

Course title: Biofuels and decentralized energy systems				
Course code: ENR 163		No. of credits: 3	L-T-P: 28-17-0	Learning hours: 45
Pre-requisite course code and title (if any): NA				
Department: Sustainable Engineering				
Course coordinator: Dr. Lakshmi Raghupathy			Course instructor: Dr. Lakshmi Raghupathy	
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Course type: Elective			Course offered in: Semester 3	
Course description				
<p>The aim of this elective course is to make the students understand and appreciate the importance and pivotal role of biofuels in general and in the context of environmental constraints and strategy of attaining energy security, access and independence in India. The idea is to introduce traditional and modern energy use; rural energy databases; rural energy planning and integration with other developmental activities; outline of energy resources; the feed stocks and technologies for production of biofuels. Several case studies will be presented along with experiences from industries/NGOs to acquaint the students with the practical issues around biofuels</p>				
Course objectives				
<p>The objective of the course is to train the students:</p> <ul style="list-style-type: none"> ▪ To analyze Rural Energy Database for development activities ▪ To perform financial estimations of the biofuel projects ▪ To get insight of the various biofuel technologies 				
Course contents				
Module	Topic	L	T	P
1	Advance material and energy balance.	4	3	0
2	Traditional and modern energy use; Methods of accounting the role of traditional energy in the overall energy system. Energy consumption patterns in rural areas.	3	3	0
3	Need and development of rural energy data bases (REDB); Case studies of REDB	3	0	0
4	Energy access in rural India, access to clean energy: power and cook stove; rural industries and social development	2	2	0
5	Use of efficient/appropriate/renewable energy technologies for rural areas. Technologies/products for cooking, water heating, drying, irrigation pumping, small/micro enterprises, lighting, motive power etc.	1	1	0
6	Syngas and poly-generation, chemical conversion of syngas to methanol and ethanol and some advanced fuels like bio butanol, bio propanol.	2	2	0
7	Bio CNG: biogas to green vehicle fuel; anaerobic digestion; Biogas opportunities: Landfill gas, agricultural and industrial wastewater and additional sources of methane	2	2	0

8	Bioethanol: First and second generation ethanol; production technologies World scenario; challenges and some solutions.	2	2	0
9	Biodiesel: Feedstock for biodiesel, manufacturing processes for biodiesel, biodiesel blending and technological challenges towards use in automotive, emission norms, value addition by utilization of by products, Environmental impacts of biodiesel, biodiesel from algae, biodiesel engines	4	1	0
10	Pyrolysis oil: fast pyrolysis technologies; composition and issues of bio-oil; Bio-oil up gradation technologies	1	1	0
11	Case study: International success stories and failures	4	0	0
		28	17	0
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Assignments: 20% (During Module 1, 4, 5, 8 and 9) ▪ Written Test 1: 15% (after Module 3) ▪ Written Test 2: 15% (after Module 7) ▪ Written Test 3: 50% (after Module 11) 				
Learning outcomes:				
On successful completion of this course the students will be able to:				
<ul style="list-style-type: none"> ▪ Create rural energy database (Assignment and Test 1) ▪ Interpreted big data (Assignment 1 and Test 1) ▪ Design biofuel plant (Test 2, 3) ▪ Critically analyse biofuel cases (Test 2,3) 				
Pedagogical approach				
A combination of class-room interactions, tutorials, field visits, assignments and projects.				
Reference Books				
<p>Donald Klass: Biomass for Renewable Energy, Fuels, and Chemicals, (Entech International Inc., USA)TERI/ASTRA Publication</p> <p>Biofuels engineering process technology, Caye Dapcho, John Nghiem, Tata McGraw Hill Biofuels, Wim Soetaert, Erik Vandamme, John Wiley & Sons</p> <p>An Assessment of the Biofuels Industry in India, Prepared by Joseph B. Gonsalves United Nations Conference on Trade and Development</p>				
Additional information (if any): Reference materials and handouts will be shared in the class.				
Student responsibilities				
Attendance, feedback, discipline: as per university rules.				

Course Reviewers

1. Dr. Veena Joshi, former Director, Energy and Environment, Swiss Development Cooperation, Delhi
2. Dr. SN Srinivas, UNDP, Delhi
3. Dr. P. Basu, Dalhousie University, Canada