MEMORIAL UNIVERSITY

Department of Electrical and Computer Engineering
Faculty of Engineering and Applied Science

Course Outline

ECE 6810

Fall 2021-2022

ECE 6810: Power Electronics

Instructor	**Mohsin Jamil**	**Teaching Assistants**	**Rasool Kahani**
E-mail	**mjamil@mun.ca**	**E-mail**	**rkahani@mun.ca**
Phone	**864-2751**	**Phone**	
Office Location	**EN-3031 / CSF-3124**	**Office Location**	**TBA**
Office Hours	**Mondays, 1:00 – 2:00 pm** **Wednesday, 1:00 – 2:00 pm**	**Office Hours**	**TBD**

Communication **Email: mjamil@mun.ca**

Website **http://online.mun.ca (D2L)**

CALENDAR ENTRY:

6810 Power Electronics is an overview of power semiconductor switches, an introduction to energy conversion and control techniques and examination of controlled rectifiers; phase-controlled converters; switch-mode dc/dc converters; variable frequency dc/ac inverters; ac/ac converters; gate and base drive circuits; design of driver and snubber circuits; thermal models and heat sink design.

CR: the former ENGI 6856
PR: ECE 5300
LH: eight 3-hour sessions per semester
OR: eight 1-hour tutorial sessions per semester

PREREQUISITES: ECE 5300: ELECTRONICS CIRCUITS II

SCHEDULE:

LECTURE: Mondays, Wednesdays, and Fridays, 9:00 – 9:50 am
Room: EN4034
TUTORIAL: Thursdays, 2:00 – 3:00 PM, Room: EN1003
LABORATORY: Mondays, 2:00 – 4:50 pm, Room CSF-3103

CREDIT VALUE: 3 credit hours

COURSE TYPE: Elective

LAB TYPE: HANDS ON AND SOFTWARE BASED

LAB SAFETY:

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

ACCREDITATION UNITS:
Contact hours/week: **3/2/1**

CONTENT CATEGORIES: (expressed as %, no category can be $0 < c < 25$)

Math	Natural science	Complementary Studies	Engineering Science	Engineering Design
			75%	25%

RESOURCES:

TEXT BOOK

- "Power Electronics: Circuits, Devices and Applications" by Muhammad H. Rashid, Pearson, 4th Edition, 2014.

REFERENCES

- Power Electronics Handbook, Third Edition, Muhammad H. Rashid, Elsevier, 2011.
- Principles of Power Electronics, John G. Kassakian, Martin F. Schlecht and George C. Verghese, Pearson, 1991.
- Power Electronics: Converters, Applications and Design, Ned Mohan, Tore M. Undeland and William P. Robbins, Jon Wiley and Sons, 2nd Edition, 1995.
- High Power Converters and AC Drives, Bin Wu, IEEE Press, 2006.
- IEEE Explore, http://ieeexplore.ieee.org/Xplore/home.jsp

MAJOR TOPICS:

- Principles of Power Electronics
- Power Electronic Devices
- Introduction to Rectifiers
- Single Phase and Three Phase Diode Rectifiers
- Power Factor and Measure of Distortion
- Thyristor, Triac and IGBT
- Single Phase and Three-phase Controlled Rectifiers
- Pulse Width Modulation (PWM)
- DC-DC Converters
- AC-AC Converters

- Modulation Techniques –PWM, DM and WM
- Power Factor Correction and Switch Mode Rectifiers
- Single Phase and Three Phase Inverters
- Sinusoidal PWM Voltage Source Inverters
- Soft Switching and Resonant Converters
- Thermal Modelling and Design of Heat Sink
- Applications

ASSESSMENTS:

		Approximate Due Dates
Quizzes (2)	10%	
Quiz 1		October 04
Quiz 2		November 15
Assignments (4)	10%	
Assignment 1		September 27
Assignment 2		October 18
Assignment 3		November 01
Assignment 4		November 22
Midterm	20%	October 20
Laboratory	20%	Five Laboratory Experiments
Final Exam	40%	TBA (08-17 December 2021)

LEARNING OUTCOMES:

1. Learn fundamental principles of power electronics circuits.
2. Get familiarized with various types of power electronics devices such as Diode, BJT, MOSFETS, Thyristor, IGBT, GTO, SiC, etc.
3. Learn the design and operation of single phase and three phase diode rectifiers.
4. Get introduced to switching circuits with MOSFETS and Thyristors.
5. Understand the basic operation of single phase and three phase-controlled rectifiers.
6. Learn the design and operation of phase-controlled rectifiers.
7. Get introduced to Pulse Width Modulation Techniques.
8. Understand basic principles of dc-dc power converters.
9. Learn the design of PWM controlled dc-dc converters for variable dc power supply.
10. Understand basic principles of soft-switching techniques.
11. Learn the design of soft-switching resonant converters.
12. Understand power quality and harmonic distortion.
13. Learn the design of power factor correction circuits for switch mode rectifiers.
14. Get introduced to dc-ac converters.
15. Understand the Sinusoidal Pulse Width Modulation (SPWM) technique.
16. Learn the design and operation of single phase and three phase dc-ac converters (inverters).
17. Get the basic understanding of thermal modelling of power electronics circuits.
18. Learn the application of power electronics converters.

Graduate Attributes
(Canadian Engineering Accreditation Board)

All above-mentioned learning outcomes comply with graduate attributes.

PA-D (Problem Analysis ability – Developed)

INV.-D (Investigation ability- Developed)

Des.-D (Design ability- Developed)

Tools-D (Use of Engineering Tools- Developed)

The learning outcomes are assed in assignments, the midterm exam, laboratory reports and the final exam.

Course Instructional Level: D (Intermediate Development)

ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:
Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at http://www.mun.ca/engineering/undergrad/academicintegrity.php and Memorial University's Code of Student Conduct at http://www.mun.ca/student/conduct/.

INCLUSION AND EQUITY:
Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

STUDENT ASSISTANCE:
Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at www.mun.ca/student

COVID-19 RELATED INFORMATION:
Welcome to the fall 2021 term! This course is designed to be held in-person and remotely as well. Our class lectures have been carefully designed to emphasize safety while providing a rich learning experience for all students. Following campus-wide policy, masks are required for all students in our classroom. Should other health directives or the overall situation connected to COVID-19 change over the course of the term, a back-up plan for remote delivery is in place to ensure that the course will continue and to

minimize disruption to the student experience

There is nothing more important than your mental and physical health. Doctors' notes are not required for medical absences in this course. You are encouraged to seek appropriate medical attention from the Student Wellness and Counselling Centre. I am committed to working with students with pre-existing medical and mental health needs, as well as new needs that may arise within the semester. I encourage you to reach out to the Blundon Centre as early as possible to discuss any adjustments you think may be necessary in this course. Let's explore the options to help you succeed, no matter what is going on.

If Memorial University campus operations are required to change because of health concerns related to the COVID-19 pandemic, it is possible that this course will rapidly move to a fully online delivery format. Should that be necessary, students will need to have access to a networked PC or Mac computer with webcam and microphone for remote delivery of the class. The university has published minimum computer requirements which you can review.

While the COVID-19 pandemic is slowly subsiding in many parts of the world and vaccination rates are increasing, this is still a stressful time for many. It's important that we support each other and keep informed of current information. The Memorial COVID-19 website is an excellent source of information and support, with specific links for students, supports and services, and health and wellness.