



Electrical and Renewable Energy Engineering Program

Course Specification - (2025-2026)

Biomass and Waste Conversion Technology – ERE323

Academic Year	2025/2026	Semester	Spring
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1. Basic Information

Course Title (according to the bylaw)	Biomass and Waste Conversion Technology				
Course Code (according to the bylaw)	EPR323				
Prerequisite:	Heat Transfer – GME221				
Department/s participating in delivery of the course	Electrical and Renewable Energy Engineering				
Number of credit hours/points of the course (according to the bylaw)	Credit	Contact Hours			
	Hours	Lecture	Tutorial	Practical	Total
	3	2	2	1	5
Course Type	Compulsory - Major Requirements of Electrical and Renewable Energy Engineering				
Academic level at which the course is taught	Fourth Level				
Academic Program	Bachelor of Engineering of Electrical and Renewable Energy				
Faculty/Institute	Faculty of Engineering				
University/Academy	Nahda University				
Name of Course Coordinator	Prof. Dr. Mohamed Saber Gad				
Course Specification Approval:	Department council		Faculty council		
Date of Approval of the course Specification:	13 / 9 / 2025		16 / 9 / 2025		



1. Course Overview

Characterization of Waste, Types of Biomass, Biomass Properties, Pre-Treatment of Biomass, Thermo-Chemical Processes, Fast and Slow Pyrolysis, Gasification, Transesterification, Design of Gasifiers, Drying and Devolatilization, Heat and Mass Transfer across Small and Large Biomass Particles, Combustion, Chemical Kinetics, Types of Reactors, Incinerators, Bio-Chemical Conversion, Anaerobic Digestion and Fermentation, Operation of Biomass Boilers and Stoves, Use of Bio-Fuels in Internal Combustion Engines and Gas Turbines, Emissions, Cost Considerations.

2. Course Learning Outcomes CLOs

Matrix of course learning outcomes CLOs with program outcomes POs (NARS/ARS)

Program Outcomes (NARS/ARS) (according to the matrix in the program specs)		Course Learning Outcomes Upon completion of the course, the student will be able to:	
Code	Text	Code	Text
A5	Practice research techniques and methods of investigation as an inherent part of learning.	CLO1	Design and analyze pyrolysis reactors, gasifiers and digesters
		CLO3	Discuss biochemical conversion technologies (anaerobic digestion, fermentation).
D1	Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations	CLO5	Analyze the performance of different biomass conversion technologies.
		CLO6	Compare various waste-to-energy techniques based on efficiency, cost, and emissions.
D2	Identify, analyze and evaluate the energy's conversion processes and management techniques.	CLO4	Identify the environmental and economic impacts of biomass and waste-to-energy systems. Evaluate conversion methods for specific types of biomass or waste.
		CLO5	Analyze performance of different biomass conversion technologies.
D3	Model, analyze, design, implement, test and operate renewable energy systems such as solar	CLO2	Design of reactors, incinerators, anaerobic digester and fermentation systems.



Program Outcomes (NARS/ARS) (according to the matrix in the program specs)		Course Learning Outcomes Upon completion of the course, the student will be able to:	
Code	Text	Code	Text
	photovoltaics, solar thermal, wind, biomass and waste, hydro-tidal and wave, and other renewable energy applications.	CLO3	Analyze mass and energy balance to biomass conversion systems. Discuss biochemical conversion technologies (anaerobic digestion, fermentation).

3. Teaching and Learning Methods

1. Interactive Lectures
2. Self-Learning
3. Experimental Learning
4. Field Visits
5. Discussion
6. Tutorials

Course Schedule

Number of the Week	Scientific content of the course (Course Topics)	Total Weekly Hours	Expected number of the Learning Hours				
			Lecture Hours	Tutorial Hours	Practical Hours	Self-learning (Assignments / Project)	Other
1	Characterization of Waste, Types of Biomass	7	2	2	1	2	-
2	Biomass Properties, Pre-Treatment of Biomass,	7	2	2	1	2	-
3	Thermo-Chemical Processes, Fast and Slow Pyrolysis,	7	2	2	1	2	-
4	Gasification, Transesterification,	7	2	2	1	2	-
5	Design of Gasifiers	9	2	2	1	2	Quiz 1 (2 Hr)
6	Drying and Devolatilization,	7	2	2	1	2	-
7	Heat and Mass Transfer across Small and Large Biomass Particles	7	2	2	1	2	
8	Combustion, Chemical Kinetics	7	2	2	1	2	-
9	Types of Reactors, Incinerators, Bio-Chemical Conversion	7	2	2	1	2	-
10	Anaerobic Digestion and Fermentation	9	2	2	1	2	Quiz 2 (2 Hr)



11	Operation of Biomass Boilers and Stoves	7	2	2	1	2	-
12	Use of Bio-Fuels in Internal Combustion Engines and Gas Turbines	7	2	2	1	2	-
13	Emissions	7	2	2	1	2	-
14	Cost Considerations	7	2	2	1	2	-
15	Revision	7	2	2	1	2	-
16	Final Term Exam						

4. Methods of students' assessment

No.	Assessment Methods *	Assessment Timing (Week Number)	Marks/ Scores	Percentage of total course Marks
1	Mid-term written Exam	7	20	20%
2	Final Written Exam	16	40	40%
3	Assignments	2- 14	15	15%
4	Quizzes	5, 10	15	15%
5	Final Practical Exam	15	10	10%

5. Learning Resources and Supportive Facilities

Learning resources (books, scientific references, etc.) *	The main (essential) reference for the course	1) Kai Yan, Rongliang Qiu, Shizhong Wang, Biomass Conversion and High-Value Utilization, Elsevier 2025. 2) Nirmala N, Arun J, Dawn S S , “Advances in Waste Biomass Conversion to Bioenergy”, Igi Global Scientific Publishing, Sep 26, 2025 - Technology & Engineering.
	Other References	Anju Dahiya, Bioenergy: Biomass to Biofuels and Waste to Energy, Elsevier Science & Technology 2020.
	Electronic Sources	www.ekb.eg
	Learning Platforms	https://lms.nub.edu.eg/login/index.php
Supportive facilities & equipment for	Devices/Instruments	Data Show
	Supplies	White Board
	Electronic Programs	-----



teaching and learning	Skill Labs/ Simulators	–
	Virtual Labs	–
	Other (to be mentioned)	Lecture Hall and Laboratory Usage

Prof. Dr. Mohamed Saber Gad
Course Coordinator

Dr. Mohamed Kourany Saad
Program Coordinator