system**, including battery charging and load management.

List of Experiments

1. To measure solar radiation for different tilt angles of solar panel.
2. To study the design, working, and efficiency of a solar water heating system
3. To measure the power output of a solar PV panel under varying sunlight conditions.
4. To study the working of a solar-powered lighting setup, including battery charging and load performance
5. To study the process of biogas generation using a lab-scale digester.
6. Performance evaluation of a solar water heater.
7. Calculation of power output from a wind turbine using a laboratory-scale setup.
8. Study of the production of biogas from organic waste.

RES/DSC/T/101- Solar Energy Applications

Marks:-50 **Total Contact Hours (30 Periods)**

Learning Objectives of the course:-

- Provide a comprehensive understanding of **solar radiation, its measurement, and global availability**.
- Explain the **principles of solar energy conversion**, including thermal and photovoltaic technologies.
- Develop knowledge of **solar thermal applications**, such as water heating, space heating/cooling, drying, and cooking.
- Introduce **solar photovoltaic (PV) systems**, their components, and applications in standalone and grid-connected setups.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Explain the **nature and measurement** of solar radiation and assess the potential of solar energy in different regions.
- Understand the **working principles and applications of solar thermal systems**, including water heaters, dryers, cookers, and power plants.
- Describe the **components and functioning of photovoltaic (PV) systems** and their role in energy conversion.
- Design and analyze **PV systems for residential and industrial applications**, considering efficiency and economic factors.

Unit 1: Fundamentals of Solar Energy **(6 Hours)**

- Solar radiation: Nature, spectrum, and measurement
- Solar energy availability: Global and regional perspectives
- Basics of solar energy conversion: Thermal and photovoltaic
- Solar energy potential and challenges

Unit 2: Solar Thermal Applications **(8 Hours)**

- Solar water heating systems: Design and performance analysis
- Solar space heating and cooling systems
- Solar dryers: Working principles and applications in agriculture
- Solar cookers: Types, advantages, and limitations
- Solar thermal power plants: Overview and working principles

Unit 3: Solar Photovoltaic Systems **(8 Hours)**

- Principles of photovoltaic (PV) energy conversion
- Components of a PV system: Solar cells, modules, inverters, batteries, and charge controllers
- Applications of PV systems:

- Standalone systems (solar home systems, solar lanterns)
- Grid-connected systems

- Design and sizing of PV systems for residential and industrial use
- Economic analysis of PV systems

Unit 4: Emerging Trends and Future Prospects **(4 Hours)**

- Solar energy storage technologies
- Integration of solar energy with smart grids
- Building-integrated photovoltaics (BIPV)
- Concentrated solar power (CSP) systems
- Solar-powered desalination and industrial processes

Unit 5: Policies, Economics, and Environmental Impact **(4 Hours)**

- Government policies and incentives for solar energy adoption
- Economic analysis: Payback period, levelized cost of electricity (LCOE), and subsidies
- Environmental benefits and challenges of solar energy systems
- Case studies of successful solar energy projects

Reference Books:-

1. Solar Energy: Principles of Thermal Collection and Storage by S.P. Sukhatme and J.K. Nayak
2. Solar Photovoltaics: Fundamentals, Technologies, and Applications by Chetan Singh Solanki
3. Renewable Energy: Power for a Sustainable Future by Godfrey Boyle

RES/DSC/P/ 127-Practical on Solar Energy Applications

Marks:-50 Total contact Hours:-60

Learning Objectives of the course:-

- To understand the principles of solar radiation measurement and its significance in solar energy applications.
- To analyze the performance of solar thermal systems, including solar water heaters, cookers, and dryers.
- To study the electrical characteristics of solar photovoltaic (PV) modules and their efficiency under different conditions.
- To familiarize with the components of grid-connected PV systems, including inverters and batteries.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Measure and analyze solar radiation intensity using a pyranometer.
- Assess the efficiency and performance of solar water heaters, cookers, and dryers.
- Interpret I-V and P-V characteristics of solar PV modules under varying irradiance conditions.
- Identify and understand the role of different components in a grid-connected solar PV system.

List of Experiments

1. Measurement of solar radiation intensity using a pyranometer.
2. Performance evaluation of a solar water heater: Measurement of inlet, outlet water temperatures, and system efficiency.
3. Study of a solar cooker: Measuring its performance under varying solar radiation conditions.
4. Study of a solar dryer: Measuring drying rate and moisture removal efficiency for agricultural produce.
5. Study of the I-V and P-V characteristics of a solar PV module under different irradiance levels.
6. Study of the components of a grid-connected solar PV system, including inverters and batteries.
7. Comparison of energy generation from PV systems with different tilt angles and orientations.

REC/DSC/T/102-Fundamentals of Electronics

Marks:-50 **Total Contact Hours (30 Periods)**

Learning Objectives of the course:-

- To understand the fundamental concepts of electronics and their significance in modern technology.
- To differentiate between analog and digital signals and comprehend basic electronic quantities like voltage, current, resistance, and power.
- To explore the properties of semiconductors and the working principles of diodes and their applications.
- To study the construction, operation, and applications of Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET).

