Course Information

Course Code	5670463
Course Section	1
Course Title	STATIC POWER CONVERSION I
Course Credit	4
Course ECTS	7.0
Course Catalog Description	Power switches and their characteristics. Power converter definitions, classification. VTA method. Midpoint and bridge rectifiers: non-ideal commutation, harmonics, input power factor, utility-factor, winding utilization and unbalances in rectifier transformers. Applications.
Prerequisites	Students must complete one of the following sets to take this course.

Set	Prerequisites
1	5670212, 5670361

Schedule	Tuesday , 13:40 - 14:30, EA312 Thursday , 10:40 - 12:30, EA312

Instructor Information

Name/Title	Assist.Prof.Dr OZAN KEYSAN
Office Address	C-113
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Office Phone	
Office Hours	Wednesday 15:40-16:30

Course Assistants

Name/Title	Araş.Gör. İLKER ŞAHİN
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Course Objectives

Students will be able to comprehend basic power electronics conversion principles.

Students will be able to understand and characterize the terminal properties of power semiconductor devices and use these characteristics in design of power converters.

Students will be able to characterize the input and output characteristics of rectifiers and use the characteristics in power converter design and control.

Course Learning Outcomes

Student, who passed the course satisfactorily will be able to:

Determine the basic components of switching matrix, the periodic switching rules, use the switching rules to achieve a specific power conversion target.

Evaluate the structure, material, and control properties of the power semiconductors, determine the terminal properties of power semiconductors.

Experimental characterization of the power semiconductor terminal properties: measure v-i curves, determine the parasitic effects, cross-compare characteristic parameters for trade-off relations.

Characterize the rectifier output voltage waveforms, calculate the average and ripple values, characterize the rectifier input current waveforms, calculate the harmonic and rms values, evaluate the harmonics ad distortion values and compare with standards.

Program Outcomes Matrix

Undergraduate

		Level of Contribution			
	Program Outcomes	**0**	**1**	**2**	**3**
1	Foundations: understanding of and ability to apply fundamental science and engineering of permanent value (ABET Criteria 3a, 3b, 3e and 3k)				X
2	Breadth: familiarity with the diverse areas of Electrical and Electronics Engineering (ABET Criteria 3a, 3b)			X	
3	Depth: ability to apply in depth knowledge of one or more specializations within the diverse fields of Electrical and Electronics Engineering (ABET Criteria 3a, 3b, 3c, 3e)				X
4	Design: ability to participate in creative, synthetic, integrative activities of EE design (ABET Criteria 3c and 3e)			X	
5	Life-long learning: desire and ability to keep learning throughout life (ABET Criteria 3i)			X	
6	Communication skills: ability to express ideas persuasively, in written and oral form (ABET Criteria 3g)			X	
7	Social skills: ability to work with others, in professional and social settings (ABET Criteria 3d)			X	
8	Global view: appreciation of diversity in the world and in intellectual areas (ABET Criteria 3h and 3j)			X	
9	Professional ethics: ability to recognize and appreciate importance of ethical standards in professional work (ABET criteria 3f)			X	

0: No Contribution **1:** Little Contribution **2:** Partial Contribution **3:** Full Contribution

Instructional Methods

The following instructional methods will be used to achieve the course objectives: Lecture, questioning, discussion, group work, simulation, laboratory experiments.

