SEE4114: BIOENERGY ENGINEERING: PRINCIPLES AND APPLICATIONS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Bioenergy Engineering: Principles and Applications

Subject Code
SEE - School of Energy and Environment
Course Number
4114

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
BCH1200 OR CHEM1200 Discovery in Biology or equivalent; and
SEE2101 Engineering Thermofluids I or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to educate students on the principles and applications of renewable bioenergy. The various forms, advantages and limitations of bioenergy from liquid transportation fuels to biogases to bio-electricity will be introduced. The fundamental biological mechanisms for harnessing and generating bioenergy derived from various sources whether directly from sunlight, plant biomass or organic waste will be emphasized. The engineering and analysis of bioenergy systems and innovative technology such as microbial fuel cells, photobioreactors, anaerobic fermentation, anaerobic digestion, and consolidated bioprocessing will be discussed. With knowledge in basic and applied sciences, students will be prepared to conduct advance and innovative science research in bioenergy and to design, manage and evaluate bioenergy systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the importance of bioenergy	10	x	x	
2	Analyse the basic microbiology of bioenergy generation	20		x	
3	Apply science principles to generation of the common bioenergy	30		x	
4	Design with engineering concepts of bioenergy systems and technology	30		x	
5	Identify the knowledge gap and future research needs in bioenergy	10	x		

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will learn key concepts and principles related to bioenergy and the design of engineering processes for bioenergy production.	1, 2, 3, 4, 5	

2	Tutorials	Students will engage in exercises aimed at strengthening their understanding of concepts and applying the knowledge covered in lectures.	1, 2, 3, 4, 5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments (enable students to practice calculations and apply concepts learned in lectures)	1, 2, 3, 4, 5	45	
2	Test (assess students' ability to comprehensively apply knowledge learned in lectures)	1, 2, 3, 4, 5	15	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Examination: Assess students' ability to comprehensively apply knowledge learned in lectures

Examination duration: 2 hrs
Percentage of continuous assessment, examination, etc.: 60% by continuous assessment; 40% by exam

To pass a course, a student must do ALL of the following:
1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Assignments

Criterion

Ability to explain concepts, analyze and solve problems related to bioenergy engineering

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Test

Criterion
Ability to explain concepts, analyze and solve problems related to bioenergy engineering

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Examination

Criterion
Ability to explain concepts, analyze and solve problems related to bioenergy engineering

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Forms of renewable bioenergy; Social and environmental impacts; Biomass conversion; Biocatalysts; Biochemical engineering; Bioprospecting and gene discovery; Microbial physiology and metabolism; Fermentation; Microbial photosynthesis; Algal biofuels; Bio-electricity; Microbial fuel cell; Bioenergy system and technology; Bioreactor design and engineering; Consolidated bioprocessing; Organic waste to fuels

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Buckley, M. and J. Wall. 2006. Microbial energy conversion. The American Academy of Microbiology Colloquia Reports.
2	Madigan, M. T., J. M. Martinko, P. V. Dunlap, and D. P. Clark. 2008. Brock biology of microorganisms, 12th edn. Benjamin Cummings.
3	van der Meer, J.R. and A. Steinbuchel (eds.). 2010. Energy biotechnology. Current Opinion in Biotechnology. 21:235-310.
4	Wall, J., C. S. Harwood, and A. L. Demain (eds.). 2008. Bioenergy. ASM Press.
5	Lee, S. and Y. T. Shah. 2012. Biofuels and bioenergy: Processes and technologies. CRC Press.
6	Fogler, S.H. 2005. Elements of chemical reaction engineering (4th ed). Prentice Hall.