



FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester I

Course Code: 102440104

Course Title: Hydrogen Energy and Fuel Cell

Type of Course: Program Elective I

Course Objectives: To impart knowledge on use of hydrogen for achieving sustainable growth and facilitate analysis of the challenges in transition to hydrogen economy

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	40 /16	20 /08	60 /24	30 /12	150 /60

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	HYDROGEN ENERGY Introduction to hydrogen economy, production, storage and transportation systems, hydrogen from fossil fuels, electrolysis of water, thermo chemical cycles, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems	8
2	FUEL CELLS Concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output.	10
3	FUEL CELL DESIGN AND PERFORMANCE Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC	11
4	FUEL CELLS -APPLICATION AND ECONOMICS Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells	10
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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
15%	20%	25%	25%	10%	5%	

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 slightly from above table.

Reference Books:

1	Fuel cell Fundamentals, John Wiley and sons, Willey
2	Fuel cells: Principles and Applications, Viswanathan B and AuliceScibioh, University Press
3	Hydrogen – A fuel for Automatic Engines, Prashukumar G P, ISTE
4	Fuel Cells: Theory and Applications, Hart A B and Womack G J, Chapman and Hall
5	Tomorrow's Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT
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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Students able to understand and demonstrate the hydrogen production technologies, storage methods and strategies for transition to hydrogen economy	30
CO-2	Students able to know the concepts and characteristics of various types of fuel cell	25
CO-3	Students able to consist and demonstrate the working of fuel cells	25
CO-4	Students able to know the application of fuel cells with economic and environment analysis	20
CO-5	Click or tap here to enter text.	Click
CO-6	Click or tap here to enter text.	Click
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CO-9	Click or tap here to enter text.	Click
CO-10	Click or tap here to enter text.	Click



List of Practicals / Tutorials:

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1	To study fundamentals of Hydrogen energy and its application
2	To study various methods for production of hydrogen
3	To study different methods for storage of hydrogen
4	To study about safety, environmental impacts and economics of transition to hydrogen system
5	To study principle, working, thermodynamics and kinetics of fuel cell process
6	To study different types of Fuel Cells along with its merits and demerits
7	To study and demonstration of Proton Exchange Membrane Fuel Cell
8	To study about different parameters affecting the performance of fuel cell
9	To study usage of fuel cell for domestic power system and large-scale power generation
10	To study various applications and economics of fuel cell
11	Case study on recent trends in Hydrogen Fuel Cell, Hydrogen Storage and supply Technologies
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Supplementary learning Material:

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Curriculum Revision:

Version:	1
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22