Course Code ESE-801	Credit Hours (Th-Pr) 3-0	**Biofuel Engineering (core)**	Contact Hrs/Week (Th) 3-0	Total Contact Hrs (Th) 45-0

Course Outline:

Process Dynamics & Machinery

Biodiesel Technologies & Regulatory Issues

Biodiesel Process Analysis

Ethanol Process Fundamentals

Ethanol Separation Technology

Eligibility Criteria: B.E (Chemical, Mechanical, Electrical, Environmental and Materials)

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Biofuels Engineering Process Technology	Caye M. Dramcho, Nighiem Phu Nhuan, Terry H. Walker	CM	Text
2.	Chemical Process Engineering Design and Economics	Harry Sila	HC	Reference
3.	Standard Hand book for mechanical Engineering	George F. Baumiester	GF	Reference

Course Objectives:

The primary objectives of this course are to familiarize students with practical applications of the principles of Bio-fuel processes and engineering pertaining to production of biofuels i.e. Biodiesel and Ethanol.

Learning outcome:

The course will provide an intense treatment in bio-fuel production technologies, the students will be able to appreciate the design concepts of plant & machinery involved in the production chain i-e Crude production, bio-refining and characterization.

Topics Covered:

No.	Topics	Text Book	Contact Hours
1.	**Process Machinery:** This course will provide knowledge of machinery commonly found in a process facility such as pumps, valves, heat exchangers, cooling towers, centrifuges, compressors, thermal oxidizers, distillation towers, compressors, refrigeration principles and boiler systems. Startup, shutdown, operation and troubleshooting of each of these mechanical systems will be explained.	CM +GF	6
2.	**Instrumentation and Control:** .Study in details P& ID terminologies with applied applications. PFDs will be used to examine the sequence of operation, including residence time, pressures, and temperature seen in various stages of production.	CM	6
3.	**Process Dynamics:** Cover in details about major chemical process separations units, apply appropriate criteria for selecting among alternative separation technologies. Complete design calculations for equilibrium staged separation processes(e.g distillation, absorption, solvent extraction). Applying mass transfer fundamentals to calculate rates of mass transfer for practical situations and to identify rate limiting processes.	CM+HC	6
4.	**Biodiesel Technologies and Regulatory Issues:** Investigates the underlying research and reaction processes that are used to produce biodiesel. Studying feedstock options coupled with past and present technologies provides	CM	6

	foundational knowledge about the industry. The course includes an in-depth review of the ASTM Standards for biodiesel and the regularity issues that can arise from non compliance.		
5.	**Biodiesel Processes Analysis:** Provides detailed information regarding the overall process of biodiesel production. The course will include a review of biodiesel chemistry, process engineering, post reaction processing, fuel specification and properties, feedstock preparation, treatment and recovery of side streams, fuel transportation storage and general plant operations.	CM	6
6.	**Ethanol Process and Separation Technology:** Covers in detail the overall fundamentals process of ethanol production. A process flow Diagram (PFD) of a typical ethanol plant will be used to examine the sequence of operation, including residence time, pressures, and the temperatures seen in various stages of production. This course will explain the rationale for feedstock and additives used in ethanol processing as well as product and co-product production and use. Covers the basic principles of ethanol distillation, evaporation, and dehydration. Included will be an understanding of the operating components in a distillation system ;demonstrable familiarity with startup, cleaning operating, and shutdown procedures; and the ability and its role in processing plants will also be converted as well as the theory of the molecular sieve dehydration and how it is used in the ethanol process.	CM	8
7.	**Reaction Kinetics and Reactor Design:** Covers in details the kinetic data, determination of rate laws, analysis of complex reaction networks and design of ideal isothermal reactors.. Analyze data for heterogeneous catalytic reactions. Design reactor systems for given synthesis with special emphasis on trans-esterification and biofermentation	CM+ HC	7

	Bio fuel Engineering experiments for thesis: • Perform an experiment using NaOH and KOH as a catalyst with ethanol & methanol separately. • Assignment: Write the mass balance of a continuous transesterification process for production of crude biodiesel from 250,000 kg/h rapeseed oil reacted with 75,000 kg/h ethanol and 250 kg/h potassium hydroxide with 1 h residence time. Determine the production yield of biodiesel assuming 95 percent conversion rate making use of: a. Microsoft Excel or similar spreadsheet to compute the mass balance for each stream. • Separation of bio diesel and its bio products with the help of oil test centrifuge • Calculate the % age of the water contents in the bio diesel sample • Observe the flash point of bio diesel prepared in the lab using Flash point apparatus. • Characterization of bio diesel (GC, HPLC, Bomb calorimeter, cetane no, viscosity, sulphur & carbon residues etc)		