ELCT3005

Power Electronics

Session 1, In person-scheduled-weekday, North Ryde 2022

School of Engineering

Contents

General Information

Unit convenor and teaching staff
Lecturer
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Wednesday 2:00-4:00 pm, upon email appointment

Credit points
10

Prerequisites
(ELEC2070 or ELEC270) and (ELEC2005 or (ELCT2005 or ELEC295) or (ELEC2075 or ELEC275))

Corequisites

Co-badged status

Unit description
This unit develops fundamental knowledge and skills in the area of power electronics converters and their typical applications. Foundation knowledge in semiconductor devices, passive components and general circuit analysis is assumed. The unit extends those fundamentals to electrical energy conversion systems operating with relatively high current and voltage levels. Topics covered include: an introduction on power semiconductors and converters; power computations essential in analysing and designing power electronics circuits; dc-dc converters and dc power supplies; single and three phase inverters and rectifiers; and power electronics applications. This unit uses problem/team based learning approach, where students have to choose a project topic and their team members, and then design, simulate, build and test a converter prototype. PLECS simulation tool and a control board are used in the development of the project.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Describe the relationship between physical structure and performance

characteristics of passive electrical components and active semiconductor power electronic devices;
ULO2: Analyse and simulate power electronic circuits and derive accepted performance parameters, including power quality metrics;
ULO3: Design and critically assess key aspects of power converters such as AC-DC, DC-DC and DC-AC converters;
ULO4: Design, model/build and analyse a complete power converter application based on a set of user specifications;
ULO5: Demonstrate knowledge of emerging applications of power electronics in the renewable energy systems, energy storage systems and micro-grids;

General Assessment Information

Grading and Passing Requirement for Unit

- In order to pass this Unit a student must obtain a mark of 50 or more for the Unit (i.e. obtain a passing grade P, CR, D, or HD).
- For further details about grading, please refer below in the policies and procedures section.
- If you receive special consideration for the oral presentation and demonstration of the Project, a supplementary conventional exam will be scheduled by the faculty during a supplementary exam period, typically about 3 to 4 weeks after the normal exam period. By making a special consideration application for the oral presentation and demonstration of the Project you are declaring yourself available for a conventional exam during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to applying. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Hurdle Requirements

- Students must attend and participate in at least **6 of the 7 weekly PC Labs** (Weeks 1-7) to pass this unit.
- Students must attend and participate in at least **5 of the 6 weekly Project Labs** (Weeks 8-13) to pass this unit.

Late Submissions and Re-submissions

- Online quizzes, in-class activities, or scheduled tests and exam must be undertaken at

the time indicated in the unit guide. Should these activities be missed due to illness or misadventure, students may apply for Special Consideration.

- All other assessments must be submitted by 5:00 pm on their due date.
- Should these assessments be missed due to illness or misadventure, students should apply for Special Consideration.
- Assessments not submitted by the due date will receive a mark in accordance with the late submission policy as follows:
    - A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark: 12 to 24 hours late = 10% deduction; for each day thereafter, an additional 10% per day or part thereof will be applied until five days beyond the due date. After this time, a mark of zero (0) will be given. For example, an assessment worth 20% is due 5 pm on 1 January. Student A submits the assessment at 1 pm, 3 January. The assessment received a mark of 15/20. A 20% deduction is then applied to the mark of 15, resulting in the loss of three (3) marks. Student A is then awarded a final mark of 12/20.
- Re-submissions of work are not allowed.

Students are reminded of the University policies regarding assessment, academic integrity and disruption to studies.

Requests for extension on assessable work are to be made to the Unit Coordinator but will only be considered in the event of illness or misadventure.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignments (PC Labs)	20%	No	Weeks 2-7
Assessment (Project)	50%	No	Weeks 13-14
Pre-Class Quiz (Lectorials)	10%	No	Weeks 2-7
Class Quiz (Lectorials)	20%	No	Week 8

Assignments (PC Labs)

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 12 hours
Due: **Weeks 2-7**
Weighting: **20%**

Evaluation of Lab activity during first part of the semester. This evaluation focuses on students ability to perform modelling, design and implementation of power electronics systems using PLECS.

On successful completion you will be able to:

- Analyse and simulate power electronic circuits and derive accepted performance parameters, including power quality metrics;
- Design and critically assess key aspects of power converters such as AC-DC, DC-DC and DC-AC converters;
- Design, model/build and analyse a complete power converter application based on a set of user specifications;

Assessment (Project)

Assessment Type [1]: Project
Indicative Time on Task [2]: 20 hours
Due: **Weeks 13-14**
Weighting: **50%**

This is the major assessment of this Unit. It will consist of 3 individual assessments and 1 team assessment, as follows: - Individual assessments: ◦ Oral presentation and demonstration of the project; ◦ Peer assessment regarding the actual contribution of each team member; ◦ Evaluation of project log book of each team member. - Team assessment: ◦ Project report to be submitted in iLearn by each team.

On successful completion you will be able to:

- Describe the relationship between physical structure and performance characteristics of passive electrical components and active semiconductor power electronic devices;
- Analyse and simulate power electronic circuits and derive accepted performance parameters, including power quality metrics;
- Design and critically assess key aspects of power converters such as AC-DC, DC-DC and DC-AC converters;
- Design, model/build and analyse a complete power converter application based on a set of user specifications;
- Demonstrate knowledge of emerging applications of power electronics in the renewable

energy systems, energy storage systems and micro-grids;

Pre-Class Quiz (Lectorials)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 5 hours
Due: **Weeks 2-7**
Weighting: **10%**

Students are expected to go through the iLearn content, understand the theory and attempt the online quiz each week prior to attending the class activities of that week.