Tentative Weekly Outline

Week	Topic	Relevant Reading	Assignments
1	Introduction: applications, multidisciplinary nature of power electronics, fields of power electronics, etc.	(Chapter 1 of Mohan)	
2	Principles of Power Electronics: Switching rules, basic operating rules for switching circuits, volt-seconds rule, ampere-seconds rule, periodical solutions, the switching matrix, switch requirements, unidirectional and bidirectional switches, etc.	(Chapter 1 and chapter 3 of Mohan)	
3	Semiconductors: Power Diodes	(Chapter 2, 19,20 of Mohan)	
4	Semiconductors: Thyristors	(Chapter 2, 19,23 of Mohan)	Assignment on power semiconductor device characteristics
5	Introduction to Rectifiers: Rectifier principles, single switch, uncontrolled, semi controlled, analysis	(Chapter 5,6 Mohan, 2,3 Lander)	
6	Rectifiers	(Chapter 5,6 of Mohan, 2,3 of Lander)	Assignment on Single Phase Rectifiers involving simulations
7	Rectifiers	(Chapter 5,6 of Mohan, 2,3 of Lander)	
8	Rectifiers	(Chapter 5,6 of Mohan, 2,3 of Lander)	Assignment on Three Phase Rectifiers involving simulations
9	Input/Output Harmonics and Filtering	(Chapter 7 of Lander and 5,6,16,17,18 of Mohan)	
10	Filtering Continued and Computer Simulations of Power Electronic Circuits with Simplorer/PSpice/Simulink	(Chapter 4 of Mohan)	
11	Precharge Circuits, Inrush Currents, Thermal Management and Design	(Mohan Chapter 29)	

Week	Topic	Relevant Reading	Assignments
12	Thermal Management	(Mohan Chapter 29)	Assignment on thermal management, analysis and design
13	Control of Rectifiers	(Handouts)	
14	Protection, snubbers, gate driving, and other issues of rectifiers	(Handouts)	

Course Textbook(s)

1) Cyril W. Lander, Power Electronics, McGraw-Hill, 1993, Third Edition.
2) N. Mohan, T. M. Undeland, W.P. Robbins, Power Electronics, John Wiley Publishing Co., 2003. (Media Enhanced Third Edition) Wiley International Edition

Course Material(s) and Reading(s)

Material(s)

Books

Reading(s)

Cyril W. Lander, Power Electronics, McGraw-Hill, 1993, Third Edition.

N. Mohan, T. M. Undeland, W.P. Robbins, Power Electronics, John Wiley Publishing Co., 2003. (Media Enhanced Third Edition) Wiley International Edition

Supplementary Readings / Resources / E-Resources

Readings

Follow http://keysan.me/ee463 for handouts and presentations

Follow http://github.com/odtu/ee463 for project assignments

Resources

1) P. T. Krein, Elements of Power Electronics, Oxford University Press, 1998.
2) J.G. Kassakian, M.F. Schlecht, G.C. Verghese, Principles of Power Electronics,

Addison Wesley, 1992.

3) R.W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, Kluwer, 2001.
4) B. J. Baliga, Power Semiconductor Devices, PWM Publishing Co., 1996.

Assessment of Student Learning

Assessment	Dates or deadlines

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Assignments: The homework assignments will be designed to help you learn specific skills covered in class. They will be handed out at the end of each class or posted at METU-CLASS, and is due at the defined completion period. No late work will be accepted, besides in excused (instructor approved) circumstances.	A week after the completion of the associated subject in the classroom the assignment will be collected. Distribution is usually during the associated lectures.
Midterm exams: One midterm exam will be conducted. In class exam (with one page of cheat-sheet supplied). You may use calculator; however, it cannot be shared during the exam. More detailed instructions regarding format and content of the exam will be given later in the semester.	Probably 8th week of the semester (Exact date to be announced)

Course Grading

Deliverable	Grade Points
Midterm I	15
Laboratory	20
Simulation Projects	15
Final Exam	30
Hardware Project	15
Participation	5
Total	100

Course Policies

Late Submission of Assignments

No late submissions will be allowed for any assignments

Other

Important Note: Any of the following actions will result in NA grade:

- Not submitting at least three software projects
- Not attending to one laboratory session
- Not attending to the final exam

Information for Students with Disabilities

To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the website of Disability Support Office: http://engelsiz.metu.edu.tr/

Academic Honesty

The METU Honour Code is as follows: *"Every member of METU community adopts the following honour code as one of the core principles of*

academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."