

WM3G3-15 Electric Drives and Control

27/28

Department

WMG

Level

Undergraduate Level 3

Module leader

Matt Sokola

Credit value

15

Module duration

14 weeks

Assessment

100% coursework

Study locations

University of Warwick main campus, Coventry Primary

Distance or Online Delivery

Description

Introductory description

The module discusses various aspects of different types of Electrical Drives and Control.

It firstly introduces the three-phase electrical supply system and usage of phasors in both electric grid and modelling AC machines. The module then discusses modelling and control of electric drives, including the scalar and vector control. Finally, the focus is on power electronics, with an emphasis on DC-DC and DC-AC converters for variable speed drives.

This module is linked with C1, C2, C3, C4, C6, C12, C13 and C17 of the AHEP 4.

LO1 - C1, C3, C6

LO2 - C1, C2, C3, C6

LO3 - C1, C2, C3, C6, C17

LO4 - C4

LO5 - C1, C2, C3, C6, C12, C17

[Module web page](#)

Module aims

The main module aim is to equip learners with knowledge and skills necessary to design control systems and power electronics for electric drives that meet specifications for some typical applications.

The secondary aim is to continue developing a systematic approach to solving complex engineering problems often met by both electrical and control engineers.

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.

- AC waveforms – peak, rms, phase lag, power (instantaneous, average), power factor, usage of phasors;
- Electric power: generation, transmission, distribution, consumption;
- Consumption diagrams: - daily, weekly, seasonal variations on local, regional, national level;
- 3-phase AC electric machines: induction and permanent-magnets;
- Modelling of 3-phase AC electric machines in d-q reference frame;
- Control of AC machines and drives: scalar control and vector control;
- Controller design and selection of parameters;
- Rectifiers: 1-phase, 3-phase; Controlled rectifiers; R-L loads, Capacitive filters;
- DC-DC converters - Buck and Boost: analysis, simulation and practical design;
- Active power factor correction(PFC) circuits
- Power MOSFETs and IGBTs characteristics
- Switched mode power supplies;
- DC-AC inverters;
- Simulation and experimental lab.

Learning outcomes

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

- Apply 3-phase phasor analyses to electric grid and to AC machines [AHEP:4-C1, C3, C6].
- Develop models of 3-phase permanent-magnet motors and induction motors [AHEP:4-C1, C2, C3, C6].
- Design and simulate cascaded control in an AC drive [AHEP:4-C1, C2, C3, C6, C17].
- Discriminate electronic switching devices used in power electronic converters [AHEP:4-C4].
- Design and implement an effective low power DC-DC converter or a DC-AC inverter [AHEP:4-C1, C2, C3, C6, C12, C17].

Indicative reading list

[Reading lists can be found in Talis](#)

[Specific reading list for the module](#)

Subject specific skills

- Select, use and apply approved problem-solving methods to solve complex problems and determine appropriate solutions or actions (S2 in ST0023 and ST0024).
- Collate and use a range of data sources and supporting documentation to support projects (S3 in ST0023 and ST0024).
- Observe, record and draw accurate and auditable conclusions from data and/or developmental or test evidence (S5 in ST0023 and ST0024).
- Demonstrate leadership when undertaking control system engineering activities (S10 in ST0023; S11 in ST0024).
- Ensure that all instrumentation has been correctly configured and calibrated before use (S11 in ST0023; S13 in ST0024).

Transferable skills

Problem Solving: Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions.

Critical Thinking: Recognise patterns, themes and key messages from sometimes confused and incomplete data;

Make informed decisions on the value of a range of sources allowing an evidence based conclusion based on this analysis.

Professionalism: Prepared to operate autonomously; Aware of how to be efficient and resilient; Manages priorities and time; Self-motivated, setting and achieving goals, prioritising tasks.

Communication - Verbal; Written (present arguments, knowledge and ideas); **Active listening:** questioning, reflecting, summarising.

Information Literacy: Critical awareness of how information is gathered, used, managed and synthesised; Understanding of the relative value of different sources and the importance of provenance.

Study

Study time

Type	Required
Lectures	14 sessions of 1 hour (9%)
Seminars	6 sessions of 1 hour (4%)
Practical classes	4 sessions of 1 hour (3%)
Online learning (scheduled sessions)	6 sessions of 1 hour (4%)
Online learning (independent)	5 sessions of 1 hour (3%)
Other activity	5 hours (3%)
Private study	50 hours (33%)
Total	150 hours

Type	Required
Assessment	60 hours (40%)
Total	150 hours

Private study description

- Self-guided study: revision on module contents, solution of additional seminar-type questions, video tutorials and supplementary materials.
- Study and advanced use of simulation software.
- Analyse datasheets of components.
- Online forum for discussing queries with course peers and tutors (asynchronous).

Other activity description

- Pre-module reading list given on Moodle to encourage flipped learning approach.
- Preparation for the practical lab.
- Online consulting session for providing one to one support to help struggling students.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
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Assessment component

Assignment 1	40%	24 hours	No
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Portfolio of work to include:

- 1. poster-style A3 presentation on phasors;
- 1. written solutions to PMSM or IM modelling, with equivalent to 600 words and
- 1. set of simulation diagrams for controller tuning, equivalent to 1000 words.

For items 1, and 2. , students will work in groups of 3 (exceptionally 2) to enable peer-to-peer

Weighting

Study time

Eligible for self-certification

learning, but will have different electric motors to apply the modelling to. For item 3, every student will have different targets for controller response.

Students submit individually. No peer-marking is expected.

Reassessment component is the same

Assessment component

Assignment 2	60%	36 hours	Yes (extension)
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Individual written assignment: Analysis and discussion of simulations and experiments.

Experiments will be done in Groups of 3 (possibly 2), but the report is written and submitted individually.

Reassessment component

Assignment 2	No
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Individual written assignment: Analysis and discussion of simulations and experiments.

Experiments will be done in Groups of 3 (possibly 2), but the report is written and submitted individually.

Feedback on assessment

Feedback given as appropriate to the learning in the module and to the assessment type:
FORMATIVE:

- Cohort-level feedback on the submitted draft posters for Assessment 1, item 1 - before the second block of teaching.
- Verbal feedback given during seminar/tutorial sessions.

SUMMATIVE:

- Written individual feedback on Assessment 1.
- Written individual feedback on Assessment 2.

Availability

Courses

This module is Core for:

- Year 4 of UWMS-H7C3 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer)
- Year 4 of DWMS-H7C7 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer) (Degree Apprenticeship)
- Year 4 of UWMS-H7C2 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer)
- Year 4 of DWMS-H7C6 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)