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Explain the significance of electronics and differentiate between analog and digital signals.
- Apply Ohm's Law and analyze the behavior of passive components like resistors, capacitors, and inductors.
- Describe the properties of semiconductors and examine the working and applications of PN junction diodes.
- Illustrate the operation of BJTs and FETs and compare different transistor configurations.
- Apply Boolean algebra to simplify logic circuits and design basic combinational and sequential circuits.

Unit 1: Basics of Electronics **(4 Hours)**

- Introduction to electronics and its significance
- Overview of electronic signals: Analog and digital signals
- Voltage, current, resistance, and power relationships (Ohm's Law)
- Passive components: Resistors, capacitors, and inductors

Unit 2: Semiconductor Basics **(6 Hours)**

- Properties of semiconductors: Intrinsic and extrinsic
- PN junction diode: Construction, working, and VI characteristics
- Applications of diodes: Rectifiers (half-wave and full-wave), clippers, and clampers
- Light-emitting diodes (LEDs) and photodiodes

Unit 3: Transistors and Amplifiers **(6 Hours)**

- Bipolar Junction Transistor (BJT): Construction, types, and operation
- Configurations of BJT: CE, CB, and CC
- Field Effect Transistor (FET): Construction, operation, and characteristics
- Basic amplifiers: Concept and working principles

Unit 4: Digital Electronics **(6 Hours)**

- Number systems: Binary, decimal, octal, and hexadecimal
- Boolean algebra and basic logic gates (AND, OR, NOT, NAND, NOR, XOR)

- Introduction to combinational circuits: Multiplexers, demultiplexers, and encoders
- Basics of flip-flops and sequential circuits

Unit 5: Power Supplies and Oscillators **(4 Hours)**

- Regulated power supplies: Zener diodes and voltage regulators
- Basic concepts of oscillators: Types and applications
- Introduction to operational amplifiers and their applications

Reference Books:-

1. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
2. Principles of Electronics by V.K. Mehta and Rohit Mehta
3. Digital Fundamentals by Thomas L. Floyd

REC/DSC/P/128-Practical on Fundamentals of Electronics

Marks:-50 Total contact Hours:-60

Learning Objectives of the course:-

- Analyze the characteristics of PN junction diodes, Zener diodes, and BJTs to understand their working principles.
- Study and compare the performance of half-wave and full-wave rectifiers using diodes.
- Examine the operation of Zener diodes in voltage regulation applications.
- Implement and verify logic gates, adders, and flip-flops to understand digital circuit fundamentals.
- Perform practical experiments to reinforce theoretical knowledge and enhance circuit-building and testing skills.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Demonstrate knowledge of semiconductor devices by analyzing the characteristics of diodes, BJTs, and LEDs.
- Design and analyze rectifier circuits and compare their efficiencies.
- Implement voltage regulators using Zener diodes and evaluate their performance.
- Construct and verify digital logic circuits including logic gates, adders, and flip-flops.
- Apply operational amplifiers in oscillator circuits and understand their role in signal generation..

List of Experiments

1. Study of the characteristics of a PN junction diode.
2. Study and comparison of the performance of half-wave and full-wave rectifiers using diodes.
3. Zener diode as a voltage regulator: Measurement of Zener breakdown voltage and application in a voltage regulation circuit.
4. Study of light-emitting diodes (LEDs) and their characteristics.
5. Study of the characteristics of a Bipolar Junction Transistor (BJT): Input and output characteristics for Common-Emitter configuration.
6. Study of logic gates: Implementation and verification of AND, OR, NOT, NAND, NOR, and XOR gates.
7. Construction of a half-adder and full-adder using logic gates.
8. Study of flip-flops: Construction and working of SR, JK, D, and T flip-flops.
9. Study of a simple RC oscillator circuit using an operational amplifier (Op-Amp).

RES/GE/OE/T/100-Computer Hardware

Marks:-50 **Total contact Hours:-30**

Learning Objectives of the course:-

- Gain knowledge of the basic structure and components of computer systems, including desktops, laptops, servers, and embedded systems.
- Learn about the internal structure of the CPU, memory hierarchy, and data transfer processes.
- Study the functioning, role, and communication methods of various input and output devices.
- Learn about expansion cards, peripherals, ports, connectors, and their role in system functionality.
- Gain hands-on experience in diagnosing, repairing, and maintaining computer hardware components safely.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Describe the structure and function of computer hardware components, including input, processing, output, and storage devices.
- Explain CPU architecture and memory organization, including the role of ALU, control unit, registers, cache, and buses.
- Demonstrate knowledge of input and output device interactions with the CPU and their communication protocols.
- Compare different storage technologies and evaluate their performance in various applications.
- Diagnose and troubleshoot common hardware issues using diagnostic tools and preventive maintenance techniques..

