Department of Biotechnology	LP: OE22201
~~B.E~~/B. Tech/~~M.E/M.Tech~~ : **B. Tech** Regulation: 2022 UG Specialisation : Except Biotechnology Sub. Code / Sub. Name : OE22201/ Biomass Conversion and Biorefinery Unit : I	Rev. No: 00 Date: 21.01.2025

Unit Syllabus: INTRODUCTION TO BIOMASS **9 hours**

Virgin biomass production and selection; Waste biomass; Dedicated energy crops; Annual crops; Perennial herbaceous crops; Short rotation woody crops; Oil crops and their biorefinery potential; Microalgae as feedstock for biofuels; Enhancing biomass properties for biofuels, Challenges in conversion.

OBJECTIVE: To provide an insight into biomass, their structure and composition.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Virgin biomass production and selection	T1 (91-136)	BB & LCD
2.	Waste biomass	T1 (137-158)	BB & LCD
3.	Dedicated energy crops	T4 (61-68)	BB & LCD
4.	Annual crops and Perennial herbaceous crops	T4 (69-72)	BB & LCD
5.	Short rotation woody crops	T4 (73-78)	BB & LCD
6.	Oil crops and their biorefinery potential	T4 (47-60)	BB & LCD
7.	Microalgae as feedstock for biofuels	T4 (79-90)	BB &LCD
8.	Enhancing biomass properties for biofuels	T3 (457-475)	BB & LCD
9.	Challenges in conversion	T1 (550-551)	BB & LCD
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 minutes

Sub. Code / Sub. Name : OE22201/ Biomass Conversion and Biorefinery
Unit : II

Unit Syllabus: BIOREFINERY AND BIOMASS PRE-TREATMENT 9 hours

Basic concept, types of biorefineries, biorefinery feedstocks and properties, economics; Barriers in lignocellulosic biomass conversion, pre- treatment technologies such as acid,alkali, autohydrolysis, hybrid methods, role of pre-treatment in the biorefinery concept.

OBJECTIVE: To understand various biomass pretreatment methods for effective biofuel production.

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Basic concept of biorefineries	T4 (3-15)	BB & LCD
11.	Types of biorefineries	T4 (15-26)	BB & LCD
12.	Biorefinery feedstocks and properties, economics	T3 (71-88)	BB & LCD
13.	Barriers in lignocellulosic biomass conversion,	T3 (261-291)	BB & LCD
14.	Pre-treatment technologies - acid	T4 (91-110)	BB & LCD
15.	Pre-treatment technologies - alkali	T4 (91-110)	BB & LCD
16.	Pre-treatment technologies - autohydrolysis	T4 (91-110)	BB & LCD
17.	Pre-treatment technologies - hybrid methods	T4 (91-110)	BB & LCD
18.	Role of pre-treatment in the biorefinery concept	T3 (213-231)	BB & LCD
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 mins

Sub. Code / Sub. Name : OE22201/ Biomass Conversion and Biorefinery
Unit : III

Unit Syllabus: CONVERSION PROCESSES 9 hours

Physical and Thermal Conversion Processes: Types, fundamentals, equipments and applications; thermal conversion products, commercial success stories; Microbial Conversion Process: Types, fundamentals, equipments and applications, products, commercial success stories.

OBJECTIVE: To study about various conversion technologies such as physical, chemical and microbial.

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Physical Conversion Processes: Types, fundamentals, equipment and applications	T1(159-175)	BB & LCD
20.	Physical Conversion Processes: Types, fundamentals, equipment and applications	T1(175-182)	BB & LCD
21.	Physical conversion: products, commercial success stories	T1(182-190)	BB & LCD
22.	Thermal Conversion Processes: Types, fundamentals, equipment and applications	T1 (191-224)	Video lecture & LCD
23.	Thermal Conversion Processes: Types, fundamentals, equipment and applications	T1 (225-240)	BB & LCD
24.	Thermal conversion: products, commercial success stories	T1 (271-280)	BB & LCD
25.	Microbial Conversion Process: Types, fundamentals, equipment and applications	T1 (445-456)	BB & LCD
26.	Microbial Conversion Process: Types, fundamentals, equipment and applications	T1 (457-470)	BB & LCD
27.	Microbial Conversion: products, commercial success stories.	T1 (470-482)	BB & LCD

