

WM994-15 Electrical Drivetrains

22/23

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

30 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. Interpret practicalities of electrical drivetrains in real-world application to hybrid and electric vehicles
- 5. Systematically compare electric drivetrain designs of 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	8 sessions of 1 hour 30 minutes (8%)
Seminars	1 session of 8 hours (5%)
Supervised practical classes	2 sessions of 4 hours (5%)
Other activity	2 hours (1%)
Private study	60 hours (40%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Private study and independent learning include:

- Preparation and completion of prework
- Preparation of lectures before delivery and revision after delivery
- Prior research before starting the PMA

Other activity description

Introduction to PMA and practicals

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 A

	Weighting	Study time
Evaluation of technology application	50%	30 hours
This part is related to discussing a typical electric machine configuration and their associated control and power electronics system. It covers all the ILOs.		
Electric machine performance and simulation	20%	12 hours
The computer-based task consists in evaluating the performance and efficiency of different Electric Motors in the context of Hybrid/Battery Electric Vehicles using related software. Students are assessed by answering a set of questions regarding the task described.		
Evaluation of practical activities	30%	18 hours
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. This written report covers ILO 2 or 3, depending on the chosen practical. This written report is marked collectively.		

Assessment group R1

	Weighting	Study time
Evaluation of tests and technology application	100%	
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.		
Students only need to work on the failed LOs for the resubmission, being able to reuse the content of the original resubmission.		

Feedback on assessment

Take-home examination: 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](#)

Post-requisite modules

If you pass this module, you can take:

- WM983-15 Electrical machine 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]