HUMBER

Course Outline

Course Name: Power Electronics (ELEC 324)

Academic Period: 2023 - 2024

Faculty:

Faculty Availability:

Associate Dean:
Shaun Ghafari
shaun.ghafari@humber.ca

Schedule Type Code:

Land Acknowledgement

Humber College is located within the traditional and treaty lands of the Mississaugas of the Credit. Known as Adoobiigok [A-doe-bee-goke], the "Place of the Alders" in Michi Saagiig [Mi-Chee Saw-Geeg] language, the region is uniquely situated along Humber River Watershed, which historically provided an integral connection for Anishinaabe [Ah-nish-nah-bay], Haudenosaunee [Hoeden-no-shownee], and Wendat [Wine-Dot] peoples between the Ontario Lakeshore and the Lake Simcoe/Georgian Bay regions. Now home to people of numerous nations, Adoobiigok continues to provide a vital source of interconnection for all.

Equity, Diversity and Inclusion Statement

Humber College and the University of Guelph-Humber (Humber) are leaders in providing a learning, working and living environment that recognizes and values equity, diversity and inclusion in all its programs and services. Humber commits to reflect the diversity of the communities the College serves. Students, faculty, support and administrative staff feel a sense of belonging and have opportunities to be their authentic selves.

Faculty or Department	Faculty of Applied Sciences & Technology
Course Name:	Power Electronics (ELEC 324)
Pre-Requisites	CALC 103 & ELEC 254
Co-Requisites	none
Equates	none
Restrictions	none
Credit Value	3
Total Course Hours	56

Developed By:	Prepared By:	Approved by:
		Shaun Ghafari

Humber Learning Outcomes (HLOs) in this course.

The HLOs are a cross-institutional learning outcomes strategy aimed at equipping Humber graduates with the employability skills, mindsets, and values they need to succeed in the future of work. To explore all the HLOs, please consult the Humber Learning Outcomes framework.

- Sustainability
- Critical Thinking
- Communication
- Digital Fluency
- Professionalism
- Strategic Problem-Solving

Course Description

This course describes the applications of power semiconductor devices such as uncontrolled and controlled rectifier circuits for single-phase and three-phase supply, DC-DC converters (Choppers), and DC to AC inverter circuits for single-phase and three-phase load. The course also introduces pulse width modulation technique used for controlling the output of inverters. Laboratory exercises will be performed to model many of these circuits along with the related techniques.

Course Rationale

This course aims to develop student knowledge and understanding of power semiconductor devices and power conversion techniques. Students would apply their mathematical skills and knowledge of electronics to analyze and solve power electronic circuits. The course will prepare students for studying power electronic applications in variable frequency drives and motor controls.

Course Learning Method(s)

- Lecture

Learning Outcomes

- Define the term power electronics, using power semiconductor devices as switches, and typical applications of power electronics.
- Describe the characteristics and operation of power semiconductor diodes and their applications
- Describe the characteristics and operation of high-power Thyristors and their applications,
- Describe the characteristics and operation of high-power MOSFET and IGBT transistors and their applications
- Calculate relevant output voltages and currents of single-phase and three-phase half-wave and full-wave uncontrolled rectifiers with resistive and inductive loads.
- Analyze with the help of waveforms, the operation of single-phase and three-phase, half-wave and full-wave, controlled rectifiers with resistive and inductive loads.
- Calculate relevant output voltages and currents of single-phase and three-phase half-wave and full-wave controlled, rectifiers with resistive and inductive loads
- Analyze the basic DC chopper circuits and the operation of a step-down (buck) choppers and step-up (boost) choppers
- Design basic step-down (buck) and step-up (boost) DC-DC converter circuits.

- Describe the operation and control of a voltage source and current source inverters, explain the operation of half-bridge, full-bridge voltage source inverters and pulse-width-modulation technique.
- Define the concepts of harmonics, distortion factor, ripple factor, displacement power factor and true RMS voltage and current

Assessment Weighting

Assessment	**Weight**
Final Exam	
Final Exam	30%
In-class Activity	
Lab - In process Evaluation	30%
Quiz	
Quiz 1	5%
Quiz 2	5%
Midterm Exam	
Midterm Exam	30%
Total	**100%**

Modules of Study

Module	**Course Learning Outcomes**	**Resources**	**Assessments**
Introduction to Power Electronics and waveform quality	• Define the term power electronics, using power semiconductor devices as switches, and typical applications of power electronics. • Define the concepts of harmonics, distortion factor, ripple factor, displacement power factor and true RMS voltage and current	1. Chapter 1 (Rashid) 2. Black board course notes	• Midterm Exam • Quiz 1 • Lab - In process Evaluation
Power Diodes and Rectifiers	• Describe the characteristics and operation of power semiconductor diodes and their applications • Calculate relevant output voltages and currents of single-phase and three-phase half-wave and full-wave uncontrolled rectifiers with resistive and inductive loads.	1. Chapter 2 and 3 (Rashid) 2. Black board course notes	• Midterm Exam • Quiz 1 • Lab - In process Evaluation