Unit 1: Introduction to Computer Hardware **(4 Hours)**

- Overview of computer systems and hardware
- Basic structure of a computer system: Input, processing, output, and storage
- Computer hardware vs. software: Understanding the difference
- Types of computers and their hardware configurations (desktop, laptop, servers, embedded systems)

Unit 2: Central Processing Unit (CPU) and Memory **(6 Hours)**

- Architecture of the CPU: ALU, control unit, and registers
- CPU clock and instruction cycle
- Types of memory: Primary memory (RAM, ROM), secondary memory (hard disk, SSD), and cache memory
- Memory hierarchy: Access time, data transfer rates, and caching techniques
- Overview of buses and data pathways in the system

Unit 3: Input and Output Devices **(6 Hours)**

- Input devices: Keyboard, mouse, scanner, microphone, etc.

- Output devices: Monitor, printer, speakers, etc.
- Interaction between input/output devices and the CPU
- Understanding device drivers and their role in hardware communication
- Communication protocols for input/output devices (USB, Bluetooth, etc.)

Unit 4: Storage Devices and Media **(6 Hours)**

- Primary storage devices: RAM, ROM, and cache memory
- Secondary storage devices: Hard disk drive (HDD), solid-state drive (SSD), optical drives (CD, DVD), and flash memory
- Storage technologies: Magnetic, optical, and solid-state storage
- RAID (Redundant Array of Independent Disks) technology and configurations
- Storage performance and data transfer rates

Unit 5: Expansion Cards and Peripherals **(4 Hours)**

- Expansion cards: Graphics card, sound card, network interface card (NIC), etc.
- Role of the motherboard in connecting hardware components
- Peripheral devices: Printers, scanners, external hard drives, and other devices
- Understanding ports and connectors: USB, HDMI, VGA, Ethernet, etc.
- Bus systems: PCI, PCIe, ISA, AGP

Unit 6: Troubleshooting and Maintenance **(4 Hours)**

- Common hardware problems: System boot issues, overheating, hardware failure, etc.
- Diagnostic tools and techniques: Using BIOS/UEFI settings, POST codes, and software utilities
- Preventive maintenance and care of hardware
- Upgrading computer hardware: Installing memory, hard drives, and peripheral devices
- Safety precautions while handling computer hardware

RES/SEC/T/100-Fundamentals of Instrumentation

Marks:-50 **Total Contact Hours:-15**

Learning Objectives of the course:-

- Learn the definition, scope, and components of an instrumentation system, including sensors, transducers, and actuators.
- Study different types of sensors and transducers, their classification, and selection criteria for various applications.
- Understand the role of amplifiers, filters, and conversion techniques in improving measurement accuracy.
- Gain knowledge of analog and digital measuring instruments, including voltmeters, multimeters, oscilloscopes, and power meters.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Explain the components and principles of an instrumentation system, including sensors, transducers, and actuators.
- Differentiate between various types of sensors and transducers and select appropriate ones for specific measurement tasks.
- Design and implement signal conditioning circuits using amplifiers, filters, and conversion techniques.
- Operate and analyze measurements using analog and digital instruments, such as multimeters, oscilloscopes, and energy meters.

Unit 1: Introduction to Instrumentation **(4 Hours)**

- Definition and scope of instrumentation
- General components of an instrumentation system: Sensors, transducers, and actuators
- Measurement standards and units
- Static and dynamic characteristics of instruments

Unit 2: Sensors and Transducers **(6 Hours)**

- Basic principles of sensors and transducers
- Types of sensors: Temperature, pressure, flow, and level sensors
- Classification of transducers: Active and passive
- Strain gauges, thermocouples, RTDs, and LVDTs
- Selection criteria for sensors and transducers

Unit 3: Signal Conditioning **(6 Hours)**

- Principles of signal conditioning
- Amplifiers: Operational amplifiers, instrumentation amplifiers
- Filters: Low-pass, high-pass, and band-pass filters
- Analog-to-digital and digital-to-analog conversion techniques

- Noise and error reduction in measurement systems

Unit 4: Measuring Instruments **(6 Hours)**

- Analog and digital instruments
- Measurement of voltage, current, power, and resistance
- Digital voltmeter and Multimeter: Principles and working
- Cathode ray oscilloscope (CRO): Working principle and applications
- Power and energy meters

Unit 5: Data Acquisition Systems and Applications **(6 Hours)**

- Basics of data acquisition systems (DAQ): Components and working
- Principles of signal sampling, multiplexing, and conversion
- Introduction to LabVIEW and other data acquisition software
- Application of instrumentation in industrial, biomedical, and environmental monitoring
- Case studies on instrumentation in real-world systems

Reference Books: -

1. Principles of Instrumentation and Measurement by Alan S. Morris
2. Instrumentation for Engineering Measurements by James W. Dally, William F. Riley, and Kenneth G. McConnell
3. Electronic Instrumentation and Measurement Techniques by William D. Cooper and A. D. Helfrick
4. Principles of Measurement System by:- John P. Bentley
5. Electronic Instrumentation by H. S. Kalsi
6. A Course in Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney

Paper:-RES/SEC/P/101-Practical on Fundamentals of Instrumentation

Marks:-50 **30 (Periods)**

Learning Objectives of the course:-

- Develop a fundamental understanding of instrumentation and measurement techniques.
- Learn how to measure voltage, current, and resistance using digital multimeters.
- Understand the working principle and operation of a Cathode Ray Oscilloscope (CRO).
- Explore the working of pressure transducers for pressure measurement.
- Design and implement simple amplifier circuits using operational amplifiers (Op-Amps).

