University of Global Village (UGV), Barishal

Sessional and Lab module

Departmental Name: Electrical and Electronics Engineering

Subject Name:	Renewable Energy Lab	Total Class: 17 Total Class Hour: 35 hours
Subject Code:	Semester: 5th	Total Practice Hour: 50 hours
Directed by:	Abdul Hai Siddique/Apurbo Saikat Roy	Total: 85 hours

Course Rationale

This course is essential for understanding renewable energy systems. It provides a foundation in renewable energy technologies, including solar, wind, and battery systems, enabling students to grasp the underlying mechanisms, practical implementations, and innovations in renewable energy systems. Through hands-on experiments and design-based learning, students will develop the skills necessary to analyze, design, and integrate renewable energy components effectively.

Course Objectives

1. To provide students with a comprehensive understanding of renewable energy sources and their practical applications.
2. To develop hands-on skills in the design, testing, and integration of renewable energy systems, including solar panels, wind turbines, and batteries.
3. To enable students to analyze the performance of renewable energy technologies using simulation tools and experimental methods.
4. To foster critical thinking and problem-solving abilities in addressing real-world challenges related to renewable energy systems.
5. To prepare students for further research or professional work in the field of sustainable and renewable energy.

Course learning outcomes (CLO): After successful completion of the course students will be able to -

CLO	Description
CLO 1	Match basic experimental experiences in physical operation and circuit applications of electronic devices with the theoretical knowledge.
CLO 2	Investigate the working principle of different electronic components.
CLO 3	Design different electronic projects and apply the knowledge in societal and environmental issues.

Assessment Pattern:

Continuous Assessment		Semester End Assessment			
Bloom's Category	**Test (20)**	**Bloom's Category (30)**	**Test (20)**	**Quiz (10)**	**External Participation in Curricular/Co-Curricular Activities (20)**
Imitation	12	Imitation	06	06	Bloom's Affective Domain: (Attitude or will) • **Attendance: 10** • **Viva-Voca: 5** • **Report Submission: 5**
Manipulation	8	Manipulation	04	04	
Precision	6	Precision	06	-	
Articulation	2	Articulation	02	-	
Naturalization	2	Naturalization	02	-	

Table 1: Lab Activities Overview

Serial No.	Experiment Name	Topics Covered	Learning Outcome	Theory Time (hrs)	Practice Time (hrs)	Corresponding CLO
1	Simulation Study on Solar PV Energy System	Principles of PV systems, simulation of power generation, and efficiency calculation	Understand solar PV system operation and simulate power generation to analyze output parameters.	2	3	CLO1
2	Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System	PV module testing, IV curve analysis, efficiency determination	Conduct experiments to analyze the VI characteristics of a 1kWp solar PV system and calculate its efficiency.	2	3	CLO1, CLO2
3	Experiment on Shadowing Effect and Diode-Based Solution in 1kWp Solar PV System	Impact of shading on PV performance, bypass diode working and testing	Study the effects of partial shading on PV systems and explore diode-based solutions to mitigate power losses.	2	3	CLO1, CLO2
4	Experiment on Performance Assessment of Grid-Connected and Standalone 1kWp Solar Power System	System setup, load testing, and performance comparison of grid-connected vs. standalone configurations	Analyze the differences in performance and efficiency of grid-connected and standalone solar power systems under various conditions.	2	3	CLO2, CLO3
5	Simulation Study on Wind Energy Generator	Simulation of wind turbine power generation, impact of wind speed variations	Simulate wind turbine systems and study the relationship between wind speed, turbine design, and power generation.	2	3	CLO1
6	Experiment on Performance Assessment of	Small-scale wind turbine testing, power output analysis, and	Conduct practical testing of a micro wind turbine and analyze its performance under	2	3	CLO2

