

Course Outline (F2023)

ELE754: Power Electronics

Instructor(s)	Dr. David Xu [Coordinator] Office: ENG320 Phone: (416) 979-5000 x 556075 Email: dxu@torontomu.ca Office Hours: Tuesday 12-2PM
Calendar Description	A course in power electronics and solid-state converters. Major topics include switching devices (SCR, MOSFET, IGBT, GTO, etc.), non-isolated and isolated DC-DC switched-mode converters, diode and thyristor bridges, voltage-sourced converters (inverters and rectifiers), and industry applications of power electronics. Typical digital and analog control schemes for power electronic converters will also be discussed. Important concepts are illustrated through computer and/or hardware labs.
Prerequisites	ELE 504
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. "Power Electronics -- Converters, Applications, and Design" by N. Mohan, T.M. Undeland, and W.P. Robbins, 3rd Edition, 2003, John Wiley & Sons, ISBN 978-0-471-22693-2.
Reference Text(s):	1. "Fundamental of Power Electronics, Second Edition" by R.W. Erickson and D. Maksimovic, published by Springer Science+Business Media Inc.
Learning Objectives (Indicators)	<p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> 1. Interconnect the concepts of various engineering knowledge to design and solve the real world engineering problem. (1c) 2. Predict the outcomes of power converter experiment and justify the assumptions given. (3b) 3. Generate solutions for more complex power converter design. (4b) 4. Design and develop software to perform the given tasks in the project. (5a) 5. Demonstrate and explain the result using graphics, waveforms and others. (7c) 6. Perform projects and lab works in groups. (8a) 7. Design and develop power converters suitable for wind turbine and solar panel. (9a) <p>NOTE:Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p>
Course Organization	3.0 hours of lecture per week for 13 weeks 2.0 hours of lab per week for 12 weeks 0.0 hours of tutorial per week for 12 weeks

Teaching Assistants	Shirin Hosseini: shirin.hosseini@torontomu.ca Uday Kiran Elemasetty: uelemasetty@torontomu.ca																		
Course Evaluation	<table border="1" data-bbox="428 243 1354 772"> <thead> <tr> <th colspan="2" data-bbox="428 243 1354 302">Theory</th> </tr> </thead> <tbody> <tr> <td data-bbox="428 302 1240 361">Midterm Examination</td> <td data-bbox="1240 302 1354 361">25 %</td> </tr> <tr> <td data-bbox="428 361 1240 420">Final Examination</td> <td data-bbox="1240 361 1354 420">40 %</td> </tr> <tr> <td data-bbox="428 420 1240 478">Quizzes</td> <td data-bbox="1240 420 1354 478">10 %</td> </tr> <tr> <th colspan="2" data-bbox="428 478 1354 537">Laboratory</th> </tr> <tr> <td data-bbox="428 537 1240 596">Digital controlled power electronic platform</td> <td data-bbox="1240 537 1354 596">5 %</td> </tr> <tr> <td data-bbox="428 596 1240 655">Digital controlled dc-dc converter and dc motor drive</td> <td data-bbox="1240 596 1354 655">10 %</td> </tr> <tr> <td data-bbox="428 655 1240 714">Digital controlled IGBT inverter and induction motor drive</td> <td data-bbox="1240 655 1354 714">10 %</td> </tr> <tr> <td data-bbox="428 714 1240 772">TOTAL:</td> <td data-bbox="1240 714 1354 772">100 %</td> </tr> </tbody> </table> <p data-bbox="310 827 1463 1003">Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p>	Theory		Midterm Examination	25 %	Final Examination	40 %	Quizzes	10 %	Laboratory		Digital controlled power electronic platform	5 %	Digital controlled dc-dc converter and dc motor drive	10 %	Digital controlled IGBT inverter and induction motor drive	10 %	TOTAL:	100 %
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Examinations	Two quizzes are tentatively scheduled in the class of week 4 and week 10, half-hour each, open-book test; Midterm exam is approximately in Week 7, three hours, close-book; Final exam, during exam period, three hours, close-book; Details will be announced in D2L.																		
Other Evaluation Information	Two formal reports on the projects are required. Each report will be assessed not only on academic and laboratorial performance, but also on the communication skills exhibited.																		
Other Information	1) Each lab may contain micro-controller control code and experiment. The sample code (in C language) will be provided in D2L 2) A formal report is required for each lab. The reports should be submitted via D2L before the deadline. 3) The laboratory component is not only evaluated based on the reports but also the lab performance during the lab class.																		

Course Content

Week	Hours	Chapters / Section	Topic, description
1-3	9	pp.161-199	DC-DC Switch Mode Converters 1.1 Introduction

			<ul style="list-style-type: none"> 1.2 Non-isolated DC/DC Converters 1.3 Isolated DC/DC Converters 1.4 Choppers 1.5 Control of dc-dc converters
4-6	9	pp.79-160	<ul style="list-style-type: none"> Diode and Thyristor Rectifiers 2.1 Introduction 2.2 Single and three phase diode rectifiers 2.3 Total harmonic distortions and power factor 2.4 Single and three phase thyristor (SCR) rectifiers 2.5 Control of thyristor rectifiers
7	3		midterm
8-10	9	pp.200-248 & 399-434	<ul style="list-style-type: none"> Inverters (dc -ac converters) 3.1 Introduction 3.2 Single-phase Inverters 3.3 Three-phase IGBT Inverters 3.4 PWM techniques 3.5 Current source Inverters 3.6 Induction Motor Speed Control
11-12	6	pp.354-364 367-398 460-504	<ul style="list-style-type: none"> Applications 4.1 Introduction 4.2 Uninterruptible power supplies (UPS) 4.3 Power supplies 4.4 AC/DC Motor drives 4.5 Active power filters 4.6 Static var compensators 4.7 Electronic ballasts
13	3	pp.667-743	<ul style="list-style-type: none"> Design Considerations 5.1 Introduction 5.2 Snubber circuit design 5.3 Gate drive circuits 5.4 Heatsink design

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
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2-3	Tutorial	Digital controlled power electronic platform
4-8	Project 1	Digital controlled dc-dc converter and dc motor drive
9-13	Project 2	Digital controlled IGBT inverter and induction motor drive

University Policies

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: Academic Consideration Request (ACR) to submit this request.

For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.