

WM994-15 Electrical Drivetrains

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 contact 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 electric machine characterisation and testing as well as classroom-based investigation and consolidation of the control technology employed.

Module aims

The purpose of the module is for the students to learn about advanced propulsion technologies for hybrid and electric vehicles. In particular, the learning is focused on electric machines appropriate for hybrid and electric vehicles. The learning will also be based on how to design, drive and control these electric machines particularly in the context of hybrid and electric 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.

- Electric machine types and characteristics.

- Design of control for electric machines.
- Use of power electronics in electric machines.
- The future of propulsion technology in the automotive industry.
- Hands-on practical: Electric machine characterisation.
- Hands-on practical: Electric machine drivetrain and efficiency evaluation.
- Hands-on practical: Electric machine control and test design class.

Learning outcomes

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

- 1. Interpret electric machine technologies, operation and their characteristics.
- 2. Demonstrate comprehensive understanding of control methods for different machine technologies.
- 3. Demonstrate comprehensive understanding of power electronics devices and circuits.
- 4. Understand practicalities of electrical drivetrains in real-world application to hybrid and electric vehicles
- 5. Systematically compare electric drivetrain designs for hybrid and electric vehicles.

Indicative reading list

- “Principles of Electric Machines and Power Electronics”, P.C. Sen. New York: John Wiley and Sons, 2013 (3rd Edition). ISBN : 978-1-118-07887-7
- “Electric Machinery” - A.E. Fitzgerald, C. Kingsley, S.D. Umans, 2003
- “Mathematics for engineers” - Anthony Croft, Robert Davison 2015
- “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamental, Theory and Design”, M Ehsani, Y Gao, S Gay, A Emadi. CRC Press, Sept 2009 (2nd Edition), ISBN 9781420053982
- “Electric and Hybrid Vehicles Design Fundamentals”, I. Husain. CRC Press, 2011, ISBN 9781439811757

A variety of up-to-date sources including:

- Latest government / UK Automotive Council roadmaps for automotive technology (<https://www.automotivecouncil.co.uk/technology-group-2/automotive-technology-roadmaps/>)
- Latest automotive emissions legislation and current academic research in the field of engine and electric machines for hybrid and electric vehicles (references to be provided within the specific lectures and practical sessions)

[View reading list on Talis Aspire](#)

Subject specific skills

- Electric machine types and characteristics
- Power electronics used in electric motors;
- Control systems for electric machines
- Future propulsion technology in the automotive industry
- Hands-on practical in Electric machine characterisation.
- Hands-on practical in Electric machine control design and test

- Hands-on practical in Electric drivetrain and efficiency

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 30 minutes (12%)
Seminars	1 session of 1 hour 30 minutes (1%)
Tutorials	1 session of 3 hours (2%)
Demonstrations	1 session of 3 hours (2%)
Supervised practical classes	2 sessions of 4 hours (5%)
Online learning (independent)	1 session of 10 hours (7%)
Other activity	3 hours 30 minutes (2%)
Private study	11 hours (7%)
Assessment	92 hours (61%)
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
Evaluation of practical activities and technology application	80%	80 hours
<p>PMA is comprised of two parts. The first part will cover ILOs 1, 4 and 5 or ILOs 2 to 5, and it is related to the work completed in the practical sessions. The student needs to choose one practical to report out of the total of three practicals completed. The number of ILOs covered depends on the practical the student decides to choose. The second part covers all ILOs. Part 2 is related to discuss a typical electric machine configuration and their associated control and power electronics system.</p>		
Electric Machine control design and test	20%	6 hours
<p>Design and test activity in MATLAB/Simulink to control electric machines. ILO 2 is assessed.</p>		

Assessment group R

	Weighting	Study time
Evaluation of tests and technology application	100%	
<p>PMA is comprised of one part. This part covers all ILOs. It is related to discuss a typical electric machine configuration and their associated control and power electronics system.</p>		

Feedback on assessment

Online test: Correct answers will be given after completion of each test.

In-class test: Feedback comments on submission with grade mark and rating scale description. The submitted script will be annotated in addition to further consolidated written feedback.

Written report: Scaled ratings for comprehension, effort and presentation, individual written feedback and overall mark. The written feedback will be provided based on WMG feedback template and it will address each of the questions submitted, including feedback comments on presentation, structure and grammar. Approximately 100-250 words will be provided as feedback

Availability

Pre-requisites

To take this module, you must have passed:

- All of

- [WM985-15 Automotive Hybridisation and Electrification](#)

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]