# ES2G1-15 Power Electronics

## 21/22

**Department**
School of Engineering
**Level**
Undergraduate Level 2
**Module leader**
Christos Mias
**Credit value**
15
**Assessment**
60% coursework, 40% exam
**Study location**
University of Warwick main campus, Coventry

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## Description

### Introductory description

Practically all electronic equipment, whether domestic or industrial, requires power conditioning to deliver the energy for it to operate correctly. This is using electronics for power processing, not information processing. The applications vary widely from power supplies for laptops and mobile phone chargers, through industrial motor drives, hybrid and electric vehicle drives, electric rail transport, to solar and wind energy systems and power transmission and distribution systems. Learning of power electronic devices and power electronic converters is therefore essential and it is the subject of this module.

### Module aims

The module aims are: • To introduce the concept of power electronics as power processing and control, and to present the range of applications of power electronics in today’s society. • To introduce power semiconductor devices as basic switching elements used in power electronic converters, and describe the theory of their operation. • To introduce power electronic converters, explain their operation and give examples of applications. • To develop an understanding of the issues present in converter and device design, including the impact of physical layout and fabrication techniques

### 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.

Introduction to power electronics, devices and applications.
Semiconductor theory
Power semiconductor device physics: PiN and Schottky diodes, thyristors, bipolar transistors, MOSFETs, IGBTs.
An introduction to wide bandgap semiconductors and devices.
Power semiconductor device fabrication.
Power converters: AC-DC converters, DC-DC converters, isolated converters, bridges and introduction to DC-AC inverters.
Non-ideal cases, commutation and overlap, introduction of power quality and filters.
Simulation of converters and devices.
Applications of power electronics.

## Learning outcomes

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

- Simulate the operation of power semiconductor devices
- Design and analysis of a simple power DC/DC converter
- Analyse the power quality and harmonics. Design the basic filters required to smooth the converter output and to improve the power quality.
- Explain the practical issues in converter design
- Measurement of a power electronic circuit performance
- Understand power DC/AC inverters
- Design and analysis of simple power AC/DC converters

## Indicative reading list

Power Electronics: a first course, Ned Mohan, ISBN : 978-1-118-07480-0, Wiley 2012.

## Subject specific skills

Communicate technical information with others at all levels, including technical reports and the use of digital tools.
Follow a methodical approach to engineering problem-solving.
Establish and report engineering design briefs.
Produce electrical drawings using Computer-Aided Design(CAD) and manual systems.
Design functional electronic systems and circuits from component level.
Communicate effectively on complex engineering matters with technical and non-technical audiences.

## Transferable skills

Hold paramount the health and safety of themselves and others, and model health and safety-conscious behaviour.
Self-motivated, work independently and take responsibility for their actions. Set themselves challenging personal targets and make own decisions.

Communicate confidently to create and maintain working relationships. Be respectful.
Prioritise quality. Follow rules, procedures and principles in ensuring work completed is fit for purpose, and pay attention to detail / error checks throughout activities.
Exercise responsibilities in an ethical manner, with openness, fairness and honesty.
Commit to personal learning and professional development.

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## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 12 sessions of 1 hour (18%) |
| Tutorials | 6 sessions of 1 hour (9%) |
| Supervised practical classes | 9 sessions of 1 hour (14%) |
| Work-based learning | 30 sessions of 1 hour (46%) |
| Online learning (scheduled sessions) | 4 sessions of 2 hours (12%) |
| Online learning (independent) | (0%) |
| Total | 65 hours |

### Private study description

85 hours guided independent learning (including VLE use).

## Costs

No further costs have been identified for this module.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group D

| | Weighting | Study time |
|---|---|---|
| Laboratory based assignment 1 | 30% | |
| PSPICE simulation of power electronic devices for the optimisation of power converters. | | |
| Laboratory based assignment 2 | 30% | |
| Design and test of a DC to DC boost converter. | | |
| Online Examination | 40% | |

| | Weighting | Study time |
|---|---|---|
| Centrally-timetabled online assessment - Online multiple choice assessment<br><br>~Platforms - AEP,QMP | | |

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- Online examination: No Answerbook required

### Feedback on assessment

Solutions to questions in problem sheets and discussion of the solutions during example classes.
Feedback on marked assignments.
Cohort level feedback on examinations

Past exam papers for ES2G1

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## Availability

## Courses

Course availability information is based on the current academic year, so it may change.
This module is Core for:

- Year 3 of DESA-H360 Undergraduate Electromechanical Engineering (Degree Apprenticeship)