Content beyond syllabus covered (if any): Nil

* Session duration: 50 mins

Sub. Code / Sub. Name : OE22201/ Biomass Conversion and Biorefinery
Unit : IV

Unit Syllabus: BIOFUELS **9 hours**

Biodiesel: Diesel from vegetable oils, microalgae and syngas; transesterification; FT process, catalysts; biodiesel purification, fuel properties; Biooil and Biochar: Factors affecting biooil, biochar production, fuel properties, biooil upgradation; Bioethanol and Biobutanol: Corn ethanol, lignocellulosic ethanol, microorganisms for fermentation, current industrial ethanol production technology

OBJECTIVE: To know about various products such as biofuels, platform chemicals, polymers etc.

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Biodiesel: Diesel from vegetable oils, transesterification; FT process, catalysts;	T3 (141-163)	BB & LCD
29.	Microalgae and syngas;	T3 (123-139)	GCR / BB & LCD
30.	Biodiesel purification, fuel properties;	T4 (205-234)	BB & LCD
31.	Biooil and Biochar: Factors affecting biooil, biochar production,	T2 (380-385)	BB & LCD
32.	Fuel properties, biooil upgradation	T2 (380-385)	BB & LCD
33.	Bioethanol and Biobutanol: Corn ethanol	T3 (185-198)	GCR / BB & LCD
34.	Bioethanol and Biobutanol: lignocellulosic ethanol,	T3 (261-291)	BB & LCD
35.	Microorganisms for fermentation,	T3 (293-310)	BB & LCD
36.	Current industrial ethanol production technology	T3 (311-330)	BB & LCD

Content beyond syllabus covered (if any): Nil

* Session duration: 50 mins

Sub. Code / Sub. Name : OE22201/ Biomass Conversion and Biorefinery

Unit : V

Unit Syllabus: INTEGRATED BIOREFINERY **9 hours**

Concept, corn/soybean/sugarcane biorefinery, lignocellulosic biorefinery, aquaculture and algal biorefinery, waste biorefinery, hybrid chemical and biological conversion processes, techno-economic evaluation, life-cycle assessment.

OBJECTIVE: To get knowledge on integrated biorefineries and type of biorefinery

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Concept - corn/soybean biorefinery	T4 (27-46)	GCR / BB & LCD
38.	Concept - sugarcane biorefinery	T4 (27-46)	BB & LCD
39.	Lignocellulosic biorefinery	T3 (261-291)	BB & LCD
40.	Aquaculture and algal biorefinery	R1 (95-115)	BB & LCD
41.	Waste biorefinery	T1 (137-151)	BB & LCD
42.	Hybrid chemical conversion processes	T1 (547-591)	GCR / BB & LCD
43.	Hybrid biological conversion processes	T1 (547-591)	BB & LCD
44.	Techno- economic evaluation	T2 (29-46)	BB & LCD
45.	Life-cycle assessment	T2 (29-46)	BB & LCD

Content beyond syllabus covered (if any): Nil

* Session duration: 50 mins

TEXT BOOKS:	
1.	Donald L. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, Elsevier, 2006.
2.	Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.
3.	A.A. Vertes, N. Qureshi, H.P. Blaschek, H. Yukawa (Eds.), Biomass to Biofuels: Strategies for Global Industries, Wiley, 2010.
4.	S. Yang, H.A. El-Enshasy, N. Thongchul (Eds.), Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuels, Chemicals and Polymers, Wiley, 2013.
5.	Shang-Tian Yang (Ed.), Bioprocessing for Value Added Products from Renewable Resources, Elsevier, 2007.
REFERENCE BOOKS:	
1.	Moheimani, N. R, Boer M. P. M. K, Parisa A, and Bahri, "Biofuel and Biorefinery Technologies", Volume 2, Springer, 2015.
2.	Eckert C. A. and Trinh C T. "Biotechnology for Biofuel Production and Optimization", Elsevier, 2016.

	Prepared by	Approved by
Signature	21.1.25	
Name	Mr. Vimal Arasan. A	Dr. Nakkeeran. E
Designation	Assistant Professor	HOD
Date	21.01.2025	21.01.2025
Remarks *: The Same lesson plan will be followed in the subsequent year		
Remarks *:		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD