Subject Description Form

Subject Code	ME5201
Subject Title	Hydrogen and Fuel Cells
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the importance of the use of hydrogen energy in solving energy and environmental problems we are facing. 2. To provide students with fundamental knowledge of hydrogen production and utilization technologies. 3. To design and analyze fuel cell application systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand concepts and components of hydrogen production technologies. b) apply the fundamental knowledge of hydrogen production technologies for applications and innovations. c) obtain comprehensive knowledge and skills on fuel cell technologies. d) design and evaluate fuel cell systems. e) have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Introduction***: renewable energy resources and utilization, climate change, energy conversion and storage; carbon-neutral goal ***Hydrogen***: hydrogen economy; hydrogen energy; conventional hydrogen production technologies; grey hydrogen; blue hydrogen; green hydrogen; water electrolysis; electrolytic cell; alkaline liquid electrolyte water electrolysis; proton exchange membrane water electrolysis; photocatalysis and photoelectrochemical cells for hydrogen production; hydrogen storage and utilization ***Fuel cell technologies:*** thermodynamics and kinetics; electrochemical cells; classifications; working principles; basic components; nanomaterials and catalysts; reaction mechanisms; porous electrodes; membranes; membrane electrode assemblies; bipolar plates; cell designs; proton exchange membrane fuel cells; direct alcohol fuel cells; single-cell and stack

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, in-class tests, report & presentation, and final examination.

2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for hydrogen and fuel cells.

3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes				
	a	b	c	d	e
1. Lecture	✓	✓	✓	✓	✓
2. Tutorial	✓	✓	✓	✓	
3. Report & presentation		✓		✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. In-class tests	20%	✓	✓	✓	✓	
2. Homework	10%	✓	✓	✓	✓	
3. Project	20%		✓		✓	✓
4. Examination	50%	✓	✓	✓	✓	
Total	100 %					

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

Overall Assessment:

0.50 × Examination + 0.50 × Continuous Assessment

1. The continuous assessment will comprise three components: homework assignment (10%), team project (20%) and several in-class tests (20%). They are aimed at evaluating their understandings on hydrogen and fuel cell systems and enhancing the integration of their knowledge learnt.
2. The examination (50%) will be used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently, and to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Tutorial	9 Hrs.
	Other student study effort:	
	▪ Self-learning	55 Hrs.
	▪ Report and presentation	21 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	*Books*: A.L. Dicks, D.A.J. Rand, *Fuel Cell Systems Explained*, Wiley, latest edition. J. Newman, K.E. Thomas-Alyea, *Electrochemical Systems*, Wiley, latest edition. *Journals*: *International Journal of Hydrogen Energy*, Elsevier. *Journal of Power Sources*, Elsevier. *Fuel Cells*, Wiley. *Journal of Fuel Cell Science and Technology*, The American Society of Mechanical Engineers (ASME). *Applied Energy*, Elsevier.	

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