

Course title: Wind, small hydro and RE hybrid systems				
Course code: ENR 152		No. of credits: 2	L-T-P: 24-6-0	Learning hours: 30
Pre-requisite course code and title (if any): NA				
Department: Department Energy and Environment				
Course coordinator: Dr. Naqui Anwer			Course instructor: Dr. Naqui Anwer / Dr. Aviruch Bhatia	
Contact details: naqui.anwer@terisas.ac.in				
Course type: Core			Course offered in: Semester 2	
Course description				
<p>This course on wind, small hydro and RE hybrid systems introduces technologies and related engineering associated with implementation of onshore and offshore wind farms with modern wind turbines from an applied industry and project implementation perspective. Small hydro, micro-hydro RE hybrid projects are also discussed. The course intends to provide the students with a high level of practical understanding of these technologies and projects.</p>				
Course objective				
<ul style="list-style-type: none"> ▪ To impart practical knowledge and insights on implementation of wind projects with modern wind turbines ▪ To understand the functioning of small hydro projects ▪ To impart knowledge on design, system integration and planning of RE hybrid systems. 				
Course contents				
Module	Topic	L	T	P
1	Wind technologies Modern wind turbine, is working, trends in evolution and worldwide development Different types of wind turbines Transport, logistics, assembly and installation of wind turbines Offshore wind turbines Considerations in offshore Wind turbine manufacturing Grid connection	10	2	0
2	RE hybrid systems Wind and Solar hybrids, considerations on design and optimization. Different types of hybrids. Different configurations. Design of Wind-Solar Parks Repowering	6	2	0
3	Small hydro & micro hydro General description classification of schemes, siting and economic considerations, system components: weir/intake, channel, desilting, forebay, spillway, penstock, turbine – Impulse and Reaction, generator, governor, control. Different types of small hydro projects	8	2	0
	Total	24	6	0
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Assignments: (after completion of module 2) - 20% ▪ Written Test 1: (after completion of module 1) - 15% ▪ Written Test 2: (after completion of module 2) - 15% ▪ Written Test 3: (at the end of the semester after completion of modules 3) - 50% 				
Learning outcomes				

On successful completion of this course the students will be able to:

- Calculate renewable energy potentials (Test 1)
- Translate theories into practice (Test 2)
- Do financial analysis of renewable energy projects. (Test 3)

Pedagogical approach

A combination of class-room interactions, tutorials, field visits, assignments and projects.

Materials

Recommended readings

Text Books

VVN Kishore, “**Renewable Energy Engineering and Technology – A Knowledge Compendium**” ed. (TERI Press, 2008)

Reference Books

Paul Gipe, “**Wind energy basics: A guide to small and micro wind**”, Chelsea Green Publishing, 2008)
Adam Harvey, Andy Brown and Priyantha Hettiarachi: **Micro-Hydro Design Manual: A Guide to Small-scale water power schemes** (ITDC Publishing, 1993)
Godfrey Boyle, “**Renewable Energy**” (Atlantic Publishing Company, 2008)
Hnologien, “GATE”, 1988

Additional information (if any):NA

Student responsibilities

Attendance, feedback, discipline: as per university rules.

Course Reviewers

1. Sanjay Chaturvedi, COO, Sembcorp
2. Dr. V V N Kishore, Retired Professor from TERI, Pune