

<b>Course title:</b> Wind, small hydro and RE hybrid systems				
<b>Course code:</b> ENR 152		<b>No. of credits:</b> 2	<b>L-T-P:</b> 22-6-0	<b>Learning hours:</b> 28
<b>Pre-requisite course code and title (if any):</b> NA				
<b>Department:</b> Department Energy and Environment				
<b>Course coordinator:</b> Dr. Naqui Anwer			<b>Course instructor:</b> Dr. Naqui Anwer/ Dr Aviruch Bhatia	
<b>Contact details:</b> naqui.anwer@terisas.ac.in				
<b>Course type:</b> Core			<b>Course offered in:</b> Semester 2	
<b>Course description</b>				
<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>				
<b>Course objective</b>				
<ul style="list-style-type: none"> <li>▪ To impart practical knowledge and insights on implementation of wind projects with modern wind turbines</li> <li>▪ To understand the functioning of small hydro projects</li> <li>▪ To impart knowledge on design, system integration and planning of RE hybrid systems.</li> </ul>				
<b>Course contents</b>				
<b>Module</b>	<b>Topic</b>	<b>L</b>	<b>T</b>	<b>P</b>
1	<b>Wind technologies</b>	10	2	0
	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				
2	<b>RE hybrid systems</b>	5	2	0
	Wind and Solar hybrids, considerations on design and optimization. Different types of hybrids.			
	Design of Wind-Solar Parks			
Repowering				
3	<b>Small hydro &amp; micro hydro</b>	7	2	0
	General description classification of schemes, siting and economic considerations, system components: weir/intake, channel, desilting, forebay, spillway, penstock, turbine, generator, governor, control.			
	Different types of small hydro projects			
	<b>Total</b>	<b>22</b>	<b>6</b>	<b>0</b>
<b>Evaluation criteria</b>				
<ul style="list-style-type: none"> <li>▪ Assignments: 20%</li> <li>▪ Two Minor tests: 15% (each)</li> <li>▪ Major exam: 50%</li> </ul>				
<b>Learning outcomes</b>				
<p>On successful completion of this course the students will be able to:</p> <ul style="list-style-type: none"> <li>▪ Calculate renewable energy potentials</li> <li>▪ Translate theories into practice</li> <li>▪ Do financial analysis of renewable energy projects.</li> </ul>				

**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 Mannual: 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