

Module Title	Power Electronics and Drives
Module Number	M3X0006
Brief statement of Content	This module provides an in depth understanding of power electronic circuits and systems and drive systems for electric machines
JACS code	
ASC Group	
Date of Validation and Credit Calibration (If different from date of validation)	
Module Value	20
Level	6
University Code	
Faculty responsible for delivery	
Pre-requisite/co-requisite modules	None
Programme Associations:	None
• Compulsory	Yes (for Honours students)
• Core	No
• Optional	Yes (for Ordinary degree students)
• Elective	No

Aim/s
To develop in the student an in depth understanding of power electronic circuits and systems, their use in power supply and energy storage systems and their use in electrical drive systems. To develop the appropriate skills necessary for the analysis and design of power electronic systems including electrical drive systems.

Module Intended Learning Outcomes (MILOs)

Upon successful completion of this module, the student will be able to:

1. Analyse and design power electronic systems employing established and emerging techniques.
2. Analyse electrical drive systems and apply established and emerging techniques to ensure effective operation of these systems.

Indicative Content:

Power Electronic Converters - Power electronic components and circuits. AC to DC, DC to AC, DC to DC, and AC to AC conversion processes.

Calculation of peak, mean and RMS values of voltage and current associated with each converter. Maximum Power Point Tracking.. Grid synchronization. Calculation of harmonic distortion factors. Switching losses, conversion efficiency (for example in solar PV).Power factor calculations. Protection of devices.

Switch Mode and Uninterruptible Power Supplies -Design and analysis of switch mode circuits and systems.

Design and analysis of uninterruptible power supply systems, incorporating energy storage systems. Charge and discharge control algorithms for various battery types.

DC and AC Motor Drives including an overview and analysis of electrical machine systems - analysis of AC machine and DC machine systems and their representation by equivalent circuits.

Application of power electronic converters to motors to provide variable speed and variable torque.

Analysis of electrical drive systems, consisting of DC and AC machines and a broad range of power electronic converters. Analysis and design of speed and torque control techniques for electrical drives, including vector control.

Teaching & Learning Strategy and Implementation

This module will be taught using a range of teaching and learning strategies which may include formal lectures with use of presentations, practical demonstrations, laboratory exercises, software simulations, worked examples, design exercises and group work where appropriate. The student will be expected to support the learning process by extensive background reading and research investigations into the topics covered.

Indicative Contact hours:

Lecture	60
Seminar	n/a

Tutorial	n/a
Laboratory, Studio or Workshop	30
Student Private Study	110
TOTAL Hours:	200
Semester(s) in which normally delivered	1 and 2

Assessment	
The student will typically be required to complete two practical laboratory based assignments and one end exam. Assignment 1: (15%) Assignment 2: (15%) Exam (70%): Typically, students would be required to sit a 2 hour exam answering 3 out of 4 questions that cover both outcomes 1 and 2.	
Coursework:	30 %
Examination:	70 %
Oral Examination/ Presentation:	n/a
Work Based:	n/a

Details of Outcome Assessment:	
Outcomes	Assessment Criteria: To achieve each outcome a student must demonstrate the ability to :
1. Analyse and design power electronic systems employing established and emerging techniques	- Analyse and show a detailed understanding of the circuits used for the conversion of AC > DC, DC > AC, AC > AC and DC > DC incorporating high frequency techniques. - Apply appropriate methods for improving efficiency of operation.
2. Analyse electrical drive systems and apply established and emerging techniques to ensure effective operation of these systems.	- Analyse and show a detailed understanding of a range of single and three phase rectifying circuits for AC to DC conversion. - Analyse and show a detailed understanding of the configuration of, and the control techniques employed in commercial drives. - Apply appropriate design methods for the control of a motor for improved stability.

Physical Resource Needs:	
Reading List	
Essential Texts	Rashid M H. <i>Power Electronics Handbook, Devices, Circuits and Applications</i>, 3rd Edition. Elsevier. ISBN: 0123820367 (2010) Wildi T. <i>Electrical Machines, Drives and Power Systems</i>. Prentice Hall. ISBN: 0131969188. (2005) Mohan N. <i>Power Electronics</i> Wiley (2011)

Background Reading	Vukosavic S <i>Electrical Machines (Power Electronics and Power Systems)</i> Springer (2013) ISBN-10: 1461403995 Lander C W, <i>Power Electronics, 3rd Edition</i>. McGraw-Hill Higher Education. ISBN: 0077077148 (1993) Krishnan R. <i>Electric Motor Drives Modelling, Analysis, and Control</i>. Prentice Hall. ISBN: 0130910147 (2001) Mohan N, Undeland T M, Robbins W P. <i>Power Electronics, Converters, Applications and Design, 3rd Edition</i>. John Wiley & Sons Inc. 978-0471226932 (2002) Fitzgerald A E, Kingsley C, Umans S D. <i>Electric Machinery, 6th Edition</i>. McGraw-Hill Higher Education. ISBN 978-0071230100. (2002) Hughes A. <i>Electric Motors and Drives: Fundamentals, Types and Applications</i>. Newnes ISBN: 0750647183 (2005)
Journals	
Web Resources	
Equipment Requirements:	
Room Requirements	PCs with Simulation software, laboratory with suitable power equipment including motors and drives.
Staff Resource Needs:	
Module Co-ordinator	Mr Gordon Dickers
Staff Delivering Module	Mr Gareth Jones Mr Gordon Dickers