

Course Type	Course Code	Name of the course	L	T	P	Credits
DE	NFMD510	Biofuels	3	0	0	3

Prerequisites: Knowledge of polymer science, organic chemistry, and simple mass and energy balances.

Course Objective
The main aim of the course is to • Give detailed information about the processing and utilization of biofuels. • Different bioresources, green liquid and gaseous fuel productions.
Learning Outcomes
At the end of this course, students will be able to • Analyse different types of biofuel processing and characterizations. • Biofuel production methods, current technologies, potential challenges

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Introduction and perspective of biofuels: Fossil versus renewable energy, resources, economic impact of biofuels, Comparison of Bio-energy Sources, Bio-refinery, biofuel production and applications, alternative energies, environmental impact of biofuel, Fuel Ratings.	6	Knowledge on basics of biomass and coal classifications
2.	Harvesting Energy from Biochemical Reaction: Biochemical Pathways for various metabolic processes, chemical oxygen demand and biological oxygen demand Biochemistry of Bioethanol production. Biomass preprocessing: drying, size reduction, and densification. Biofuel Feedstocks and production of biofuel: Various types of feedstocks, starch feedstocks, sugar feedstocks, lignocellulosic feedstocks, plant oils and animal fats, miscellaneous feedstocks	6	Advanced knowledge in characterization techniques especially thermal analysis, organic characterization techniques
3.	Bioenergy from biomass as source of alternative energy: Ethanol production from sugar and starch feedstock ethanol production from lignocellulosic feedstocks, fermentation process and types of fermenters. Wet milling of grain for alcohol production, grain dry milling cooking for alcohol production, use of cellulosic feedstocks for alcohol production chemistry of biodiesel production Biodiesel production by using various microorganisms, algae and Transesterification	9	Advanced knowledge in the thermochemical conversion process of biomass, including gasification, pyrolysis, combustion

	process, Chemistry of biodiesel production, oil Sources and production by plants and other sources, methods of biodiesel production.		
4.	Production of Hydrogen: Hydrogen production from biomass through pyrolysis, gasification, SMR, etc, Hydrogen Production by Fermentation various metabolic processes for hydrogen production, and Bioreactor Design for Biofuel Production. Fermentation process, various types of fermenters, bioreactor operation and design.	9	Advanced knowledge in thermochemical processes including fast pyrolysis, reaction mechanism of fast pyrolysis hydrothermal
5.	Microbial Fuel Cells and its role in energy production: Microbiology of methane production, biomass sources for methane production, biogas composition and use, biochemical basis of fuel cell design, Global warming and its environmental impact. Introduction to global warming, global warming factors, geo-chemical cycles, carbon-nitrogen and hydrogen cycles	6	Advanced knowledge of different applications of coal and biomass as soil ameliorant, waste water treatment, etc.
6.	Environmental impacts: Environmental impacts of biofuel production, Energy balance and life-cycle analysis of biofuel production, Value-added processing of biofuel residues and co-products	6	Advanced knowledge of biomass uses for small power plants
Total		42	

Text Books:

1. Drapcho, Caye M., Nghiem Phu Nhuan, and Terry H. Walker. Biofuels engineering process technology. New York: McGraw-Hill, 2008.

Reference Books:

1. Anju Dahiya, Bioenergy: Biomass to Biofuels.
2. Yebo Li, Samir Kumar Khanal, Bioenergy: Principles and Applications, Wiley, 2016,
3. Butterworth-Heinemann, Product Recovery in Bioprocess Technology, Elsevier