WM986-15 Energy Storage Systems

20/21

Department
WMG
Level
Taught Postgraduate Level
Module leader
Carlos Pastor Fernandez
Credit value
15
Module duration
1 week
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

39 hours over 1 week consisting of interactive presentations, question and answer sessions and discussion, videos, small group exercises and problem classes.

The module includes a significant practical element (~30%) where students gain hands-on experience of battery and fuel-cell testing in WMG's Vehicle Energy Facility and classroom-based design representative of real-world vehicle applications.

Module aims

The module provides a comprehensive study of energy storage systems for hybrid and electric vehicle applications in the automotive industry, and the complexities and challenges of introducing high voltage technology to passenger vehicles. Students will gain hands-on experience of battery and fuel-cell testing, including under the widely varying conditions of real-world applications.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Energy storage requirements for vehicle applications
- Storage technologies and metrics for comparison
- Fuel cells theory and applications
- Modular battery packs, packaging, thermal control and legislative implications
- High voltage distribution, safety systems and battery charging
- Hands-on practical: Fuel-Cell characterisation and modeling
- Hands-on practical: Battery characterisation and testing
- Hands-on practical: Fuel-Cell and Battery interaction
- Problem class: Battery pack design
- Battery management systems
- Battery life cycle

Learning outcomes

By the end of the module, students should be able to:

- 1. Evaluate the wide variety of energy storage technology for vehicle applications.
- 2. Independently make a systematic and sound choice of energy storage technologies, architecture and means of conversion for practical real-world vehicle applications
- 3. Independently design the electrical configuration of a traction energy storage pack, interpreting thermal management, energy management, safety and environmental considerations.
- 4. Creatively design the integration of high voltage systems into vehicle platforms, critiquing design trade-offs and autonomously applying a sound knowledge of integration issues, best practice guidelines, safety systems, legislation and practical considerations.
- 5. Systematically compare energy storage designs for hybrid and electric vehicles.

Indicative reading list

View reading list on Talis Aspire

Subject specific skills

Energy storage requirements for vehicle applications; Storage technologies and metrics for comparison; Fuel cells and applications; Modular battery packs, packaging, thermal control and legislative implications; High voltage distribution, safety systems and battery charging; Battery management systems. Hands-on practical: Fuel-Cell characterisation and modeling, Battery characterisation and testing and Fuel-Cell and Battery interaction. In-Class problem: energy storage design.

Transferable skills

Critical thinking; Problem solving; Self-awareness; Communication; Teamwork and working effectively with others; Information literacy (research skills); Digital literacy; Sustainability; Professionalism; Organisational awareness.

Study

Study time

Type	Required
Lectures	13 sessions of 1 hour 30 minutes (13%)
Seminars	1 session of 2 hours 30 minutes (1%)
Tutorials	1 session of 1 hour 30 minutes (1%)
Supervised practical classes	3 sessions of 4 hours (8%)
Online learning (independent)	1 session of 10 hours (7%)
Other activity	3 hours 30 minutes (2%)
Private study	12 hours (8%)
Assessment	89 hours (59%)
Total	150 hours

Private study description

Daily self-study (contents review), preparation for practicals and preparation to structure the PMA

Other activity description

Introduction to module: 1 x0.5h
Introduction to PMA and practicals: 1 x 1.5h
PMA Q&A session: 1x1.5h

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D

	Weighting	Study time	Eligible for self-certification
Evaluation of practical activities and technology application	80%	80 hours	Yes (extension)

	Weighting	Study time	Eligible for self-certification
PMA is comprised of two parts. The first part will cover ILO 2, 3 and 5 and it is related to the work completed in the practical sessions. The second part covers all ILOs. Part 2 is related to discuss a typical energy storage design based on given requirements.			
Energy Storage Design Class	10%	3 hours	No
Energy Storage Design Class consists to design three alternative energy storage solutions for a real-world automotive application, based on each of three different technologies: electrochemical, electrostatic and mechanical flywheel. The student should also make a final recommendation to the customer. This is a group task where students are divided into groups of 4 or 5 supported by a group leader. The assessment is conducted via a presentation of each group. Each group receives a mark. This mark is the same for each of the students that form a group. This part covers all ILOs.			
Daily online test for taught sessions	10%	6 hours	No
Online test students need to complete after each taught session day (Monday, Tuesday and Friday) to review and reflect the main concepts learnt during that day. Wednesday and Thursday take place the practical sessions.			

Assessment group R

	Weighting	Study time	Eligible for self-certification
Evaluation of tests and technology application	100%		Yes (extension)
PMA is comprised of one part. This part covers all ILOs. It is related to discuss a typical energy storage design based on given requirements.			

Feedback on assessment

Scaled ratings for Comprehension, Effort and Presentation, individual written feedback and overall mark following on from WMG feedback sheet templates.

Past exam papers for WM986

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - WM985-15 Automotive Hybridisation and Electrification

Post-requisite modules

If you pass this module, you can take:

- WM995-15 Battery Electrochemistry, Design and Manufacturing

Courses

This module is Core optional for:

- Engineering Competence (Sustainable Automotive Electrification) [New Course]
- MSc in Sustainable Automotive Electrification (FT) [New Course]
- MSc in Sustainable Automotive Electrification (PT) [New Course]