	Micro Wind Energy Generator	efficiency calculation	varying wind conditions.			
7	Simulation Study on Hybrid (Solar-Wind) Power System	Combined solar and wind power generation, hybrid system simulation	Understand and simulate the operation of hybrid power systems to optimize performance and reliability.	2	3	CLO3
8	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System	System integration, load management, power output, and efficiency comparison	Analyze the performance of a hybrid solar-wind system under different environmental and load conditions.	2	3	CLO2, CLO3
9	Simulation Study on Hydel Power	Hydropower generation principles, turbine operation, and system simulation	Simulate small-scale hydropower systems to understand energy extraction, turbine design, and generation performance.	2	3	CLO1
10	Experiment on Performance Assessment of 100W Fuel Cell	Fuel cell working principle, setup and testing, efficiency, and power output analysis	Perform experiments to analyze the power output, efficiency, and environmental impact of a 100W fuel cell system.	2	3	CLO2, CLO4

Table 2: Weekly Breakdown of Lab Exercises

Week	Experiment Name	Learning Strategy	Assessment Strategy	Corresponding CLO	Content/Video Link
1	Simulation Study on Solar PV Energy System	Simulate the working of solar PV systems, study system components	Submit a simulation report on solar power generation and efficiency	CLO1	Link
2	Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System	Conduct hands-on experiments to study VI characteristics and efficiency	Report on VI characteristics and calculate system efficiency	CLO2	Link
3	Experiment on Shadowing Effect & Diode-Based Solution in 1kWp Solar PV System	Explore the effects of shading on PV performance and diode-based solutions	Report on shading effect and bypass diode implementation	CLO2	Link
4	Experiment on Performance Assessment of Grid-Connected and Standalone 1kWp Solar Power System	Compare the performance of grid-connected and standalone solar systems	Report on power output and efficiency comparison	CLO3	Link
5-6	Simulation Study on Wind Energy Generator	Simulate the operation of wind turbines and energy generation	Simulation report on wind turbine power output under varying conditions	CLO1	Link
7	Experiment on Performance Assessment of Micro Wind Energy Generator	Perform hands-on testing of a small wind turbine	Report on measured power output and turbine efficiency	CLO2	Link
8-9	Simulation Study on Hybrid (Solar-Wind) Power System	Simulate combined solar and wind power systems	Report on the hybrid system's simulated performance and reliability	CLO3	Link
10-11	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System	Analyze real-time hybrid system performance	Report on efficiency and power sharing between solar and wind sources	CLO2, CLO3	Link

12	Simulation Study on Hydel Power	Simulate small-scale hydropower systems	Simulation report on turbine operation and power generation	CLO1	Link
13-14	Experiment on Performance Assessment of 100W Fuel Cell	Perform testing on a 100W fuel cell system	Report on power output, efficiency, and environmental impact	CLO2, CLO3	Link
15	Review Class	Recap key concepts, address questions	Participation in discussions	All CLOs	
16	Practice Class	Perform additional experiments or simulations	Spot evaluations and participation	All CLOs	
17	Final Lab Test and Quiz	Practical and theoretical evaluation covering all experiments	Comprehensive lab test and final quiz	All CLOs	

Reference Books:

S.No.	Book Title	Author(s)	Topics Covered
1	Renewable Energy: Power for a Sustainable Future	Godfrey Boyle	Covers various renewable energy sources, including solar, wind, hydro, and biomass energy.
2	Introduction to Renewable Energy	Vaughn C. Nelson, Kenneth L. Starcher	Introduces the principles behind renewable energy technologies such as solar and wind.
3	Renewable Energy Systems: A Smart Energy Systems Approach to the Choice and Modeling of 100% Renewable Solutions	Henrik Lund	Focuses on designing 100% renewable energy systems with a systems approach.
4	Wind Energy Explained: Theory, Design, and Application	James F. Manwell, Jon G. McGowan, Anthony L. Rogers	Comprehensive guide on wind turbine theory, design, and applications.
5	Solar Engineering of Thermal Processes	John A. Duffie, William A. Beckman	Detailed examination of solar thermal systems, ideal for students focusing on solar energy.