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Demonstrate the ability to measure electrical parameters using digital multimeters.
- Operate a Cathode Ray Oscilloscope (CRO) to display and analyze different waveforms.
- Use strain gauges to measure strain and analyze data using a Wheatstone bridge.
- Measure pressure using pressure transducers and interpret the results.
- Design and implement simple amplifier circuits using operational amplifiers.

List of Experiments

1. Measurement of voltage, current, and resistance using a digital multimeter.
2. Study of the working principle and operation of a Cathode Ray Oscilloscope (CRO): Display of sine, square, and triangular waveforms.
3. Study of strain gauges: Measurement of strain and analysis using a Wheatstone bridge.
4. Measurement of pressure using a pressure transducer or pressure sensor.
5. Design and implementation of a simple amplifier circuit using an operational amplifier (Op-Amp).
6. Design of low-pass, high-pass, and band-pass filters using passive components (Resistors, Capacitors).
7. Analog-to-digital conversion: Study of an ADC module and its use in converting an analog signal to a digital output.
8. Introduction to data acquisition: Use of a DAQ system to collect data from a sensor (e.g., temperature or pressure sensor).

Paper:- RES/SEC/T/101-Physics of Energy Sources

Marks:-50 **Total Contact Hours:-15**

Learning Objectives of the course:-
Understand the basic principles and classifications of energy sources, including renewable and non-renewable.
Explain the scientific concepts behind solar, wind, and hydroelectric energy production.
Analyze the operation and applications of fossil fuels and nuclear energy as power sources.
Explore alternative and emerging energy technologies like bioenergy and geothermal energy.

Course Outcomes (COs):- on successful completion of this course, students should be able to:
Demonstrate knowledge of the physics principles underlying various energy sources.
Compare and contrast different energy sources based on their advantages, limitations, and environmental effects.
Apply their understanding to discuss innovations and trends in the energy sector.
Develop a practical or research-based project to explore the application of an energy source in real-world scenarios.

Unit-I **Introduction to Energy Sources** **(2 contact hours)**
Overview of energy and its significance. Types of energy sources: Renewable and Non-renewable.

Unit-II **2. Solar Energy** **(3 contact hours)**
Principles of solar energy conversion (e.g., photovoltaic effect). Design and applications of solar panels.
Benefits and challenges of solar energy.

Unit-III **3. Wind and Hydroelectric Energy** **(3 contact hours)**
Wind Energy: Basics, wind turbines, and harnessing wind power.
Hydroelectric Energy: Energy generation from water, working of hydroelectric power plants, and their environmental impact.

Unit-IV **4. Fossil Fuels and Nuclear Energy** **(4 contact hours)**
Fossil Fuels: Types (coal, oil, natural gas), energy production, and environmental concerns.
Nuclear Energy: Concepts of fission and fusion, working of nuclear reactors, and safety considerations.

Unit-V **5. Alternative and Emerging Energy Sources** **(2 contact hours)**
Bioenergy and its applications.
Basics of geothermal energy and its potential.
New innovations in energy storage systems, including batteries and supercapacitors.

Paper:- RES/SEC/P/127-Physics of Energy Sources

Marks:-50 **Total Contact Hours:-15**

Learning Objectives

By the end of this course, students should be able to:

1. Understand the significance of energy sources and their impact on the environment and society.
2. Identify and differentiate between renewable and non-renewable energy sources.
3. Explain the principles of solar energy conversion and analyze the design and applications of solar panels.
4. Describe the mechanisms of energy generation from wind and hydroelectric sources, and evaluate their environmental and practical challenges.

Course Outcomes:- Upon successful completion of this course, students will:

1. Gain a foundational understanding of energy sources and their relevance to modern energy demands.
2. Develop practical skills in designing and evaluating small-scale models of solar, wind, and hydroelectric energy systems.
3. Be able to critically assess the environmental impacts of conventional energy sources like fossil fuels and nuclear energy.
4. Acquire knowledge of cutting-edge energy solutions, including bioenergy and energy storage innovations, to address sustainability challenges.

List of Experiments:-

1. **Energy Audit:** Conduct an energy audit of your classroom or home. Identify renewable and non-renewable energy usage.
2. **Build a Mini Solar Panel Model: Assemble a small solar-powered device, such as a fan or LED** light, and test its efficiency in sunlight and artificial light.
3. **Solar Cooker Activity:** Design and test a basic solar cooker to observe how solar energy can be harnessed for heating/cooking.
4. **Environmental Impact Study:** Compare the environmental effects of wind and hydroelectric projects through case studies.
5. **Fuel Combustion Experiment:** Demonstrate the combustion of small quantities of solid or liquid fuels and measure energy released using calorimeters (ensure safety precautions).
6. **Pollution Analysis:** Measure air quality before and after burning small quantities of natural fuels to understand environmental concerns.
7. **Bioenergy Experiment:** Generate biogas using organic waste (like food scraps) in a controlled environment to understand bioenergy production.
8. **Battery Efficiency Test:** Compare the performance of different types of batteries, including rechargeable and supercapacitors, in powering a small device.

