Subject Description Form

Subject Code	ABCT5033
Subject Title	Renewable Energies and Technologies I: Hydrogen and Biofuels
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To equip students with the basic concepts, science, production, and application of alternative forms of energy, and to update students with operating principles and market opportunities related to hydrogen, biofuels, and other emerging alternative energy technologies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) understand, in a broad context, the basic knowledge of physical and chemical processes involved in renewable energy technologies. (b) explain the principles of various hydrogen production methods and biomass conversion into various biofuels with the fundamental chemical view, differentiating carbon-neutral approaches from conventional approaches. (c) demonstrate critical skills to identify problems associated with new energy technologies and compare their pros and cons. (d) evaluate the performance and analyze the market opportunities of these renewable energy technologies.
Subject Synopsis/ Indicative Syllabus	**Hydrogen energy:** • Fundamentals of hydrogen as a new energy carrier • Hydrogen production methods - Conventional methods: steam methane reforming, methane pyrolysis, partial oxidation, and coal gasification. - Recent hydrogen production by water electrolysis, photo- and thermochemical methods, and biological methods. • Hydrogen economy and its storage methods: various physical and material-based methods. Required equipment and material properties. • Hydrogen transportation methods including road, pipeline, and ship transportation. • Application of hydrogen technology in industry including fuel cell electric vehicles, power generation, waste treatment, remote monitoring, and sensing.

	• Hydrogen safety, risk management, and international regulations **Biomass energy:** • Fundamentals of biofuels as renewable energies -Physicochemical properties, sources, classifications, and challenges. • Biofuels production methods - Primary biofuels: Firewood, wood chips, animal waste, forest crop residues, and landfill gas. - Secondary biofuels: First, second, third, and fourth generations. - Barriers to biofuels being widely produced and used. • Biodiesel and bioethanol: Introduction of these two representative biofuels, their production processing, and various industrial applications. • Biofuel transportation methods - Biofuel engine technologies and combustion processes. - Biofuels in road, aviation, and marine transportation. Assessment and Future Trends of Biofuels: Life cycle assessment (LCA); Economic assessment of biofuel production; Constraints, challenges, and future trends.
Teaching/Learning Methodology	**Lectures:** Related key concepts and background will be introduced. Students are expected to read and understand the contents of textbooks after the lectures, which provide more details in addition to the content of lectures. Reading materials from the literature will be provided before lectures as supplements. Guest speakers will be invited to deliver lectures on selected topics if deemed necessary. The flipped classroom will be fostered to stimulate interactive discussions and critical thinking. **Group presentations:** Groups of students will work together to prepare and deliver a presentation on selected topics and answer questions from the lecturer and other students. This will reinforce their teamwork, enabling them to better understand the given topics and promote collaborative learning, as well as communication skills.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Examination	50%	✓	✓	✓	✓		
2. In-class activity	20%	✓	✓	✓	✓		
3. Presentation	30%			✓	✓		
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Each student will be required to participate in class activities, including flipped classroom and group discussion, which will assess their ability to understand the related topic and critically think of the related issues.

Students will be grouped to deliver presentations on selected topics, which will assess their ability to conduct case analysis, present the result, use proper skills for presentation, and argue points in support of their rationale.

The examination will reflect how much the students have learned from the subject.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Self-study	81 Hrs.
▪	Hrs.
Total student study effort	120 Hrs.

Reading List and References

1. Introduction to Chemicals from Biomass, Second Edition Clark, James H; Deswarte, Fabien; New York: John Wiley & Sons, Incorporated; 2015
2. Hydrogen energy: challenges and solutions for a cleaner futureZohuri, Bahman; Cham, Switzerland: Springer; 2019
3. Biofuels: Alternative Feedstocks and Conversion Processes for the Production of Liquid and Gaseous Biofuels, Second Edition; Elsevier; 2019