

---

**Materia: FUEL CELLS PRINCIPLES, OPERATIONS AND APPLICATIONS**

---

Duración	Sesiones/semana	Carga semanal	Semestre
16 semanas	2	3 hrs	Variable

Profesores que han impartido el curso: *Dr. Velumani Subramaniam*

**Propósitos:** In this course it is intended to introduce the concept of fuel cells, various types of fuel cells, general working conditions, its limitations and its applications.

We'll take a quick look at each of the existing or emerging fuel-cell technologies. Various types of fuels used in the different fuel cells will be discussed. Finally a through review and impact on the applications of fuel cells in various fields will be given considering the today's energy crisis faced by world. We'll detail how one of the most promising technologies works, and we'll discuss the potential immediate applications of fuel cells along with hands on training to students in the Fuel cell laboratory.

**Contenidos:**

- 1 Introduction.
  - 1.1 Hydrogen fuel cells – basic principles.
  - 1.2 Fuel cell types, efficiency and efficiency limits.
  - 1.3 Operational fuel cell voltages – terminology, fuel cell irreversibility, activation losses, ohmic losses, mass transportation or concentration losses, combining the irreversibilities.
  - 1.4 Charge double layer distinguishing irreversibilities.
  
- 2 Proton Exchange Membrane Fuel cells.
  - 2.1 Proton exchange membrane fuel cells: Overview.
  - 2.2 Working, Electrodes and structure.
  - 2.3 Water management.
  - 2.4 Cooling and air supply.
  - 2.5 Construction methods.
  - 2.6 Operating pressure.

2.7 Reactant composition.

2.8 Example systems.

3 Different types of fuel cells.

3.1 Alkaline electrolyte fuel cells: -types.

3.2 Electrodes.

3.3 Medium and high temperature fuel cells: Construction, working and limits of DMFC, PAFC, MCFC, SOFC.

4 Fuels for fuel cells.

4.1 Fueling fuel cells: fossil fuels.

4.2 Petroleum, petroleum in mixtures, tar sands, oil shales.

4.3 Gas hydrates, LPG, coal, coal gases, natural gases.

4.4 Bio fuels, steam reforming, hydrogen generation by pyrolysis or thermal cracking.

4.5 Methanol reforming, methanol CPO/air to thermal reforming.

4.6 Gasoline reforming.

4.7 Hydrogen storage – compressed gas, liquid, metal hydride, alkali metal hydrides, comparison.

5 Applications.

5.1 Stationary applications:

5.2 Mobile applications.

5.3 Natural gas fed PEMFC and PAFC.

5.4 Delivering fuel cell power.

5.5 DC regulation and voltage conversion switching devices, switching regulators.

5.6 Invertors single and three phase.

5.7 Regulator issues and tariffs, power factor correction.

5.8 Fuel cell/battery hybrid system.

Books for Study:

1. Fuel Cell Systems Explained (Second Edition) By James Larminie and Andrew Dicks, John Wiley & Sons, ISBN 0-470-84857 (2004).

2. Fuel Cell Technology Handbook - Mechanical Engineering Series By Gregor Hoogers, CRC Press LLC, USA (Taylor & Francis Group), ISBN 0-8493-0877-1 (2002).