WM986-15 Energy Storage Systems

24/25

Department
WMG
Level
Taught Postgraduate Level
Module leader
Carlos Pastor Fernandez
Credit value
15
Module duration
1 week
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

30 hours over 4 weeks consisting of interactive presentations, question and answer sessions and discussion, online sessions, videos, small group exercises and problem classes.

The module includes a significant practical element (~30%) where students gain hands-on experience in battery modeling and characterisation testing.

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.

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

- Modular battery packs and packaging
- Battery modeling and battery charging
- Battery management systems
- Battery diagnostics and end of life
- Hands-on practical: Battery modeling
- Hands-on practical: Battery characterisation and testing
- Problem class: Energy storage design

Learning outcomes

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

- Evaluate the wide variety of energy storage technology for vehicle applications [AHEP:4; 7, M2]
- Independently make a systematic and sound choice of energy storage technologies, architecture and means of conversion for practical real-world vehicle applications [AHEP:4; 7, M2, M6]
- Independently design the electrical configuration of a traction energy storage pack, interpreting thermal management, energy management, safety and environmental considerations [AHEP:4; 7, M2, M3, M6]
- 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 and practical considerations [AHEP:4; 7, M2, M3]
- Interpret battery characterisation or battery modelling activities in electric vehicles [AHEP:4; 7, M2]
- Work within a team to resolve problems in the context of energy storage systems [AHEP:4; 7, M16]

Indicative reading list

- Battery systems engineering, Christopher D. Rahn; Chao-Yang Wang, 2013.
- Lithium-ion batteries: basics and applications, edited by Reiner Korthauer; Michael Wuest, 2018.
- Systems Approach to Lithium-Ion Battery Management, Phil Weicker, 2013.
- Battery management systems for large lithium-ion battery packs, Davide Andrea, 2010.
- The handbook of lithium-ion battery pack design: chemistry, components, types and terminology, John Warner, 2015.

View reading list on Talis Aspire

Subject specific skills

Energy storage requirements for vehicle applications; storage technologies and metrics for comparison; modular battery packs and packaging; battery modeling and battery charging; battery management systems; battery diagnostics and end of life. Hands-on practical: battery modeling; battery characterisation and testing. 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	12 sessions of 1 hour (8%)
Seminars	2 sessions of 1 hour (1%)
Supervised practical classes	16 sessions of 1 hour (11%)
Online learning (independent)	15 sessions of 1 hour (10%)
Private study	45 hours (30%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Online independent learning includes:

- Completion of prework activities prior the start of the module

Private study learning includes:

- Revision of lectures after delivery
- Completion of homework
- Prior research required to complete the PMA

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A2

	Weighting	Study time	Eligible for self-certification
Evaluation of technology application	60%	36 hours	Yes (extension)

This part is related to discussing a typical energy storage design based on given requirements.

Energy Storage Design Class - Group work	10%	6 hours	No

Energy Storage Design Class consists to design an energy storage system for a real-world case study. The student should also make a final recommendation to the customer.

This is a group task where students are divided into groups of 3 to 6 supported by a tutor. The assessment is conducted via a presentation of each group. Each group receives a mark.

Module owner is able to observe the group work in sufficient detail to allocate individual marks without the use of peer assessment.

Evaluation of practical activities - Group work	30%	18 hours	No

This is a group task and consists in reporting the investigations of one of the practicals undertaken in the module. The group chooses which practical to report. Peer review assessment methodology will be implemented in this assessment.

Feedback on assessment

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

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

There is currently no information about the courses for which this module is core or optional.