Prifysgol Wrecsam
Wrexham University

Module specification

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Module Code	ENG6AL
Module Title	Power Electronics and Electrical Drives
Level	6
Credit value	20
Faculty	FACE
HECoS Code	100188
Cost Code	GAME
Pre-requisite module	None

Programmes in which module to be offered

Programme title	Core/Optional/Standalone
BEng (Hons) Mechatronics Engineering	Core

Breakdown of module hours

Learning and teaching hours	60 hrs
Placement tutor support hours	0 hrs
Supervised learning hours e.g. practical classes, workshops	0 hrs
Project supervision hours	0 hrs
Active learning and teaching hours total	**0** hrs
Placement hours	0 hrs
Guided independent study hours	140 hrs
Module duration (Total hours)	200 hrs

Module aims

1. To develop the understanding of power electronic devices into the control or provision of power supplies and in controlling electrical machinery and thus to design and prove electronics-based circuits for the control of electrical machines and power supplies.
2. To develop the students' abilities to analyse techniques and performance of ac and dc electric drives by an in-depth knowledge of the principles of operation in order to exercise the ability to select an appropriate system for a given task.

Module Learning Outcomes

At the end of this module, students will be able to:

1	Comprehensively understand the principles and operation of the electronic devices available for power applications.
2	Critically analyse and evaluate the effects of power electronics equipment on electrical supplies and loads.
3	Apply appropriate techniques in the design of different types of converters.
4	Critically analyse the operating characteristics of the dc and ac electric drives with interaction to mechanical loads.
5	Critically evaluate the various types of electric drives used in industry and select the appropriate system for optimum performance.

Assessment

Indicative Assessment Tasks:
This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment 1: A 3-hour written exam covering outcomes 1, 2, 3 and 4. It is an unseen time-constrained.

Assessment 2: A laboratory practical work with report.

Assessment number	Learning Outcomes to be met	Type of assessment	Duration/Word Count	Weighting (%)	Alternative assessment, if applicable
1	1, 2, 3, 4	Examination	3 hrs	80%	
2	5	Practical	2000 words	20%	

Derogations

None

Learning and Teaching Strategies

The module will be delivered through lectures, tutorials and student-driven investigative work. A significant amount of the content is to be achieved through individual study. Approximately one third of the timetabled time will be devoted to formal lectures. The remainder of the time

will be allocated to tutorials and to individual study but also with some programmed access to lab/computer facilities, for practical investigation and analysis activities.

Welsh Elements

Programme is delivered in English and Chinese, however students can submit assessments in Welsh.

Indicative Syllabus Outline

Power Semiconductor Devices: Operation, characteristics, ratings, applications of diodes, thyristors, MOSFETs, IGBTs. Darlington-pair configuration, transistor as a switch. Analysis and calculation of power losses in power semiconductors. Selection of devices for particular tasks.

Thermal Consideration: Cooling systems and heat sinks. Thermal resistances. Thermal equivalent circuits. Heat transfer coefficient. Analysis and calculation of heat sink parameters.

AC–DC Converters - Rectifiers: Principle of operation of controlled rectifiers. Thyristor firing methods. Phase control firing circuits. Natural and forced commutation circuits. Single-phase and three-phase bridge rectifiers operating under different load conditions. Harmonics and power factor improvement.

DC–DC Converters: Principle of operation and characteristics of step-down, step-up, inverting converters. Duty ratio and voltage control.

DC–AC Converters - Inverters: Principle of operation and characteristics of single-phase and three-phase inverters. Pulse width modulation. Voltage control and harmonics.

Power Electronic Applications: Switching mode power supplies, Uninterruptible power sources. Power factor correctors. Static voltage regulators.

Introduction to Electric Drives: Mechanical system requirement for electric drives, Torque, speed and inertia in electric drive systems, Steady state and dynamic conditions, Coupling mechanisms, Rotary to linear motion, Gears, Optimum gear ratio, Types of load, Four quadrant operation.

Industrial Motor Control: Control devices, Induction motor control applications: Across-the-line starter, Reversing the direction of rotation, Primary resistance starting, Star-delta starting.

DC Electric Drives: Methods of speed control of dc motors, Speed control by controlled rectifiers, Dynamic model of dc motor, Block diagram and transfer function of dc motor, Dynamic behaviour of dc motor, Torque, speed and position sensors and feedbacks, Closed-loop torque, speed and position control, Resistance starting, Dynamic braking.

AC Electric Drives: Methods of speed control of ac motors, Variable frequency converter and cycloconverter, Speed control of squirrel cage induction motor by static voltage regulator, Speed control of wound rotor induction motor with recovering slip power.

Motor Selection: Power range, Load requirements, Thermal consideration, duty cycle and rating, Enclosures and cooling, Dimension standards, Energy saving applications.

Indicative Bibliography

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads:

Hughes, A. (2013) Electric Motors and Drives: Fundamentals, Types and Applications, 4th Edn., Oxford: Newnes.

Other indicative reading:

Rashid, M. H. (2012) Power Electronics: Devices, Circuits, and Applications, 4th Edn., Harlow: Pearson Education.

Wildi, T. (2014) Electrical Machines, Drives and Power Systems, 6th Edn., Harlow: Pearson Education.

Administrative Information

For office use only	
Initial approval date	24/09/2020
With effect from date	24/09/2020
Date and details of revision	22/07/2025 revalidated, LO 5 reworded not changed, assessment changed from 100% exam to 80 exam and 20% practical, updated template, derogation removed
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