

University of Waterloo
Department of Electrical & Computer Engineering
ECE 663: Energy Processing
Spring 2021

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Lectures: [REDACTED]

Term Period: Lectures: May 10-August 5, 2021

COURSE OUTLINE

Introduction to Power Electronics

Evolution, Scope and Applications

Power Semiconductor Devices

Diodes, Thyristors, Controllable Switches (actual and ideal characteristics, switch losses, overview of BJT, MOSFET, GTO, IGBT, and IGCT), wide-bandgap devices, power losses in switches

Power Converter Topologies

Line-Frequency Diode-Rectifiers, Line-Frequency Phase-Controlled Converters, dc-to-dc switch-mode converters, dc-to-ac and ac-to-dc switch-mode converters, interleaved converters, multilevel converters, ac-to-ac converters

Control Techniques in Power Converters

Hysteresis control, Pulse Width Modulation (PWM) and linear power amplifier concept, Phase-Shift Modulation, Space Vector Modulation, square-wave control, Selective Harmonic Elimination, average modeling of converters, controller design

Power Quality:

Harmonic Distortion, Power Quality Indices, Input/Output Filters

Applications of power electronic converters

A subset of: Switch-mode dc power supplies, Motor drives, HVDC Transmission Systems, Flexible AC Transmission Systems (FACTS), Grid interface of renewable energy sources, Active power filter, Grid interface of energy storage systems, Microgrids

Project: The project description will be given at the beginning of the second month of the term. The project work will be performed individually. The deliverable is a report in the IEEE Transactions paper format, composed of the following components: literature review, analysis, modeling, simulation results and suggestions for improvements to the existing solutions.

References:

- Mohan, Undeland, and Robbins, *Power Electronics: Converters, Applications, and Design*, 2nd or 3rd Edition, John Wiley & Sons, Inc., 1995 or 2003.
- D.W. Hart, *Power Electronics*, McGraw Hill, 2011.
- Mehrdad Kazerani, *ECE 663 Lecture Slides*.

LEARN:

LEARN will be used for administering online lectures, as well as posting course materials, drill problems, project and announcements. It will also be used for uploading the deliverables by the students to the appropriate drop boxes.

GRADING SCHEME

Project	40%
4×24-hour. Quizzes	60%
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Total	100%

Note: Those who audit the course are responsible for the project only.

Note: Missing a quiz without a valid excuse will result in a mark of ZERO. Missing a quiz with a valid excuse will result in shifting the corresponding weight to the rest of the quizzes. In order to pass the course,

the student has to obtain a passing mark in each and every component of the course (i.e., project and quizzes).

Online Lectures:

All lectures will be online. The details about online events will be announced on LEARN. Recorded videos of live online lectures will be made available for streaming.

*****Important*****

Please visit the following webpage for information regarding “Student Responsibilities, Regulations and Policies” and “Academic Integrity”.

<https://uwaterloo.ca/engineering/current-graduate-students>

“The AccessAbility Services located in Needles Hall North, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AccessAbility Services office at the beginning of each academic term.

In Person: Needles Hall North, Room 1401

Phone: 519-888-4567, ext. 35082

Fax: 519-746-2401

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