

WM983-15 Electrical machine design and manufacturing

24/25

Department

WMG

Level

Taught Postgraduate Level

Module leader

Mohammadali Abbasian

Credit value

15

Module duration

4 weeks

Assessment

100% coursework

Study locations

University of Warwick main campus, Coventry Primary

Distance or Online Delivery

Description

Introductory description

This module provides in-depth knowledge of electric machine technologies, design and manufacturing for hybrid and electric vehicles. The modelling and design of electric machines are covered in depth through lectures and simulation activities. Mechanical and thermal design fundamentals are covered. This module also include aspects of integration, control, condition monitoring and life cycle of electric machines in the context of electric vehicles, for today and future technologies.

[Module web page](#)

Module aims

The students will gain a high-standard of technical knowledge about electric machines, allowing them to act as component experts, understand stakeholder/interface requirements and limitations and liaise with researchers to translate state-of-art into business opportunities.

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.

Topologies, operation and characteristics of synchronous permanent-magnet and wound-field machines, synchronous reluctance machines and induction machines

Mechanical design of electric machines

Thermal modelling and thermal design of electric machines

Electric machine manufacturing

EV traction motor tear-downs

Electric machine modelling and design using commercial software

Electric machine testing and characterization

E-machine integration in powertrain, condition monitoring, fault analysis and life cycle

Future technology direction and state-of-art of electric machines research

Learning outcomes

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

- Work in a team to differentiate electric machine technologies, considering their operation, characteristics, mechanical aspects, and cooling concepts [AHEP4;7, M2, M4]
- Evaluate and simulate the electromagnetic, mechanical, and thermal performance of electric machines by working on a group or individual project [AHEP4;7, M3, M4]
- Interpret the practicality of electric machine designs considering manufacturing processes and cost [AHEP4;7, M5, M7]
- Systematically design electric machines for hybrid/electric vehicles , with considerations of powertrain architecture, integration and influence of manufacturing [AHEP4;7, M1, M2]
- Critique design trade-offs and technological advances of electric machines for electric and hybrid vehicles [AHEP4;7, M4, M7]
- Select and critically evaluate technical literature and other sources of information to solve complex problems [AHEP4;7, M2, M4]

Indicative reading list

1. A. Hughes, B. Drury: "Electric motors and drives: fundamentals, types and applications", 4th edition, Newnes, Oxford, 2013., ISBN: 9780080983325 and 9780080993683 (e-book)
- 2- T. Wang, in Mechanical Design of Electric Motors, Boca Raton, CRC Press, 2014, ISBN: 9781420091441 (e-book)
- 3- S. Umans, Fitzgerald & Kingsley's Electric machinery, McGraw-Hill, Seventh edition 2014, ISBN: 9780077428501 (e-book)

[View reading list on Talis Aspire](#)

Subject specific skills

Ability to apply theoretical knowledge to solve problems in existing and emerging machine technologies.

Ability to simulate and design electric machines using commercial software such as MotorCAD. Ability to evaluate limitations of design tools and choose appropriate methods and tools for designing electric machines.

Ability to propose mechanical design concepts (rotor/stator/bearing design/ NVH) and cooling concepts relating to the development of electrical machines.

Ability to identify diagnostic methods, monitoring and test equipment required for integration of electrical machines for EV and hybrid vehicles.

Ability to interpret the practicality, and manufacturability of electrical machine designs considering manufacturing process and cost.

Transferable skills

Practical competence to deliver innovative products and services.

Ability to interpret and analyse simulation and test results.

Ability to work with manufacturing specialists to ensure design can translate to manufacturing processes and system.

A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.

Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations.

Ability to use fundamental knowledge to investigate new and emerging technologies.

Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.

Ability to collaborate to complete complex design and simulation tasks

Study

Study time

Type	Required	Optional
Lectures	17 sessions of 1 hour (11%)	
Seminars	1 session of 1 hour (1%)	
Supervised practical classes	12 sessions of 1 hour (8%)	2 sessions of 1 hour
Online learning (independent)	16 sessions of 1 hour (11%)	
Private study	44 hours (29%)	
Assessment	60 hours (40%)	
Total	150 hours	

Private study description

pre-work 16 hours

consolidation lecture contents by reading recommended literature 24 hours

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
Post Module Assessment report	80%	48 hours	Yes (extension)
Post Module Assignment (PMA) consists in a design proposal of an EV traction motor considering electromagnetic, thermal and mechanical performance as well as including considerations of integration, manufacturing, failure mode and cost considerations. The student design needs to be critique in regards to other motors fitting the same set of specifications but with different technologies (type of e-machine, PM rotor type or winding type).			
Technical presentation of design activities	20%	12 hours	No
The group holds (or record) a 15min presentation describing the tasks solved during the design workshops, including comparison to competing designs when relevant. The time available should be spread among all members of the group as equally as possible. Peer review among the group supports individual portion of mark dedicated to group work skills, engagement and contribution.			

Feedback on assessment

The presentation will be marked with a group assessment report, with highlighted issues on the presentation slides.

The PMA will be marked based on achievement of LOs, with general comments and highlighted issues in their submission.

An overall mark of the module is sent to students with the PMA assessment report, detailing how well they performed against each learning outcome.

Availability

Pre-requisites

To take this module, you must have passed:

- All of
 - [WM994-15 Electrical Drivetrains](#)

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