



SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology
Bachelor of Technology



Mechanical Engineering Department
B. Tech. Semester VII

Course Name: Biomass and Waste Management **Course Code:** BTME19753
Type of course: Minors - Alternate Energy Systems
Prerequisite: Nil
Rationale of Course: The students will be able to understand basic concepts and relevant technologies for Biomass energy extraction and its conversion.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
4	0	0	4	60	25	15	0	0	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	<p>Biomass</p> <p>Biomass resources, Classification, Availability, Agricultural and Forest residue, Aquatic and Marine biomass, consumption, surplus biomass, energy plantation, Photosynthesis of Biomass and its conversion related properties, composition and analysis, Moisture content, ash content, organic content, Physical Conversion process of Biomass, dewatering, drying, size reduction, densification, briquetting</p>	20	30%



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Sr. No.	Topics	Teaching Hrs.	Module Weightage
2.	<p>Biomass Conversion Process Basic principle of Direct combustion process, Pyrolysis and heat of combustion of biomass and its component, Basic Principle of Thermochemical Conversion, Gasification of biomass, types of gasification technologies (Fixed bed, fluidized bed, entrained bed), Governing equations, Liquefaction of biomass, Types of liquefaction technologies and governing equations.</p>	20	35%
3.	<p>Biochemical Conversion Process Basic principle of biomass conversion in Anaerobic digestion and Methanogens, Stages of Fermentation, the methanogens, the fermentative bacteria, Biomass conversion to methane, design and construction of small scale biogas plant, various substrates used to produce Biogas (cow dung, human and other agricultural waste, municipal waste etc.) Individual and community biogas operated engines and their use. Removal of CO₂ and H₂O, Application of Biogas in domestic, industry and vehicles. Basic principle of ethanol fermentation, process description, feedstock preparation, ethanol fermentation and recovery, conversion efficiency, Ethanol as a fuel for I.C. engines.</p>	20	35%

Percentage Distribution of Marks as per Bloom’s Taxonomy (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	25	25	20	5

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.



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Reference Books:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication year	Publication edition
1.	Non-conventional Energy Resources	G. D. Rai	Khanna Publishing Company Ltd.	2011	6 th
2.	Biomass conversion process for energy and fuels	Samir S Sofer and Oskar R Zaborsky	Springer Science & Business Media	2012	1 st
3.	Biomass for Renewable Energy, Fuels, and Chemicals	Donald L. Klass	Academic Press	2004	-
4.	Introduction to Biomass Energy	V. Nelson and K. Strache	CRC Press	2016	1 st
5.	Introduction to Biomass Energy Conversion	S. C. Capareda	CRC Press	2013	1 st

Course Outcomes (CO's):

CO. No.	CO Statements After learning this subject, students will be able to	Marks % weightage
CO-1	Review bio conversion and biogas generation technology.	25
CO-2	Design biogas digester system.	25
CO-3	Develop thermal gasification system.	25
CO-4	Evaluate biomass as a source of energy.	15
CO-5	Show importance of biomass energy.	10



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Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	0	2	2	0	0	0	3	0	2	1			
CO-2	2	1	0	1	1	0	0	0	2	0	1	1			
CO-3	2	1	0	0	1	0	0	0	2	0	1	1			
CO-4	1	1	0	0	1	0	0	0	1	0	0	0			
CO-5	3	3	0	3	1	0	0	0	2	0	3	1			
Rationale*	11	9	0	6	6	0	0	0	10	0	7	4			

Rationale - Mapping of CO's with PO's and CO's with PSO's:

It states that the course will develop engineering knowledge, addresses societal, health, safety, legal and cultural issues, it focuses on individual and team work and better communication. Course also focuses on knowledge of biomass energy and its relevant technologies.

This course highly maps with Program outcomes 1, 2, 4, 5, 9, and 11. It states that the course will develop Engineering knowledge, Problem analysis, Conduct investigations of complex problems, Modern tool usage, Individual and teamwork, Project management and finance. Finally it will lead to convert conceptual knowledge of mechanical engineering to real life application and with the use of modern computing tools and apply their technical, managerial and other soft skills in their professional life.

Assignments to be given as per the requirement of the course.

List of open learning website:

1. <https://nptel.ac.in/courses/103103206>