On successful completion you will be able to:

- Describe the relationship between physical structure and performance characteristics of passive electrical components and active semiconductor power electronic devices;
- Analyse and simulate power electronic circuits and derive accepted performance parameters, including power quality metrics;
- Design and critically assess key aspects of power converters such as AC-DC, DC-DC and DC-AC converters;

Class Quiz (Lectorials)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 5 hours
Due: **Week 8**
Weighting: **20%**

A quiz is scheduled right after the mid-semester break. The quiz will assess both factual knowledge and problem solving.

On successful completion you will be able to:

- Describe the relationship between physical structure and performance characteristics of passive electrical components and active semiconductor power electronic devices;
- Design and critically assess key aspects of power converters such as AC-DC, DC-DC and DC-AC converters;
- Demonstrate knowledge of emerging applications of power electronics in the renewable energy systems, energy storage systems and micro-grids;

[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

UNIT WEBSITE

- The iLearn website for this unit can be found at: https://ilearn.mq.edu.au/login/.
    - *Note! All information and communications relevant to this Unit will be via the iLearn website.*

TEXTBOOK

- Power Electronics: A First Course, November 2011, Ned Mohan, Wiley, ISBN: 9781118215265 (Digital version recommended).
    - *Note! Links will be provided to specific sections of the Digital version in iLearn for each Lectorial.*
- *Remark: All students are expected to have access to this textbook.*
- Support Website: http://www.wileydigitalsolutions.com.au/support/article/student/ – link to the Wiley's digital solutions support page and live chat for students.

LECTORIALS

- There will be a Lectorial (3 hours) for every week in the first part of the semester (Weeks 1-7). The Lectorial will comprise of: - discussion session on fundamental knowledge; - practical examples; - interactive problem solving involving the students.
- Lectorials are a combination of traditional lecture and tutorial teaching modes, and are designed to improve student engagement inside/outside classes.
- The Lectorials are organised in a flipped classroom fashion.
- Outside class
    - links to E-Text specific sections, brief videos and/or lecture notes are posted in iLearn each week.
    - students are expected to read these E-Text sections, try to solve any given examples, and watch any videos and/or read any posted notes prior to attending the Lectorials.

- Inside class
    - brief discussion sessions on fundamental principles.
    - practical examples.
    - interactive problem solving involving students.

LABORATORIES

- PC Lab activities start from Week 1 and take place once a week (Weeks 1-7) according to the Unit schedule.
    - *Note! Students must enrol in one of the available weekly Lab sessions.*
- Interactive PC Labs use PLECS software platform to assist with the modelling and design of power electronics converters.

On-campus activities commence in Week 1. Students should contact the Unit convenor as soon as possible if they are unable to get back to campus in time.

PROJECTS

- Project activities take place once a week (Weeks 8-13) according to the Unit schedule.
    - *Note! Teams must enrol in one of the two available weekly Project sessions.*
- The team Project is the core component of this Unit. The Projects cover design and practical aspects of power electronics to be used in future Electrical, Electronics and Mechatronics units.
- Students are required to form teams.
    - *Note! When forming teams, students should agree in which weekly Project session they want to enrol.*
    - *All Project activities are performed in teams;*

TECHNOLOGY

- The laboratory work will rely on the use of PLECS software platform.
- PLECS Standalone software can be downloaded for free from Plexim website and/or or can be used on dedicated Lab PCs.
    - *Note! The PLECS server license will cover only PCs connected to MQ online network.*
- Each team will be given a hardware kit for the second half of the semester to perform experimental activities.

COMMUNICATIONS

- Students are reminded the University will communicate all official notices by email to official MQ student's account. Students should read their @student.mq.edu.au email

regularly or forward it to an account they check regularly.

- All announcements and other communication regarding this Unit will be delivered via the iLearn platform.

WEB RESOURCES

- **PLECS support:**
  - https://plexim.com/support
    - PLECS videos
    - Application examples
    - Technical solutions
    - Installation help

Unit Schedule

Refer to iLearn website for a detailed Unit schedule.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released

directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	ULO1, ULO2, ULO5
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	ULO1, ULO2, ULO5
	1.3 In-depth understanding of specialist bodies of knowledge	ULO1, ULO2, ULO3, ULO5
	1.4 Discernment of knowledge development and research directions	
	1.5 Knowledge of engineering design practice	ULO1, ULO2, ULO5
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	ULO5
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	ULO1, ULO2, ULO5
	2.2 Fluent application of engineering techniques, tools and resources.	ULO1, ULO2, ULO3, ULO4, ULO5
	2.3 Application of systematic engineering synthesis and design processes.	ULO1, ULO2, ULO3, ULO4, ULO5
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	ULO3, ULO5
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	ULO4
	3.2 Effective oral and written communication in professional and lay domains.	ULO4
	3.3 Creative, innovative and pro-active demeanour.	ULO4, ULO5

	3.4 Professional use and management of information.	ULO4, ULO5
	3.5 Orderly management of self, and professional conduct.	ULO4
	3.6 Effective team membership and team leadership	ULO4