RES B VOC SEM-II

Course Type	Course code	Course Name	Contact Hours per week		Credit assigned		Total Credit	Total contact hours for the course
			Th.	Pr.	Th.	Pr.		
Major (core)M1 Mandatory	RES/DSC/T/150	Energy Conversion systems	2	0	2	-	2+2=4	30
	RES/DSC/P/176	practical on RES/DSC/T/150	0	4	-	2		60
Major (core)M2 Mandatory	RES/DSC/T/151	Applications of wind energy	2	0	2	-	2+2=4	30
	RES/DSC/P/177	practical on RES/DSC/T/151	0	4	-	2		60
Major (core)M3 Mandatory	RES/DSC/T/152	Energy and Environment	2	0	2	-	2+2=4	30
	RES/DSC/P/178	practical on RES/DSC/T/152	0	4	-	2		60
Generic open elective (choose any one pool of courses) other than Major	RES/GE/ OE/T/150	Computer science (Fundamentals of Information technology)	2	0	2	-	2	30
VSC vocational skill course (choose any one pool of courses)	RES/VSC/T/150	Fundamentals of Electricity	1	0	1	-	1+1=2	15
	RES/VSC/P/176	Practical's Based on RES/VSC/T/150	0	2	-	1		30
	RES/VSC/T/151	Electronics(Electrical equipment Maintenance-I	1	0	1	-	1+1=2	15
	RES/VSC/P/177	Practical's Based on RES/VSC/T/151	0	2	-	1		30
AEC, VEC, IKS	RES/AEC/T/-150	Modern Indian Language (MIL-1) (Choose any one from pool of language courses)	2	-	2	-	2+2=4	
	RES/VEC/T/151	Constitution of India (choose any one pool of courses)	2	-	2	-		
OJT/FP/CEP/CC/RP	RES/CC/P/176	Yoga Education/sport and fitness	-	4	-	2	2	
Total			13	18	13	09	22	

RES/DSC/T/150-Energy Conversion systems

~~Marks:-50~~ ~~Total Contact Hours (30 Periods)~~

Learning Objectives of the course:-

- Understand the fundamentals of energy conversion and different types of energy, including mechanical, thermal, chemical, and electrical energy.
- Apply the First and Second Laws of Thermodynamics to analyze energy conversion systems.
- Evaluate the efficiency and performance metrics of various energy systems, including heat rate and work output.
- Analyze conventional energy conversion systems, such as steam and gas turbines, internal combustion engines, and nuclear power generation, along with their efficiency and environmental impacts.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Explain the basic principles of energy conversion and the various forms of energy.
- Apply thermodynamic laws to analyze and optimize energy conversion systems.
- Compare the efficiency and environmental impact of different conventional energy conversion methods.
- Demonstrate knowledge of renewable energy technologies and their applications in power generation.

Unit I: Basics of Energy Conversion **(8 Hours)**

Introduction to Energy Systems

- Types of energy: Mechanical, thermal, chemical, electrical, etc.
- Energy conversion processes and devices.
    - First and Second Laws of Thermodynamics
- Application to energy systems.
    - Performance Metrics
- Efficiency, heat rate, and work output.

Unit II: Conventional Energy Conversion Systems **(8 Hours)**

Fossil Fuel-Based Systems

- Steam and gas turbines.
- Internal combustion engines.
- Efficiency and environmental concerns.
    - Nuclear Energy Conversion
- Nuclear fission and fusion.
- Reactors and thermal energy conversion.

Unit III: Renewable Energy Conversion Systems **(8 Hours)**

Solar Energy

Basics of Solar Photo voltaic, recent trends in solar drying-solar tunnel drier, Solar Driers
Solar PV and water pumping, Solar Water Heater
Wind Energy

- Wind turbines and power generation.
    - Hydropower
- Principles of operation and types of turbines.
    - Biomass and Geothermal Energy
- Conversion technologies and applications.

Unit IV: Emerging Technologies and Energy Storage **(6 Hours)**

Emerging Energy Conversion Technologies

- Fuel cells.
- Ocean energy systems (tidal and wave).
    - Energy Storage Systems
- Batteries, supercapacitors, and pumped hydro storage.
- Importance in renewable energy integration.

References Books:-

1. Rai, G. D., *Non-Conventional Energy Sources.*
2. Cengel, Y. A., and Boles, M. A., *Thermodynamics: An Engineering Approach.*

RES/DSC/P/176 Practical on Energy Conversion systems

Marks:-50 total contact Hours:-60

Learning Objectives of the course:-

- Apply theoretical concepts of energy conversion through hands-on experiments.
- Measure and analyze the efficiency of solar photovoltaic (PV) panels under different conditions.
- Understand the working principle of fuel cells and evaluate their electricity generation efficiency.
- Investigate the charging and discharging characteristics of supercapacitors and their role in energy storage.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Conduct experiments on different energy conversion systems and interpret the results effectively.
- Evaluate the efficiency of solar PV panels by measuring power output under real-world conditions.
- Operate a fuel cell system and assess its capability to generate electricity.
- Analyze the performance of supercapacitors and batteries based on their energy storage characteristics.

