

**University of Waterloo**  
**Department of Electrical & Computer Engineering**  
**MTE 420: Power Electronics and Motor Drives**  
**Fall 2013**

**Instructor:** Mehrdad Kazerani (EIT 4171)  
Office Hour: Wednesdays, 4:30-5:30 pm  
Phone: (519) 888-4567, x-33737  
E-mail: mkazeran@ecemail.uwaterloo.ca

**Lectures:** Thursdays, 3:30-6:20 pm, E5-3102

**Tutorials:** Tuesdays, 7:00-7:50 pm, CPH-3679 (no tutorial session in first week of lectures)

**Laboratory:** CPH 1333

**Lab Technical Support:** Gannayya Bommali, CPH 1333A, x-33815, gbommali@uwaterloo.ca

**Teaching Assistant:** Marten Pape, EIT 4142, x-37472, marten.pape@uwaterloo.ca

**COURSE OUTLINE**

	<b>Lecture Hours</b>
<b>1. Introduction to power electronics:</b>	<b>1</b>
- Evolution and scope	
- Potential applications	
<b>2. Overview of power semiconductor devices:</b>	<b>3</b>
- Switching characteristics of Diode, Thyristor, and Controllable switches (BJT, MOSFET, GTO, IGBT, MCT and IGCT).	
- Switch power losses	
<b>3. Computer simulation of power electronic circuits:</b>	<b>1</b>
- Introduction to PSIM, a circuit-oriented simulator for simulation of power electronic circuits.	
<b>4. Analysis, design, control and applications of power converters:</b>	<b>24</b>
- Diode rectifiers	
- Phase-controlled converters	
- DC-to-DC switch-mode converters	
- DC-to-AC and AC-to-DC switch-mode converters	
- Hysteresis and Pulse Width Modulation (PWM) techniques	
- Industrial applications: DC motor drives, Brushless DC Motor Drives, Stepper Motor Drives, Switched Reluctance Motor Drives and Power Factor Correction.	
<b>5. Waveform Quality:</b>	<b>3</b>
- Harmonic distortion and EMI caused by power converters	
- Waveform quality indices: Distortion Factor (DF), Total Harmonic Distortion (THD), Form Factor (FF), Crescent Factor (CF), Power Factor (PF)	
- Input and output filter design	
<b>6. Practical Aspects of Converter Design:</b>	<b>4</b>
- Thermal management	
- Snubber circuits	
- Gate/base drivers	

**Labs:**

- Diode Rectifier
- Thyristor Converter
- DC-to-DC Converter
- DC Motor Control
- DC-to-AC Converter (Inverter)

Labs start on September 27, 2013. Labs 1-5 run from September 27, 2013 to December 2, 2013.

The experiments will be performed in groups of 2 students. Each group submits one report for each lab. Pre-labs are done and submitted individually.

**Simulation Project:**

- Computer-Aided Design and Simulation of Power Electronic Circuits

The simulation project has no specific location and will run in parallel with labs 4 and 5. The project will be done in groups of 2 students (the same groups as in labs). Each group submits one report for the project.

**Textbooks:**

- Mohan, Undeland, and Robbins, *Power Electronics: Converters, Applications, and Design*, second or third edition, John Wiley & Sons, Inc., 1995 or 2003.
- D.W. Hart, *Power Electronics*, McGraw Hill, 2011.

**References:**

- M. Kazerani, MTE 420 *Lecture Slides*.
- Theodore Wildi, *Electrical Machines, Drives and Power Systems, fifth edition*, Prentice Hall, 2002.
- Charles I. Hubert, *Electric Machines: Theory, Operation, Applications, Adjustment, and Control*, 2<sup>nd</sup> edition, Prentice Hall, 2002.
- Stephen J. Chapman, *Electric Machinery Fundamentals*, Forth Edition, McGraw-Hill, 2005.
- Mohamed A. El-Sharkawi, *Fundamentals of Electric Drives*, Brooks/Cole Thomson Learning, 2002.

**LEARN:**

LEARN will be used for uploading course materials, assignments, assignment solutions, lab instructions, old exams and announcements.

**Late Submissions:**

All deliverables must be submitted in-time (see the lab schedule and submission deadlines posted on LEARN) and electronically to the appropriate LEARN drop boxes. Pre-labs must be submitted in-time in order to be allowed in the lab to do the corresponding labs. Late submission of any lab or project report will result in a 5% mark deduction for each day of delay.

**GRADING SCHEME**

Midterm	20%
Labs and Project	25%
Final Exam	55%
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Total	100%

**\*\*\*Important\*\*\***

Please visit the following webpage for information on “understanding your course responsibilities”.  
[http://www.eng.uwaterloo.ca/~ugoffice/html/course\\_responsibilities.html](http://www.eng.uwaterloo.ca/~ugoffice/html/course_responsibilities.html)

Here are a few points from the webpage:

“Students are expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offence, or who need help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, TA, academic advisor, or the Undergraduate Associate Dean.”

“The AccessAbility Services located in Needles Hall, Room 1132, 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.”