

GUJARAT TECHNOLOGICAL UNIVERSITY

ENERGY ENGINEERING (39)

WIND AND SMALL HYDRO ENERGY SYSTEM

SUBJECT CODE: 2723911

SEMESTER: II

Type of course: Renewable Energy Engineering

Prerequisite: Basic knowledge of Renewable Energy

Rationale: The course provides basic understanding of wind and small Hydro along with Hybrid energy systems

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2 [#]	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
Module I			
1.	Wind Energy Fundamentals Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence.	5	10%
2.	Wind Measurements, Analysis and Energy Estimates Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis	6	15%
3.	Aerodynamics Theory Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads.	6	15%
4.	Wind Turbine Generation System Wind turbines types, Description and performance of the horizontal-axis wind machines, Description and performance of the vertical-axis wind machines, Direct drive and Gear coupled Generator Wind turbine, Modern Wind Turbine and concept of wind farm and Micro-siting, Environmental concerns	14	30%
Module II			
5.	Small Hydro Energy system Introduction – Overview and Analysis of Small, mini and micro hydro turbines – Site selection and civil works, Penstocks and turbines, Speed	14	30%

	and voltage regulation , 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. Wind and hydro based stand-alone / hybrid power systems		
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Reference Books:

1. Freris, L. L., Wind Energy Conversion Systems, Prentice Hall, 1990.
2. Spera, D. A., Wind Turbine Technology: Fundamental concepts of wind turbine engineering, ASME, 2009.
3. Johnson, G. L., Wind Energy Systems, Prentice Hall, 1985.
4. Walker, J. F., Wind Energy Technology, John Wiley, 1997.
5. Anna Mani : Wind Energy Resource Survey India-Volume 1-4, Allied Publisher Limited, 1995.
6. B.H.Khan: Non-Conventional Energy Resources, Tata McGraw-Hill, 2006
7. Manwell, J. F., McGowan, J. G and Rogers, A. L., Wind Energy Explained – Theory, Design and Application by, John Wiley & Sons, Ltd., 2010
8. Aerodynamics of Wind turbines by Martin O. L. Hansen, Earthscan, 2008.
9. Micro-Hydro Design Manual: A Guide to Small-Scale Water Power Schemes by Adam Harvey, Intermediate Technology Publications, 1993.
10. Good & Bad of Mini Hydro Power edited by Roman Ritter, 2009

Course Outcome: After learning the course the students should be able:

1. Explain basic principles of wind energy conversion
2. Measure and Estimate potential of wind energy resource
3. Understand basic concepts of aerodynamics, horizontal and vertical axis wind turbines,
4. Understand small hydro system components and design, hybrid systems and controls
5. Assess the effect of wind Turbine Generation on the environment

List of Open Source Software/learning website:

[www.nptel.iitm.ac.in/courses/;](http://www.nptel.iitm.ac.in/courses/)

<http://ocw.mit.edu/courses/energy-courses/>

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.