COURSE TITLE	**FUEL CELL TECHNOLOGY**
COURSE CODE	**01CH0509**
COURSE CREDITS	**3**

Objective:

1. 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.
2. 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.

Course Outcomes: After completion of this course, student will be able to:

1. Provide students an appreciation for the need and opportunity of an alternative clean energy technology.
2. Explain how a fuel cell works, and describe the components, their functions and applications.
3. Describe the different fuel cell types with respect to electrolyte, electrode, operating temperature, electrode reactions, and applications.
4. Discuss how fuel cells could be integrated in the society and in the existing energy system.

Pre-requisite of course: Basic knowledge of thermodynamics and mass transfer material and energy balances.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Fuel Cell and its Thermodynamics** Introduction to Fuel cell, Working of a fuel cell,, Brief history of development, Thermodynamics of fuel cells:, Review of thermodynamic concepts; Reversible cell potential;, Effect of operating conditions on reversible cell potential;, Energy conversion efficiency.	12
2	**Fuel Cell Electrochemistry** Electrochemistry of fuel cells: Electrode potential and cell polarization;, Review of electrochemical kinetics;, Activation kinetics, polarization for charge transfer reaction;, Butler-Volmer equation; Electrocatalysis	8

DR. ABHISHEK GUPTA
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Contents : Unit	Topics	Contact Hours
3	**Fuel Cell Mass Transport** Fuel cell mass transport;, Fuel cell charge transport;, Heat transfer phenomena in fuel cells	8
4	**Temperature and pressure effects** Overview of fuel cell types: Alkaline fuel cells;, Phosphoric acid fuel cells; Proton exchange membrane fuel cells;, Molten carbonate fuel cells;, Solid oxide fuel cells	10
Total Hours		**38**

Textbook :

1 Fuel Cell Fundamentals,, R. O' Hayre , S.K. Cha, W. Colella and F.B. Prinz,, Wiley, 2009

2 Fuel Cell Handbook, 7th Edition, , EG&G Technical Services, Inc., U.S. Department of Energy, , 2004

References:

1 Fuel Cells: Principles and Applications,, Fuel Cells: Principles and Applications,, B.Viswanathan and A. Scibioh, CRC Press,, 2007

2 PEM Fuel Cells: Theory and Practice, 2nd Ed., PEM Fuel Cells: Theory and Practice, 2nd Ed., F. Barbir,, Academic Press Inc,, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

DR. ABHISHEK GUPTA
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Supplementary Resources:

1 https://archive.nptel.ac.in/courses/103/102/103102015/

DR. ABHISHEK GUPTA
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)