List of Experiments

1. Measure the efficiency of a solar photovoltaic (PV) panel
2. Demonstrate the operation of a fuel cell for electricity generation.
3. Investigate the charging and discharging characteristics of supercapacitors.
4. Test the performance and efficiency of a rechargeable battery.
5. Convert biomass (e.g., wood chips) into combustible gases using a gasifier, and measure energy output from the gas.
6. Demonstrate how a fuel cell operates by generating electricity from hydrogen and oxygen, and measure its efficiency.

RES/DSC/T/151-Applications of wind energy

Marks:-50 **Total Contact Hours (30 Periods)**

Learning Objectives of the course:-

- Understand the fundamentals of wind energy and its applications in power generation.
- Analyze wind energy resources and evaluate factors affecting wind power generation.
- Examine wind turbine design considerations and their impact on efficiency and performance.
- Understand grid-connected wind farms and hybrid power systems for energy production.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Explain the principles of wind energy generation and its role in sustainable power production.
- Evaluate wind energy resources and determine the feasibility of wind power projects.
- Analyze wind turbine design considerations and their impact on efficiency.
- Understand and compare different types of wind power systems, including grid-connected and hybrid systems.

Unit I: Wind Energy and Their Applications (10 Hours)

Wind Energy Resources: Theory, Design and Applications, Introduction, Power, Wind Turbine Design Considerations, Grid Connected Wind Farms, Hybrid Power Systems, Economics of Wind Power Systems

Unit II: Wind Turbine Systems: History, Structure, and Dynamic Model (10 Hours) Wind Energy Conversion System (WECS), Overall Dynamic Model of the Wind Turbine System and Small, Signal Analysis

Unit III: Wind Turbine Generation Systems Modeling for Integration in Power Systems: (10 Hours) Introduction, Wind Turbine Modeling, Wind Modeling, Mechanical Transmission Modeling, Electrical Generator Modeling, Converter Modeling, Control Modeling, Electrical Disturbances

Reference Books:-

1. "Wind Energy Explained: Theory, Design and Application" by: James F. Manwell, Jon G. McGowan, and Anthony L. Rogers,
2. "Wind Power: Renewable Energy for Home, Farm, and Business" by: Paul Gipe,
3. "Wind Energy Handbook" by: Tony Burton, Nick Jenkins, David Sharpe, and Ervin Bossanyi,
4. "Wind Energy: An Introduction" by: Muhammad H. Rashid

RES/DSC/P/177 Practical on Applications of wind energy

Marks:-50 Total contact Hours:-60

Learning Objectives of the course:-

- Understand the principles of wind energy measurement and assess wind speed using anemometers.
- Analyze wind energy potential by collecting and evaluating wind speed data from different locations.
- Calculate wind power output using mathematical models based on wind speed variations.
- Design and simulate a hybrid wind-solar power system to optimize renewable energy integration.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Measure wind speed using an anemometer and analyze its impact on wind energy generation.
- Assess wind energy potential by evaluating site-specific wind characteristics.
- Calculate wind power output based on wind speed and turbine parameters.
- Design and simulate a hybrid wind-solar power system for renewable energy applications.

List of the Practical's

1. Measurement of wind speed using an anemometer
2. Assessment of wind energy potential at different locations
3. Calculation of wind power from wind speed data
4. Design and simulation of a hybrid wind-solar power system
5. Create a model of the wind turbine's mechanical and electrical system
6. Build a basic small-scale WECS (e.g., a small wind turbine with a dynamo)
7. Measure power output under varying wind conditions

RES/DSC/T/152-Energy and Environment

Marks:-50 **Total Contact Hours (30 Periods)**

Learning Objectives of the course:-

- Understand the fundamentals of energy sources and their classification into conventional and non-conventional types.
- Analyze global and national energy consumption patterns and their environmental implications.
- Evaluate the environmental impacts of energy systems, including pollution and greenhouse gas emissions.
- Examine the role of renewable energy in environmental sustainability and its benefits in reducing carbon footprints.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Classify different energy sources and assess their impact on the environment.
- Analyze national and global energy consumption patterns and their sustainability challenges.
- Evaluate the environmental effects of fossil fuel-based energy systems, including pollution and greenhouse gas emissions.
- Assess the benefits of renewable energy in mitigating climate change and environmental degradation.

Unit I: Introduction to Energy and Environment **(6 Hours)**

Energy Basics

- Types of energy sources: Conventional and non-conventional.
- Global and national energy consumption patterns.
- Environmental Impacts of Energy Systems
- Air, water, and soil pollution from fossil fuels.
- Greenhouse gases and global warming.

Unit II: Renewable Energy and Environmental Sustainability **(6 Hours)**

Renewable Energy Overview

- Solar, wind, hydro, biomass, geothermal, and tidal energy.
  - Environmental Benefits of Renewable Energy
  - Reduction of carbon footprint.
  - Mitigation of pollution and resource depletion.

Unit III: Climate Change and Energy Systems **(6 Hours)**

Climate Change Basics

- Causes and consequences of climate change.
- Role of energy systems in climate change.

