

University of Waterloo
Department of Electrical & Computer Engineering
ECE 663: Energy Processing
Spring 2022

Instructor: Mehrdad Kazerani
E-mail: mkazerani@uwaterloo.ca

Lectures: XXXXXXXXXX

COURSE OUTLINE

Introduction to Power Electronics

Evolution, Scope and Applications

Overview of Power Semiconductor Devices

Diodes, Thyristors, Controllable Switches, Wide-Bandgap Devices, Power Losses in Switches

Power Converter Topologies

Line-Frequency Diode-Rectifiers, Line-Frequency Phase-Controlled Converters, Switch-Mode DC-to-DC Converters, Switch-Mode DC-to-AC and AC-to-DC 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 early in the term. The project will be done and reported 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*.
- Related Journal Papers

LEARN:

LEARN will be used for 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%
Final Exam	60%
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Total	100%

Notes:

- Those who audit the course are responsible for attendance and the project only.
- In order to pass the course, a passing mark must be obtained in each and every component of the course (i.e., project and final exam).

*****Important*****

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

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

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