

PROFESSIONAL ELECTIVE COURSES – VERTICALS

VERTICAL 1 – CLEAN AND GREEN ENERGY TECHNOLOGY

22MEHO101	HYDROGEN AND FUEL CELL TECHNOLOGIES							
	CATEGORY	L	T	P	C			
	PE	3	0	0	3			
COURSE OBJECTIVES								
1	To study in detail on the hydrogen production methodologies, possible applications and various storage options							
2	To understand the working principle of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics							
3	To study the cost effectiveness and eco-friendliness of Fuel Cells							
UNIT I INTRODUCTION								
	9	0	0	0	9			
Hydrogen–physical and chemical properties, salient characteristics, Production of hydrogen – steam reforming–water electrolysis–gasification–biological hydrogen production–photo dissociation– direct thermal or catalytic splitting of water.								
UNIT II HYDROGEN STORAGE								
	9	0	0	0	9			
Hydrogen storage options–compressed gas–liquid hydrogen–Hydride–chemical Storage– comparisons, safety and management of hydrogen.								
UNIT III FUEL CELLS								
	9	0	0	0	9			
History – principle- working- thermodynamics and kinetics of fuel cell process– performance evaluation of fuel cell– comparison on battery Vs fuel cell.								
UNIT IV FUELCELL–TYPES								
	9	0	0	0	9			
Types of fuel cells–AFC, PAFC, SOFC, MCFC, DMFC, PEMFC–relative merits and demerits.								
UNIT V APPLICATION OF FUEL CELL AND ECONOMICS								
	9	0	0	0	9			
Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space, Economic and environmental analysis on usage of Hydrogen and Fuel cell, Future trends in fuel cells.								
TOTAL (45L): 45 PERIODS								
REFERENCE BOOKS:								
1	Viswanathan B. and AuliceScibioh.M, Fuel Cells – Principles and Applications,UniversitiesPress,2006							
2	Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation,Oklahoma,2005							
3	Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier,UK2005							
4	Kordeschk. And G.Simader, Fuel Cell and their Applications, Wiley-Vch, Germany 1996							
5	Hart A. B. and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London1989							
6	Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA 2002							
7	Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley,2009							

COURSE OUTCOMES:		Bloom Taxonomy Mapped
Upon completion of this course, the students will be able to:		
CO1	Describe and analyze the techniques of Hydrogen generation	Analyze
CO2	Describe and classify various options for Hydrogen storage	Analyze
CO3	Explain the principal operations of fuel cell, its thermodynamics and kinetics	Understand
CO4	Comprehend the different types of fuel cells compare their merits and demerits	Understand
CO5	Identify the potential application of a fuel cells for domestic, automotive, space craft power generations and evaluate the techno-economics of a fuel cells	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	1	0	0	0	0	0	0	0	1	1	0
CO2	3	2	0	0	1	0	0	0	0	0	0	0	1	1	0
CO3	3	2	1	1	1	0	1	0	0	0	0	0	1	1	0
CO4	3	3	1	2	1	1	1	0	0	0	0	0	1	1	0
CO5	3	2	1	1	2	2	1	0	0	0	0	1	1	1	0
Avg	3	2.2	0.6	0.8	1.2	1.5	0.6	0.0	0.0	0.0	0.0	0.2	1	1	0.0

3/2/1 – indicates strength of correlation (3 – high, 2- medium, 1- low)