- Carbon Emissions and Management
- Carbon capture and storage (CCS).
- Role of energy efficiency and conservation in emission reduction.

Unit IV: Policies and Strategies for Sustainable Energy **(6 Hours)**

Energy Policies and Regulations

- National and international frameworks (e.g., Kyoto Protocol, Paris Agreement).
- Renewable energy policies in India and globally.
- Sustainable Energy Strategies
- Energy efficiency in industries and buildings.
- Circular economy and resource optimization.

Unit V: Future Trends in Energy and Environment **(6 Hours)**

Emerging Technologies

- Smart grids and energy storage systems.
- Hydrogen economy and fuel cells.
- Socio-Economic Impacts
- Energy equity and access.
- Role of public awareness and community participation in sustainable practices.

References books:

1. *Energy and the Environment* by James A. Fay and Dan S. Golomb.
2. *Renewable Energy and Environment* by Md. Rabiul Islam, Amit Kumar, and Hasanuzzaman.

RES/DSC/P/178-Energy and Environment

Marks: 50 total contact Hours:-60

Learning Objectives of the course:-

- Analyze global and national energy consumption patterns using statistical tools and data.
- Simulate CO_2 emissions from different energy sources and evaluate their environmental impact.
- Measure solar radiation and wind speed to assess the feasibility of renewable energy sources.
- Conduct case studies on renewable energy projects and evaluate their environmental benefits and challenges.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Use statistical methods to analyze energy consumption trends at global and national levels.
- Simulate and evaluate CO_2 emissions from different energy sources using emission calculators.
- Measure and assess solar and wind energy potential using appropriate instruments.
- Conduct an environmental impact assessment of a local renewable energy project.

List of Practical's

1. Analyze global and national energy consumption trends using statistical data.
2. Simulate CO2 emissions from various energy sources using emission calculators.
3. Measure solar radiation using solarimeters and wind speed using an anemometer to assess renewable energy potential.
4. Perform a case study of a local renewable energy project and assess its environmental impact.
5. Conduct an experiment to demonstrate hydrogen production (e.g., water electrolysis) and use in fuel cells.
6. Study the efficiency of hydrogen fuel cells by powering small devices or models.

RES/GE/OE/T/150-Fundamentals of Information technology

Marks:-50 **total contact Hours:-30**

Learning Objectives of the course:-

- Understand the fundamental concepts of Information Technology (IT), including its definition, scope, and significance.
- Trace the evolution of computers and IT and explore their applications across various domains.
- Gain knowledge of computer system components, including hardware, software, and input/output devices.
- Differentiate between various types of computers and understand the role of operating systems.

Course Outcomes (COs):- on successful completion of this course, students should be able to:

- Define Information Technology and explain its significance in modern society.
- Describe the evolution of computers and IT and their applications in different fields.
- Identify and explain key computer system components and their functions.
- Differentiate between various types of computers and operating systems.

Unit 1: Introduction to Information Technology **(4 Hours)**

- Definition, scope, and significance of IT.
- Evolution of computers and IT.
- Applications of IT in various domains (education, business, healthcare, etc.).

Unit 2: Fundamentals of Computer Systems **(6 Hours)**

- Components of a computer: Hardware and software.
- Input/output devices and their functions.
- Types of computers (supercomputers, personal computers, mobile devices, etc.).
- Overview of operating systems (Windows, macOS, Linux).

Unit 3: Data Storage and Processing **(4 Hours)**

- Data representation (binary, ASCII, Unicode).
- Types of memory: Primary (RAM, ROM), secondary storage (HDD, SSD), and cloud storage.
- Introduction to databases: Concepts and examples.

Unit 4: Computer Networks and Internet Basics **(6 Hours)**

- Basics of networking: LAN, WAN, MAN.
- Internet services: WWW, email, search engines.
- Introduction to cloud computing.
- Security threats and safe internet practices.

Unit 5: Emerging Trends and Social Implications of IT **(4 Hours)**

- AI, IoT, Big Data, and Blockchain: Brief overview.
- Ethical issues in IT: Data privacy and digital rights.
- Cybersecurity and its importance.
- IT's role in bridging the digital divide.

RES/VSC/T/150-Fundamentals of Electricity

Marks:-50 **(30 Periods)**

Learning Objectives of the course:-

- Understand the fundamental concepts of electricity, including charge, current, voltage, resistance, and power.
- Identify and describe various electrical components such as conductors, insulators, resistors, capacitors, inductors, and switches.
- Apply fundamental electrical laws, including Ohm's Law and Kirchhoff's Laws, to solve basic circuit problems.
- Analyze and differentiate between series and parallel circuits and understand their practical applications.

Outcomes (COs):- on successful completion of this course, students should be able to:

- Define the basic principles of electricity and explain the importance of electrical energy in daily life.
- Describe the characteristics and functions of fundamental electrical components used in circuits.
- Apply Ohm's Law and Kirchhoff's Laws to analyze simple electrical circuits.
- Differentiate between series and parallel circuits and explain their applications in real-world scenarios.

Unit 1: Introduction to Electricity (3 Hours)

- Definition and importance of electricity.
- Basic terms: Charge, current, voltage, resistance, and power.
- Overview of electrical units and symbols.

