

GUJARAT TECHNOLOGICAL UNIVERSITY

ENERGY ENGINEERING (39) BIOMASS ENERGY CONVERSION SUBJECT CODE: 2743901 M.E. 4TH SEMESTER

Type of course: Elective

Prerequisite: Energy Resource, Economics and Environment .

Rationale: The course is designed to give fundamental knowledge and relevant technologies for Biomass energy extraction and its conversion.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits C | Examination Marks | | | | | | Total Marks |
|-----------------|----|---|--------------|-------------------|---------|-----------------|--------|----|----|----------------|
| L | T | P | | Theory Marks | | Practical Marks | | | | |
| | | | ESE (E) | PA (M) | ESE (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 |
|---------|---|-----------|-------------|
| 1 | Biomass Biomass resources, Classification, Availability, Agricultural and Forest residue, Aquatic and Marine biomass, consumption, surplus biomass, energy plantation, Photosynthesis of Biomass and its conversion related properties, composition and analysis, Moisture content, ash content, organic content, Physical Conversion process of Biomass, dewatering, drying, size reduction, densification, briquetting. | 9 | 20 |
| 2 | Biomass Conversion Process Basic principle of Direct combustion process, Pyrolysis and heat of combustion of biomass and its component, Basic Principle of Thermochemical Conversion , Gasification of biomass, types of gasification technologies (Fixed bed, fluidized bed, entrained bed), Governing equations, Liquefaction of biomass, Types of liquefaction technologies and governing equations | 18 | 40 |
| 3 | Biochemical Conversion Process Basic principle of biomass conversion in Anaerobic digestion and Methanogenesis , Stages of Fermentation, the methanogens, the fermentative bacteria, Biomass conversion to methane, design and construction of small scale biogas plant, various substrates used to produce Biogas (cow dung, human and other agricultural waste, municipal waste etc.) Individual and community biogas operated engines and their use. Removal of CO ₂ and H ₂ O, Application of Biogas in domestic, industry and vehicles. Basic principle of ethanol fermentation, process description, feedstock preparation, ethanol fermentation and recovery, conversion efficiency, Ethanol as a fuel for I.C. engines | 18 | 40 |

Reference Books:

1. Rai G D, Non-Conventional Energy Sources, Khanna Publishers, 2011
2. Samir S Sofer and Oskar R Zaborsky, Biomass conversion process for energy and fuels, Springer Science & Business Media, 06-Dec-2012.
3. Donald L. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, 1998.
4. A.A. Vertès, N Qureshi, H Yukawa, "Biomass to biofuels: strategies for global industries", John Wiley and Sons, 2009
5. David M. Mousdale, Introduction to Biofuels, CRC Press, 2010
6. Nijaguna B T, Biogas Technology, New Age International Publisher, 2002

Course Outcome:

After learning the course the students should be able to:

1. To understand bio conversion and biogas generation technology
2. To design biogas digester system
3. To develop thermal gasification system
4. To evaluate biomass as a source of energy

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.