Fuel Cell Technology - Web course

COURSE OUTLINE

To teach students fundamental knowledge required in the development of fuel cell technology.

Thermodynamics, chemical reaction engineering, transport processes and electrochemical engineering perspectives of fuel cell technology will be covered in the course.

Additionally modeling and fuel cell characterization techniques will be covered in the course, Hydrogen energy perspectives and hydrogen generation from renewal sources, storage and safety issues are covered.

Contents:

Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.

Fuel cell reaction kinetics - electrode kinetics, overvoltages, Tafel equation, charge transfer reaction, exchange currents, electrocatalyses - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

Fuel cell characterization: - in-situ and ex-situ characterization techniques, i-V curve, frequency response analyses; Fuel cell modeling and system integration: - 1D model - analytical solution and CFD models.

Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.

COURSE DETAIL

S.No	Topics	No. of Hours

NPTEL

http://nptel.iitm.ac.in

Chemical Engineering

Pre-requisites:

Fluid Mech., Reaction Engineering, Chemical Thermodynamics.

Additional Reading:

1. M.M. MENCH, Fuel Cell Engines, Wiley, 2008.
2. M.T.M. Koper (ed.), Fuel Cell Catalysis, Wiley, 2009.
3. J.O'M. Bockris, A.K.N. Reddy, Modern Electrochemistry, Springer 1998.
4. Larminie J., Dick A., Fuel Cell Systems Explained, 2nd Ed. Wiley, 2003.

Coordinators:

Dr. Anil Verma
Department of Chemical EngineeringIIT Guwahati

1	Introduction and overview of fuel cells technology: low and high temperature fuel cells.	2
2	Fuel cell thermodynamics.	5
3	Fuel cell reaction kinetics: Introduction to electrode kinetics.	7
4	Exchange current and electrocatalysis, Simplified activation kinetics, Catalyst-electrode design.	6
5	Fuel cell charge and mass transport.	6
6	Fuel cell characterization.	5
7	Fuel cell modeling and system integration: Balance of plant.	5
8	Hydrogen production and storage.	4
9	Safety issues and cost expectation and life cycle analysis of fuel cells.	2
	Total	42

Prof. S. Basu
Department of Chemical EngineeringIIT Delhi

References:

1. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, Fuel Cell Fundamentals, Wiley, NY (2006).
2. Bard, A. J. , L. R., Faulkner, Electrochemical Methods, Wiley, N.Y. (2004) Ref Book.
3. Basu, S. (Ed) Fuel Cell Science and Technology, Springer, N.Y. (2007).
4. Liu, H., Principles of fuel cells, Taylor & Francis, N.Y. (2006).