Course title: Wind, biomass, and other renewable technologies								
Course code: ENR 164	No. of credits: 3	L-T-P: 45-0-0	Learning hours: 45					
Pre-requisite course code and title (if any): NA								
Department: Sustainable Engineering								
Course coordinator: Prof. Naqui Anwer	Course ins	Course instructor(s): Prof. Naqui Anwer/						
_	Dr Sapan T	Chapar						
Contact details: naqui.anwer@terisas.ac.in								
Course type: Core	Course off	ered in: Semester 2						

Course description

This course is designed to make the students conversant mainly with various Biomasses to energy and Wind technologies. Other RE technologies, such as geothermal energy, tidal energy, wave energy and ocean thermal energy conversion will also be covered. The main topics covered are: biomass conversion technologies (both thermo-chemical and bio-chemical methods of conversion) and liquid bio fuels. Basic principles of the technologies, experience gained on the ground, levels of commercialization, challenges of integrating with conventional energy/power system are covered.

Course objectives

- To develop understanding the various route to generate energy from biomass and other renewable resources
- To calculate energy production potential; energy content in various resources.
- To identify challenges and strength of various energy convention technologies

Course contents

Module Topic		L	T	P
1. Wind techno	ologies	16	0	0
Trends in de principles, to Offshore wi turbines, flo Wind turbine Transport, le turbines	pes of wind turbines, evelopment of wind turbines, Modern wind turbine, working rends in evolution and worldwidedevelopment and turbines, onshore vs offshore wind wating wind turbines e manufacturing ogistics, assembly and installation of wind of power produced to grid transport			
2. Biomass Tec	chnology:			
biomass, be combustion, biomass, bio draft), down gasifier ther	emical conversion: Thermo-chemical conversion of piomass processing, briquetting, pelletisation, biomass, biomass stoves, biomass carbonization, pyrolysis of pmass gasification, gasifiers: [updraft (forced draft & Natural andraft (Open core, throat type & modular)], Gasifier stoves, rmal applications, gasifier for engine applications: dual fuel as mode operation, power generation systems: (decentralized, ive).	8	0	0
Bio-chemics sludge processing designs of be Liquid Bio preprocessing fuels, produ	cal conversion: Aerobic and anaerobic processes, activated dess, plug flow reactors, anaerobic fixed film reactor, UASB derobic fluidized bed reactor, estimation of methane yield, digestion system for MSW, Vermi-composting, different biogas plants for animal waste, Biogas for engine applications. Fuels: Liquid biofuels, non-edible oilseeds, oil extraction, and, transesterification, biodiesel, characterization of liquid action of syngas from biomass, production of methanol from duction of ethanol from ligno-cellulosic biomass, Liquid bio-	6		

	Other Renewable Energy Technologies			
3.	Geothermal technology, wave energy, tidal energy, ocean thermal energy, Considerations for power and heat generation, Status of commercialization Examples of operational projects and challenges Challenges of integrating renewable energy with conventional energy/power system	7	0	0
		45	0	0

Evaluation criteria

• Assignments: 20% (after Module 1 and 3 and 5)

Minor test 1: 15% (after Module 1)
Minor test 2: 15% (after Module 2)
Major test: 50% (after all module)

Learning outcomes

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

- Calculate Bioenergy and Other Renewable Energy potentials (Test 1, 2)
- Identify the best solution (Test 2, 3 and assignments)
- Quantify the amount of Energy produced (Test 2,3)
- Translate theories into practice (Assignments)

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

Donald Klass, "Biomass for Renewable Energy, Fuels, and Chemicals", (Entech International Inc., USA)

Godfrey Boyle, "Renewable Energy", (Atlantic Publishing Company, 2008)

Thomas Read & Agua Das, "Handbook of biomass downdraft gasifier engine systems" (The Biomass Energy Foundation Press, 1988)

Klaus von Mitzlaff, "Engines for Biogas – Theory, Modification, Economic O peration" (Deutsche Gesellschaft für Entwicklungstechnologien GATE, 1988)

Additional information (if any):NA

Student responsibilities

Attendance, feedback, discipline: as per university rules.

Course Reviewers

- 1. Prof. S. Maji, Department of Mechanical Engineering, SOET, IGNOU, New Delhi
- 2. Dr Oruganty Prasada Rao, Scientist, CSIR (Retired)