GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Power Electronics Engineering

Subject Code: DI04024091

Subject Name: Renewable Energy Sources

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	MOPEC

Prerequisite:	Fundamentals of Electrical Engineering, Semiconductor devices and power electronics basics.
Rationale:	The increasing global energy demand and depletion of fossil fuels make renewable energy systems essential for sustainable development. Power Electronics engineers play a crucial role in designing and maintaining systems that convert renewable sources like solar, wind, biomass and hydro energy into usable electricity. This course provides practical and technical skills related to renewable power generation. It prepares students for opportunities in industrial sectors such as solar PV installation, wind turbine control, and hybrid renewable solutions.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Identify and select the most suitable renewable power plant for a given geographic location and load requirement.	R, U
02	Design a solar PV configuration and choose appropriate power electronics converter based on actual load demand.	R, U, A
03	Select a suitable wind turbine type, rotor design, and power control method for maximum power generation in a given wind profile.	R, U, A
04	Select suitable biomass or mini/micro- hydropower system for rural/remote areas based on feedstock availability, water head, and flow rate.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE(V)	
2	0	2	3	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Renewable Energy and Power plants.** Energy scenario (India & World), Need for renewable energy, Types of energy sources, Comparison of conventional and non-conventional energy. Renewable energy power plants: solar energy, wind energy, Hydro energy, Geothermal energy, Ocean (Marine) energy- classification and working. Introduction to Hydrogen Energy Systems: Green hydrogen power plant, Fuel cell power plants.	7	23
2.	**Solar energy system** Solar cell: Basic working principle, Parameters, Factors Affecting Electricity Generated by a Solar Cell. Solar PV Modules: Ratings, Standard PV Module Parameters, Factors Affecting Electricity Generated by a Solar PV Module, Measuring Module Parameters. Solar PV Module Arrays: Connection of Modules in Series, Connection of Modules in Parallel Combination, Connection of Modules in Series and Parallel. Charge Controller: function, working, types, features and specification of charger controller MPPT: Need of MPPT, MPPT Charge Controller, Specifications of MPPT Charge Controller. Solar Inverters: Types, Specifications.	10	34
3.	**Wind Energy system** Introduction, components of wind power plant (WPP), wind turbine classes, types of rotors, Sensors in WPPs, Electric Hoist. Classification of wind power plant (WPP) Power Control Classification of WPP: Aerodynamic control: - pitch control, stall control, active stall control. Power Electronic Control (PEC): - Overview of PEC Applications Used in different types of WPPs, overview of constant speed and variable speed operation, Back-to-Back PEC in WPP.	7	23
4.	**Biomass and Hydro Power Generation** Biomass conversion technologies, Biogas plant types, components Working, Applications & limitations. Solid Waste based power generation plants and their capacities currently in India and world.	6	20

	Mini & Micro hydro systems: Basic Working Principle, Components, Types, Turbine used, applications for rural & remote locations, advantages, limitation, future scope.		
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40	**60**	**10**			

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Solar Photovoltaic Technology and Systems by Chetan Singh Solanki (PHI learning)
2. Wind Power Technology by Earnest, Joshua (PHI Learning, New Delhi)
3. Renewable Energy Sources and Emerging Technologies – Kothari, Signal & Ranjan (PHI learning)
4. Non-Conventional Energy Sources by G. D. Rai (Khanna publication)
5. Non-Conventional Energy Sources by B.H. Khan (TMH publication)

(b) Open-source software and website:

- MNRE India (Ministry of New and Renewable Energy) – Technical standards & guidelines
- www.youtube.com

Suggested Course Practical List:

Sr. No	**Suggested Course Practical**
1.	Identify different renewable energy sources using pictures/models and classify them based on availability and application.
2.	Prepare a comparative table of conventional vs. renewable power plants (cost, pollution, efficiency, capacity).
3.	Measurement of solar radiation using pyranometer.
4.	Test I–V characteristics of Solar PV panel.

5.	Test PV modules in **series and parallel** and measure voltage & current difference.
6.	Study and testing of **PWM Solar Charge Controller**.
7.	Study and testing of **MPPT Charge Controller** and comparison with PWM.
8.	Testing of Solar Inverter with different AC loads
9.	Calculate PV panel, battery and inverter rating for a **home/office load**.
10.	Identify components of a Wind Power Plant using pictures/models (blades, gearbox, generator, sensors).
11.	Study of Wind Turbine Trainer and measure output vs. wind speed.
12.	Demonstration of pitch control and stall control
13.	Performance comparison of constant-speed vs. variable-speed control using graphs/data sheets.
14.	Study of Biogas plant components using model/diagram and preparation of working report.
15.	Calculate daily biogas requirement for a household / dairy farm / hostel using simple formula.
16.	Study of mini/micro hydro power plant working (model/video) and identify key components.
17.	Select suitable turbine type based on head and water flow**.**
18.	Case study: Compare feasibility of Biomass vs. Micro-Hydro for rural electrification of a selected area.
19.	Measure wind speed using anemometer.

List of Laboratory/Learning Resources Required:

- Solar PV modules (various wattages)
- Small Wind Turbine Trainer set / Wind turbine simulation setup.
- Solar charge controllers (PWM & MPPT).
- Solar inverter (off-grid or hybrid type).
- Solar Battery bank (Lead Acid / Li-ion).
- Solar radiation measuring device / digital solar meter.
- Variable DC loads / AC loads (lamps/fans).

- Multimeters, clamp meters, DC energy meter.
- anemometer.
- Solar Street Light Demonstration Kit.
- Solar Water Pump Mini Trainer Kit.
- Solar Home Lighting System Kit.
- Solar PV I-V Characteristics Trainer (with variable load).
- Hybrid Wind–Solar Street Light Demo Kit.
- Biogas Plant Working Model (with slurry mixture & gas outlet).
- Micro-Hydro Turbine Demonstration Kit.
- Small-scale Biomass Gasifier Model.

Suggested Project List:

- Solar Powered LED Home Lighting System
- Solar Powered DC Fan / Table Fan
- Automatic Solar Street Light using LDR
- Solar Battery Charging Unit for Emergency Backup
- Solar Water Heater Thermostat Control (Model/Prototype)
- Solar Garden Light with Auto Dusk-to-Dawn Operation
- Solar Irrigation Pump Model for Agriculture (Mini Prototype)
- PWM solar charge controller demonstration
- Mini wind turbine model
- Hybrid wind–solar model
- Micro hydro working model
- Small biogas plant model
- Solar street light automatic control

Suggested Activities for Students:

- Prepare poster / model for National Energy Conservation Day
- Participate in solar panel cleaning & preventive maintenance workshop
- Make presentation on rooftop solar policy & subsidies

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