Module specification

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Refer to the module guidance notes for completion of each section of the specification.

Module code	ENG6AL
Module title	Power Electronics and Electrical Drives
Level	6
Credit value	20
Faculty	FAST
Module Leader	Dr Yuriy Vagapov
HECoS Code	100188
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BEng (Hons) Mechatronics Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	60 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	0 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**0** hrs
Placement / work based learning	0 hrs
Guided independent study	140 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	24/09/2020
With effect from date	24/09/2020
Date and details of revision	
Version number	1

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	Analyse the operating characteristics of the dc and ac electric drives with interaction to mechanical loads.
5	Evaluate the various types of electric drives used in industry and select the appropriate system for optimum performance.

Assessment

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.

Indicative Assessment Tasks:

All learning outcomes will be assessed by means of a 3-hour written examination. It is an unseen time-constrained examination with a fixed number of questions, typically six, where students are required to answer only four out of the six possible.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1, 2, 3, 4, 5	Examination	100%

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%

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.

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.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas. Click here to read more about the Glyndwr Graduate attributes

Core Attributes
Engaged

Key Attitudes
Curiosity

Practical Skillsets
Critical Thinking