

Biomass and Biofuels Engineering

1.1 Course Number: CH302

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 3rd Year-Odd

1.4 Prerequisite: Nil

1.5 Syllabus Committee Member: Dr Rakesh Kumar, Dr G K Agrahari

2. Objective: This course will provide an overview of existing energy utilization, production and infrastructure. In the course biomass characterization and conversion into biofuels with various methods will be discussed. The importance of biofuel development to replace the fossil fuels will be emphasized.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction to biomass	World energy outlook, Biomass availability & potential, Traditional biomass and energy crops	13
	Biomass Chemistry	Biomass Characterization, Organic Chemistry (structure formulas and nomenclature), Structure of Wood, Carbohydrate Chemistry, Lignin	
	Biomass Preprocessing and Pretreatment	Densification, Torrefaction, Hydrothermal Carbonization	
2	Biomass Conversion to Liquid Fuels	Biomass Pyrolysis, Gasification, and Hydrothermal Processing, Transesterification, Biochemical Conversion, Fisher-Tropsch Synthesis, Hydrogen Production	12
3	Biomass and Biofuel Utilization	Combustion, Co-firing, Biomass Gasification Combined Cycle, Fuel Cell Technology	5
4	The Biorefinery Concept	Biorefinery Classification, Building Block Chemicals	10
	Life Cycle Analysis of Biofuels	Case studies of Hydrogen, Ethanol, Biodiesel, Gasoline Production	
Total			40

4. Readings

4.1 Text Books:

1. Mark Crocker (Ed.), 2010. Thermochemical Conversion of Biomass to Liquid Fuels and Chemicals. RSC Publishing
2. Donald L. Klass, 1998. Biomass for Renewable Energy, Fuels and Chemicals. Academic Press, San Diego, CA.

4.2 Reference Books:

1. Charles E. Wyman (Ed.), 1996. Handbook on Bioethanol: Production and Utilization. CRC Press, New York.
2. Robert C. Brown, 2003. Biorenewable Resources: Engineering New Products from Agriculture. Blackwell Publishing, Ames, IO.
3. Christopher Higman and Maarten van der Burgt, 2008. Gasification. Gulf Professional Publishing, Oxford, UK. 2nd edition.
4. Brigit Kamm, Patrick R. Gruber and Michael Kamm (Ed.), 2008. Biorefineries- Industrial Processes and Products: Status Quo and Future Directions, Vol. 1 & 2. Wiley-VCH, Weinheim, Germany.

5. **Outcome of the Course:** Students will learn various sources of biomass and their characterization. They will also learn the various methods for conversion of biomass into fuels.