GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree – Energy Engineering
Subject Code : N117AP01
BE Semester – 7 (w.e.f. AY 2026-27)
Subject Name : Wind and Small Hydro Energy System

Prerequisite : Nil

Rationale : Principles of sustainability and renewable energy conversion with emphasis on wind and small hydrokinetic energy resources are equally important to complement courses on solar energy conversion, hydrogen and nuclear energy.

Teaching and Examination Scheme :

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	0	30	0	100

Content :

Sr. No.	Content	Total Hrs.
1	**Fundamentals of wind energy :** Wind generation, wind characteristics: speed, direction, shear, gust and turbulence, wind power estimation.	3
2	**Wind measurements, analysis and energy estimation :** Wind measurement basics, characterization of measurements and instrument characteristics, wind speed measuring instrumentation, wind mast, statistical analysis of wind data - Weibull distribution and Rayleigh distribution.	5
3	**Wind turbines :** Energy available from wind, basics of wind energy conversion system, wind turbines classification, HAWT and VAWT working principles, HAWT components, planning and development of a wind farm, offshore wind farms, wind pumps, wind energy potential and site selection, safety and environmental aspects, wind energy potential and installation in India.	8
4	**Aerodynamics of HAWT :** Airfoil terminology, airfoil behavior, effect of density, angle of attack and wind speed, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, relative velocity of wind, one-dimensional momentum theory and the Betz Limit, BEM theory, blade shape for ideal rotor without wake rotation, rotor performance using wind tunnel.	14
5	**Economics of wind energy :** Factors influencing the wind energy economics, The 'present worth' approach, cost of wind energy, yardsticks of economic merit.	5
6	**Small Hydro energy system :** Overview and analysis of small, mini and micro hydro turbines, site selection and civil works, penstocks and turbines, economical and electrical aspects of small, mini and micro hydro turbines, potential developments, design and reliability of small, mini and micro hydro turbines, case study.	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**40**	**20**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree – Energy Engineering
Subject Code : 117AP01
BE Semester – 7
Subject Name : Wind and Small Hydro Energy System

Note : This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books :

1. Wind Energy Explained – Theory, Design and Application, J. F. Manwell, J. G. McGowan and A. L. Rogers, John Wiley and Sons Ltd.
2. Wind Energy Conversion Systems, L. L. Freris, Prentice Hall.
3. Wind Energy Technology, J. F. Walker, John Wiley.
4. Aerodynamics of Wind turbines, Martin O. L. Hansen, Earthscan.
5. Micro-Hydro Design Manual: A Guide to Small-Scale Water Power Schemes, Adam Harvey, Intermediate Technology Publications.
6. Good and Bad of Mini Hydro Power, Roman Ritter.
7. Wind Energy Systems, G. L. Johnson, Prentice Hall.

Course Outcomes :

Sr. No.	CO statement	Marks % weightage
CO-1	To appraise basic principles of wind energy conversion, various wind parameter measuring instruments and to estimate potential of wind energy resource	18
CO-2	To appraise concept of aerodynamics geometry, design and performance of HWAT and concepts of VAWT	48
CO-3	To make calculations of the economics of wind energy system.	12
CO-4	To appraise small hydro system components and design, hybrid systems and controls.	22

List of Experiments :

1. Wind measurement for a month and statistical analysis of wind data.
2. To study the construction and working of various type of HAWT.
3. To study the construction and working of various type of VAWT.
4. To study the wind farm planning and development.
5. Programming for HAWT rotor design using Python.
6. Case study on wind energy economics.
7. To study and design of small hydro turbine.
8. To study and design of mini and micro hydro turbines.
9. To prepare a report on wind energy potential and installation in India.
10. To visit a wind farm and small hydro power energy system and to prepare reports of the same.

Major Equipment :

Digital anemometer, Computer workstation, Models of wind power plant, PAT set up

Open-source Software/learning website :

1. http://ocw.mit.edu/courses/energy-courses/
2. https://nptel.ac.in/courses/108105058/24

* * * * * * *