# BTOE 002: BIO-FUEL TECHNOLOGY AND ENGINEERING

**Course Objective:**

- To understanding about the basic technology underlying the production of biofuels, and their utility for a spectrum of domestic and industrial applications..

Credits: 03 L-T-P-J: 3-0-0-0

| Module No. | Course Content | Teaching Hours/ Percentage |
|---|---|---|
| I | Biomass Sources, Characteristics and Preparation: Biomass Sources and classification. - Chemical composition and properties of different biomass materials and bio-fuels – Sugar cane molasses and other sources for fermentation ethanol-Sources and processing of oils and fats for liquid fuels- Energy plantations -Preparation of woody biomass: Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass. Pyrolysis and Gasification of Biomass: Thermo-chemical conversion of ligno- cellulose biomass - Biomass processing for liquid fuel production - Pyrolysis of biomass – Pyrolysis regime, effect of particle size, temperature and products obtained. Thermo-chemical gasification principles: Effect of pressure, temperature and of introducing steam and oxygen. Clean Coal Technology: Biotechnology and Microbiology of Coal Degradation – Aerobic and Anaerobic pathway of coal degradation- Characterisation/identification of bioconversion substrates and products – Biosolubilization and bioliquefaction of coal- Biodesulfurisation of coal and oil- Mechanisms of coal biosolubilization- Enzymes that depolymerise coal – Recent Advances in Bioprocessing of coal. | **10//25%** |
| II | Biogas, Technology: Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues. Microbial and biochemical aspectsOperating parameters for biogas production. Kinetics and mechanism - Dry and wet fermentation. Digesters for rural application - High rate digesters for industrial waste water treatment. KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes – development in energy routes. Bio-Ethanol and Bio-Diesel Technology: Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for | **10//25%** |

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|---|---|---|
| | Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel. | |
| **III** | Green Technology – Microbial Fuel Cell: Types of Biological fuel cells – Working Principle - Applications of biological Fuel cells. A brief study of the principle, construction of different types of fuel cells. Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants | **10/25%** |
| **IV** | Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems: Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration. | **10/25%** |

## Text Books/ Reference Books:


- Chakravarthy A, Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes, Oxford and IBH publishing Co, 1989.
- Yogi Goswami D, Frank Kreith and Jan. F .Kreider, Principles of Solar Engineering, 2nd Edition, Taylor and Francis, 2000, Indian reprint, 2003.
- Mital K.M, Biogas Systems: Principles and Applications, New Age International publishers (P) Ltd., 1964.
- Nijaguna, B.T, Biogas Technology, New Age International publishers (P) Ltd., 2002.
- Venkata Ramana P and Srinivas S.N, Biomass Energy Systems, Tata Energy Research Institute, 1996.
- Rezaiyan. J and N. P. Cheremisinoff, Gasification Technologies, A Primer for Engineers and Scientists, Taylor and Francis, 2005


## Course Outcome:

CO1: To develop alternate energy routes, particularly biomass energy routes for overcoming the existing energy crisis.

CO2: To design and construct biomass to energy conversion systems, which is a promising area in green energy technology.

CO3: To demonstrate general knowledge and understanding of some of the basic facts, language, concepts and principles relating to plants, in particular the composition and properties of plants and the different ways in which

plant products have been utilised by humans

CO4: To demonstrate an understanding of the contribution that science can make to informed debate on issues arising from the use of plants and the threats posed to plants and their habitats

CO5: To make sense of information presented in different ways, including textual, numerical, graphical, multimedia and web-based material

## MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

| | Program Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **H** | **H** | **H** | **L** | **H** | **L** | **H** | | | | **H** | **H** |
| **CO2** | **H** | **H** | **H** | **L** | **H** | **M** | **H** | | | | **H** | **H** |
| **CO3** | **L** | | **L** | | **L** | **M** | | **L** | | **L** | | **M** |
| **CO4** | | **M** | **L** | **M** | **L** | | | | **M** | **L** | | **L** |
| **CO5** | | **H** | **L** | | | **M** | | **L** | | | **L** | **H** |

**H = Highly Related; M = Medium; L = Low**