COURSE ID SHEET

Course No.	5298	NTUA

Semester:	9	Core		Elective		Specialization	X

Title: **ADVANCED TECHNOLOGIES FOR ENERGY PRODUCTION AND STORAGE**

Aim:

In this course, three types of energy generation and storage technologies will be analyzed. The first type is batteries, whose operating principle is based on the spontaneous conversion of the chemical energy of the reactants within the cell into electricity. The second type is fuel cell(s), where again takes place spontaneous conversion of chemical energy into electrical, but the chemical reactants are continuously fed to the electrochemical device. The third type concerns the production, storage and management of hydrogen, which is a zero-emission fuel and can be used in both electrochemical power generation and internal combustion engines.

Content:

PART I: BATTERIES

1. Basic principles of batteries
2. Thermodynamics of batteries and electrode kinetics
3. Transfer phenomena in batteries
4. Theoretical capacity and potential
5. Battery technology: (A) Batteries of the 1st kind: A1. Leclanche cells, A2. Magnesium cells, A3. Alkaline manganese dioxide accumulators, A4. Silver oxide cells, A5. Zinc / air cells, A6. Lithium accumulators, A7. Li / SO_2, A8 cells. Li.MnO_2 cells (B). Batteries of 2nd kind: B1. Lead / Acid batteries, B2. Ni / Cd, B3. Ni / H_2 accumulators, B4. Ni / MH accumulators, B5. Li-ion accumulators.
6. Battery function modeling

PART II: FUEL CELLS

1. Fuel Cell Basics: Historical Review, Fuel Cell principles, Electrochemistry (Liquid and Solid State), Basic Fuel Cell Units, Financial Data
2. Fuel Cell Classification: Fuel Cells and Their Specifications, Polymer Membrane Fuel Cell (PEM), Direct Methanol Fuel Cell (DMFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell, Solid Oxide Fuel Cell, Single Cells and cell stacks, power calculation
3. Fuel Cell Technological Applications: Power Generation, Portable Units (Batteries for Phones, Laptops, etc.), Mobile Units (Cars, Trucks, Vessels, Airplanes, Fixed Units <10 KW, MW scale factory units, Heat generation, Hybrid power and heat generation units, Fuel cell system operation and control

PART III: HYDROGEN ECONOMY

1. Basic concepts
2. Hydrogen production: Laboratory and Industrial scale production.
3. Hydrogen storage

Hours per semester:

LECTURE	**24**	EXERCISES	**16**	LABORA-TORY	**-**	HOME-WORK	**135**	**TOTAL HOURS: 175**

Student performance /evaluation:	The evaluation will be done: • Through a Final (written) Examination, including the development of theoretical subjects, multiple-choice questions and solving of exercises without the use of books or notes. **The final grade results as follows: Final Grade = Final Examination**