Unit 2: Basic Electrical Components (4 Hours)

- Conductors, insulators, and semiconductors.
- Overview of resistors, capacitors, inductors, and switches.
- Introduction to batteries and power sources.

Unit 3: Fundamental Electrical Laws (4 Hours)

- Ohm's Law: Concept and applications.
- Kirchhoff's Laws: Current Law (KCL) and Voltage Law (KVL).
- Simple numerical problems involving these laws.

Unit 4: Circuits and Applications (3 Hours)

- Introduction to series and parallel circuits.
- Practical examples of electrical circuits in daily life.
- Basics of household electrical systems.

Unit 5: Electrical Safety and Precautions (1 Hour)

- Importance of safety in electrical systems.
- Common hazards and precautions in handling electricity.
- Overview of grounding and circuit breakers.

Reference Books: -

1. "Basic Electrical Engineering" by V.K. Mehta and Rohit Mehta
2. "Principles of Electricity" by Delmar Cengage Learning
3. "Introduction to Electrical Engineering" by M.S. Naidu and S. Kamakshaiah
4. "Electrical Technology" by B.L. Theraja and A.K. Theraja

RES/VSC/P/176-Practical on Fundamentals of Electricity

Marks:-50 **(30 Periods)**

Learning Objectives of the course:-

- Learn to use a multimeter to measure electrical parameters such as resistance, voltage, and current.
- Identify resistor values using color codes and verify them through measurement.
- Experimentally verify Ohm's Law and understand the relationship between voltage, current, and resistance.
- Construct and analyze simple electrical circuits using resistors, power supplies, and measuring instruments.

Outcomes (COs):- on successful completion of this course, students should be able to:

- Accurately measure resistance using a Multimeter and determine component values using color codes.
- Verify Ohm's Law experimentally and analyze the relationship between voltage, current, and resistance.
- Set up and operate basic electrical circuits using resistors, power sources, and measuring instruments.
- Construct and analyze series and parallel resistor circuits, calculating total resistance and verifying theoretical values with practical measurements.

List of Practicals

1. Measure resistance using a Multimeter and identify component values from color codes.
2. Verify Ohm's Law by determining the relationship between voltage, current, and resistance.
3. Set up a simple circuit with a resistor, power supply, and ammeter/voltmeter. Vary the voltage and measure the resulting current.
4. Understand the behavior of resistors in series and parallel configurations.
5. Construct series and parallel circuits, calculate total resistance, and measure voltage/current at various points.
6. Use a Multimeter to measure voltage, current, and resistance.

RES/VSC/T/151-Basics of Thermodynamics

Marks:-50 (30 Periods)

Learning Objectives

1. Understand the fundamental concepts and laws of thermodynamics.
2. Analyze thermodynamic systems and solve problems related to energy transfer.
3. Develop knowledge of entropy, energy efficiency, and thermodynamic cycles.
4. Apply thermodynamic principles to practical engineering problems.

Outcomes (COs):- on successful completion of this course, students should be able to:

1. Explain the basic principles and laws of thermodynamics.
2. Perform thermodynamic analyses using the first and second laws of thermodynamics.
3. Solve problems involving phase changes, energy, and entropy.
4. Apply thermodynamic concepts to engineering systems and evaluate efficiency.

Unit 1: Introduction to Thermodynamics **(6 periods)**

Definition and scope of thermodynamics:- Basic concepts: system, surroundings, boundary, types of systems

Properties of substances: state, path, process, cycle, equilibrium, Zeroth law of thermodynamics: temperature and its measurement

Unit 2: First Law of Thermodynamics **(8 periods)**

Energy, work, and heat: definitions and units, First law: statement and implications

Internal energy and enthalpy

Application to closed systems: isochoric, isobaric, and adiabatic processes

Application to open systems: steady flow energy equation

Unit 3: Second Law of Thermodynamics **(8 periods)**

Limitations of the first law:- Concept of entropy: definition, physical significance, and calculation

Second law: statements (Clausius and Kelvin-Planck), Carnot cycle and Carnot theorem,

Thermodynamic efficiency

Unit 4: Properties of Pure Substances **(4 periods)**

P-V-T relationships of substances, Phase diagrams and phase change processes, Use of thermodynamic tables

Unit 5: Introduction to Ideal and Real Gases **(4 periods)**

Equation of state for ideal gas, Van der Waals equation for real gases, Gas mixtures and Dalton's Law

RES/VSC/P/177-Basics of Thermodynamics

Marks:-50 (30 Periods)

---

1. Measurement of Temperature: Using thermometers and pyrometers to understand temperature scales and the Zeroth Law.
2. Verification of First Law: Experiment to demonstrate conservation of energy using heat and work interactions in a closed system.
3. Carnot Cycle Demonstration: Simulation or practical setup to study thermodynamic cycles and efficiency.
4. Properties of Substances: Using thermodynamic tables and diagrams to interpret substance properties.
5. Heat Transfer: Experiment on conduction and convection in different materials to study energy transfer.
6. Gas Behavior Study: Application of ideal and real gas equations for the calculation of pressure, volume, and temperature.

===000===