



The
University
Of
Sheffield.

Electronic &
Electrical
Engineering.

EEE6202 ENERGY STORAGE MANAGEMENT

Credits: 15

Course Description including Aims

1. To introduce fuel cell systems as a clean and efficient alternative energy source.
2. To provide a basic understanding of the principles of operation and characteristics of fuel cell systems.
3. To discuss recent development and applications of fuel cell technology.
4. To introduce battery energy storage systems and Supercapacitor storage
5. To provide basic understanding of the operation and characteristics of different battery chemistries and how Supercapacitors differ from batteries
6. To introduce single phase interfaces for bidirectional energy storage
7. To introduce mechanical energy storage in terms of flywheels / compressed air.

Outline Syllabus

Fuel cell systems: Principles of operation, different fuel cell structures, open circuit voltage and efficiency, fuel cell irreversibilities, operational characteristics, electrical dynamic behaviours, recent development and applications in electric and hybrid vehicles and energy storage. **Battery / Supercapacitor Energy storage:** Principles of primary / secondary cell operation, different battery chemistries used in energy storage in electric vehicles / hybrid electric vehicles (EV / HEVs) and in energy storage systems (ESS). Comparison of batteries and Supercapacitors. Charging of batteries / ESS interfaces at single phase for distributed energy storage. Wireless charging for vehicles. Vehicle to grid (V2G). **Mechanical Energy storage:** Principles of mechanical energy storage, flywheels / compressed air. Mechanics of energy storage, precession torques and counter-rotating systems for vehicles. Examples of energy storage.

Time Allocation

36 lectures plus 12 hours of additional support material.

Recommended Previous Courses

None.

Assessment

3-hour examination, answer 4 questions from 6.

Recommended Books

Books to be
recommended in the
course

Objectives

By the end of the module a successful student will be able to

1. Describe the principles of operation, basic characteristics and recent developments of different forms of fuel cell systems.
2. Use appropriate techniques for modeling fuel cell behavior.
3. Discuss the potentials and limitations of fuel cell systems as static and mobile electric energy sources.
4. Explain the principles of battery and Supercapacitor operation.
5. Construct a basic model of a battery system.
6. Discuss distributed ESS interface operation at single phase level.
7. Describe the principles, advantages and disadvantages of V2G systems at domestic level.
8. Describe the principles of mechanical energy storage, including flywheels and compressed air systems.