University of Manitoba

Department of Electrical & Computer Engineering
Graduate Course Outline

Summer 2022

ECE 7440 – Modern Control of Power Electronics

COURSE DESCRIPTION:

The course is an advanced course for graduated students or engineers to understand control theories behind applications of power electronics and further properly design controllers for power converters based on the theories. Audients in the course are assumed that they have basic knowledge of Power Electronics and Control Systems.

COURSE OBJECTIVE:

The objective of this course is to provide a procedure of choosing and designing controllers for power electronics systems. By the end of the course, students will compare the advantages and disadvantages of control methodologies use in modern power electronics applications and students will design controllers with stable operation and reaching performance requirements.

PRE-REQUISITES:

Undergraduate background in Power Electronics and Control Systems.

CONTACT HOURS:

3-hours per week

COURSE CONTENT:

The following topics will be discussed:

1. Review of Modern Control Systems
2. State Variable Models for Converters
3. Linear Control Systems
    a. PI and PID
    b. Design and Implementation
4. System Stability
    a. Stability Criterion
    b. Methods of Evaluation
5. Non-linear Control Systems
    a. Hysteresis
    b. Sliding Mode
    c. Boundary Control
6. Applications
    a. DC link Voltage Control
    b. Phase-Locked-Loop
    c. Grid Current Control
    d. Maximum Power Point Tracking
7. Guest Lecture x 1

HOMEWORK:

Homework will consist of individual assignments, preparation of a seminar on an assigned article from the research literature, and an group design project.

TEXTBOOK:

Nil

Recommended Reference Books

1. N. Mohan, T. M. Undeland, W. P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, 2003.
2. Muhammed H. Rashid, Power Electronics: Circuit, Devices and Applications, 2013.
3. R. C. Dorf and R. H. Bishop: Modern Control Systems, Pearson, 2016.

GRADE ANNOUNCEMENTS:

Grades for this course will be announced by January 2022

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination. Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars	1	0%	0	
Assignments	4	2.5%	10	
Project	1	30%	30	
Midterm Exam	1	20%	20	
Final Examination	1	40%	40	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

Name ..... Dr. Carl Ho
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Office Hours: ..... By appointment

VOLUNTARY WITHDRAW:

TBD, 2022

REQUIREMENTS/REGULATIONS

Student Responsibilities: It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc..

Lectures: Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

ACADEMIC INTEGRITY

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

***Plagiarism:** to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source