

Course Type	Course Code	Name of Course	L	T	P	Credits
DE	NFMD512	Thermochemical Conversion of Solid Fuels	3	0	0	3

Prerequisites: Knowledge of polymer science, organic chemistry, fundamentals of physics, integral and differential calculus.

Course Objective
The main aim of the course is to • Give detailed information about the utilization potential of Biomass and Coal, • Their Conversion technologies, applications and challenges in various industries.
Learning Outcomes
At the end of this course, students will have the knowledge of • conversion technologies of coal and biomass to various products • characterization of obtained product and their properties • applications to various industries

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to Bioenergy; Biomass harvesting; Availability; Refuse Derived Fuel; Classification of biomass feedstock: First, second and third generation biofuels. Classification of coal, Assessment of coal and biomass for thermochemical conversion processes.	7	Students will get an overview of coal and biomass potentials.
2	Characterization of feedstocks; Physicochemical properties, Ultimate and Proximate analysis, Compositional analysis, Calorific value; Thermal analysis of organic and inorganic composition of Coal and Biomass by Thermogravimetric Analysis (TGA), Derivative Thermogravimetry (DTG), Differential Scanning Calorimetry (DSC), differential thermal analysis (DTA), Ash Fusion Temperature.	9	Students will learn various characterization techniques for coal and biomass for their applicability to various technologies.
3	Biomass compaction (briquetting and pelletization); Biofuel quality up-gradation; Coal and Biomass blends; Fuel and emission quality norms. Thermochemical Processes (combustion, gasification, pyrolysis, partial oxidation, auto-thermal reforming). Technologies for the production of biofuels like bio-char, synthesis gas, bio-hydrogen, ethanol, butanol, biogas, methanol, dimethyl ether and paraffinic fuels, etc.	9	This will provide an overview of various conversion Technologies for Coal and Biomass followed by their by-products and its up gradation.

4	Biomass-fueled combustion devices for cooking and heating applications. Utilization of biomass in external combustion engines including steam turbine power plant and Gas turbine, Integrated Gasification Combined Cycle (IGCC);	9	This will provide the information about utilization of products in Thermal and metallurgical Purposes.
5	soil ameliorant, wastewater treatment, Carbon sequestration, and reducing agent for the metallurgical purpose. Case studies for setting up biomass-based small power plant (~ 1MW) capacity for rural electrification, Briquette making plants, Gasification industries, analysis of carbon neutral and carbon credit.	8	Different case studies of product Utilization.
Total		42	

Text Books:

1. Jay J. C., Biomass to Renewable Energy Processes, Taylor and Francis, CRC Press, 2018
2. Konur O., Bioenergy and Biofuels, Taylor and Francis, CRC Press, 2018

Reference Books:

1. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction Practical Design and Theory Book Third Edition 2018
2. G.Tchobanoglous, H.Theisen, S.V.Tchobanoglous, G.Theisen, H.V.Samuel, Integrated Solid Waste Management: Engineering Principles and Management issues, New York, McGraw Hill, 1993.
3. Mukunda, H. S., Understanding Clean Energy and Fuels from Biomass, Wiley India, 2011
4. Coal Gasification and Its Applications, David Bell Brian Towler Maohong Fan, 1st Edition November 2010