Prifysgol Wrecsam
Wrexham University

Module specification

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Module Code	ENG6D3
Module Title	Power Electronics and Electrical Machines
Level	6
Credit value	20
Faculty	FACE
HECoS Code	100164
Cost Code	GAME
Pre-requisite module	N/A

Programmes in which module to be offered

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

Breakdown of module hours

Learning and teaching hours	21 hrs
Placement tutor support hours	0 hrs
Supervised learning hours e.g. practical classes, workshops	21 hrs
Project supervision hours	0 hrs
Active learning and teaching hours total	**42 hrs**
Placement hours	0 hrs
Guided independent study hours	158 hrs
Module duration (Total hours)	**200 hrs**

Module aims

This module integrates advanced theoretical study with applied laboratory investigation. Students critically evaluate techniques, interpret data, and justify design or methodological decisions within a professional context. The combination of theory and practice cultivates independent learning, innovation, and readiness for individual project or dissertation work.

This module aims to develop students' understanding of the operation of power electronic systems and electrical machines, and to equip them with the analytical techniques required to design, analyse, and evaluate applications involving power electronics and electrical machinery.

Module Learning Outcomes

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

1	Critically analyse and evaluate the operation, performance and efficiency of power electronic devices and systems used in industrial power conversion applications (AHEP-4 C7).
2	Apply established analytical and calculation methods to analyse and evaluate the operational parameters of electrical machines and power electronic systems.
3	Select, use, and justify appropriate power electronic equipment and components to install, test, and maintain power electronic converters and electrical machines safely and effectively, exercising informed judgment in terms of performance, safety, and environmental and sustainability implications (AHEP-4 C7).

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: Portfolio

The assessment may comprise of a portfolio including practical laboratory investigations, problem-solving activities, and Moodle quiz covering key topics in power electronics and electrical machines.

Assessment number	Learning Outcomes to be met	Type of assessment	Duration/Word Count	Weighting (%)	Alternative assessment, if applicable
1	1-3	Portfolio	3000	100	N/A

Derogations

Credits shall be awarded by an Assessment Board for those modules in which a pass mark 40% has been achieved, with a minimum mark of 30% in each assessment element.

Learning and Teaching Strategies

Learning combines theoretical exploration with applied laboratory investigation to bridge conceptual understanding and professional competence. Students critically analyse data, test approaches, and evaluate outcomes in practical settings. Blended delivery through the Virtual Learning Environment supports flexibility and reflection. Tutorials focus on independent enquiry, innovation, and readiness for project or dissertation work.

Welsh Elements

This module will be delivered through the medium of English; however, students have the option to submit their assessments in the medium of Welsh. While this module is not currently offered fully through Welsh, Welsh language support and guidance are available, and some learning materials or tutorial discussions may incorporate Welsh elements where appropriate. To further promote bilingual learning, all students have the opportunity to take the 20-credit *Welsh for STEM* short course, designed to develop confidence and subject-specific language skills in both English and Welsh.

Indicative Syllabus Outline

Power Semiconductor Devices and Thermal Performance:
Critical analysis of the operation, characteristics, and application of power semiconductor devices, including diodes, thyristors, MOSFETs, and IGBTs, with evaluation of switching behaviour, power losses, and thermal considerations such as heat transfer, cooling systems, and thermal equivalent circuits.

Power Electronic Converters and Applications:
Evaluation of the operating principles and performance of DC–DC converters, controlled rectifiers, and inverters, including voltage control strategies, pulse width modulation, and their application in industrial systems such as power supplies, power factor correction, and voltage regulation.

Transformer Analysis and Performance:
Application of established analytical methods to transformer operation, including equivalent circuits, phasor diagrams, efficiency, voltage regulation, and power flow, supported by parameter determination and loss evaluation.

Electrical Machine Modelling and Analysis:
Analysis of DC machines and induction motors using mathematical models, including torque generation, efficiency, performance characteristics, equivalent circuits, and testing methods such as no-load and blocked-rotor tests.

Device Selection and Practical Implementation:
Selection and justification of appropriate power electronic components and configurations for specific industrial applications, considering operational requirements, safety, and system constraints.

Testing, Instrumentation, and System Integration:
Application of practical techniques for installation, testing, and maintenance of power electronic converters and electrical machines, including the use of instrumentation, performance measurement, and evaluation of system reliability and safety.

Indicative Bibliography

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

Essential Reads:

T. Wildi, *Electrical Machines, Drives and Power Systems*, 6th Ed. Harlow: Pearson Education, 2014.

Other indicative reading:

M. H. Rashid, *Power Electronics: Devices, Circuits, and Applications*, 4th Ed. Harlow: Pearson Education, 2018.

J.Bird, *Electrical Circuit Theory and Technology*, 7th Ed. Oxon: Routledge, 2022.

S. Chapman, *Electric Machinery Fundamentals*. 5th ed. McGraw-Hill Education, 2012

Plus, various others to be signposted on Moodle.

Administrative Information

For office use only	
Initial approval date	June 2026
With effect from date	September 2026
Date and details of revision	
Version number	1