Module	Course Learning Outcomes	Resources	Assessments
Thyristors and Controlled Rectifiers	• Describe the characteristics and operation of high-power Thyristors and their applications, • Analyze with the help of waveforms, the operation of single-phase and three-phase, half-wave and full-wave, controlled rectifiers with resistive and inductive loads. • Calculate relevant output voltages and currents of single-phase and three-phase half-wave and full-wave controlled, rectifiers with resistive and inductive loads	1. Chapter 9 and 10 (Rashid) 2. Black board course notes	• Midterm Exam • Quiz 1 • Lab - In process Evaluation
Power Transistors and DC-DC converters	• Describe the characteristics and operation of high-power MOSFET and IGBT transistors and their applications • Analyze the basic DC chopper circuits and the operation of a step-down (buck) choppers and step-up (boost) choppers • Design basic step-down (buck) and step-up (boost) DC-DC converter circuits.	1. Chapter 4 and 5 (Rashid) 2. Black board course notes	• Lab - In process Evaluation • Final Exam • Quiz 2
DC-AC Inverters	• Describe the operation and control of a voltage source and current source inverters, explain the operation of half-bridge, full-bridge voltage source inverters and pulse-width-modulation technique.	1. Chapter 6 (Rashid) 2. Black board course notes	• Lab - In process Evaluation • Final Exam • Quiz 2

Required Resources

Muhammad H. Rashid, 4th ed (2023). Power Electronics Devices, Circuits and Applications, PEARSON ISBN-13: 9780137982097
Class notes and lab manual will be provided by Instructor

Supplemental Resources

Daniel W. Hart (2011). Power Electronics. Indiana, USA: McGraw Hill. ISBN10: 0073380679 | ISBN13: 9780073380674

Essential Skills

Section	Skills	Measurement	Details
Communication	• Writing • Speaking • Visual Literacy	Reinforce and measure	• Communicate clearly, concisely, and correctly in written, spoken, and visual form that fulfills the purpose and meets the needs of the audience. • Tests, assignments, reports, and presentations.
Numeracy	• Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data	Teach and measure	• Execute mathematical operations accurately. • Tests, assignments, reports, and presentations.
Critical Thinking and Problem-Solving	• Analysing • Evaluating	Reinforce and measure	• Apply a systematic approach to solve problems. • Tests, assignments, reports, and presentations.
Information Management	• Gathering and managing information • Selecting and using appropriate tools and technology for a task or project	Reinforce and measure	• Locate, select, organize, and document information using appropriate technology and information systems. • Tests, assignments, reports, and presentations.
Interpersonal Skills	• Teamwork • Conflict resolution • Networking	Reinforce and measure	• Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals. • Tests, assignments, reports, and presentations.
Personal Skills	• Managing self • Managing change and being flexible and adaptable	Reinforce and measure	• Manage the use of time and other resources to complete projects. • Tests, assignments, reports, and presentations.

Prior Learning Assessment & Recognition (PLAR)

Prior Learning Assessment and Recognition (PLAR) is the formal evaluation and credit-granting process whereby candidates may obtain credits for prior learning. Prior learning includes the knowledge competencies and skills acquired, in both formal and informal ways, outside of post-secondary education. Candidates may have their prior learning evaluated against the course learning outcomes as defined in the course outline.

To find out if this course is eligible for PLAR, and how this learning would be assessed, please contact the Program Coordinator for more details.

Academic Regulations

It is the student's responsibility to be aware of the College Academic Regulations. The Academic Regulations apply to all applicants to Humber and all current students enrolled in any program or course offered by Humber, in any location. Information about academic appeals is found in the **Academic Regulations**.

Anti-Discrimination Statement

At Humber College, all forms of discrimination and harassment are prohibited. Students and employees have the right to study, live and work in an environment that is free from discrimination and harassment. If you need assistance on concerns related to discrimination and harassment, please contact the Centre for Human Rights, Equity and Inclusion or the Office of Student Conduct.

Accessible Learning Services

Humber strives to create a welcoming environment for all students where equity, diversity and inclusion are paramount. Accessible Learning Services facilitates equal access for students with disabilities by coordinating academic accommodations and services. Staff in Accessible Learning Services are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. If you require academic accommodations, contact:

Accessible Learning Services

North Campus: (416) 675-6622 X5090

Lakeshore Campus: (416) 675-6622 X3331

Academic Integrity

Academic integrity is essentially honesty in all academic endeavors. Academic integrity requires that students avoid all forms of academic misconduct or dishonesty, including plagiarism, cheating on tests or exams or any misrepresentation of academic accomplishment.

Disclaimer

While every effort is made by the professor/faculty to cover all material listed in the outline, the order, content, and/or evaluation may change in the event of special circumstances (e.g. time constraints due to inclement weather, sickness, college closure, technology/equipment problems or changes, etc.). In any such case, students will be given appropriate notification in writing, with approval from the Dean (or designate) of the School.

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