Course Information

Course Code 5670464

Course Section 1

Course Title STATIC POWER CONVERSION II

Course Credit 3

Course ECTS 5.0

Course Catalog Description Introduction to forced commutated circuits, analysis, classification of techniques. Centretap inverter. Voltage-fed inverters; waveshaping; PWM, stepped and square-waveforms, voltage regulation, harmonics. Current-fed inverters; analysis, effect of SCR turn-off time on voltage waveform, overlap. DC-DC switching converters; time-ratio control, effect of loading, parameter optimization. Device failure mechanisms. Thermal considerations, maximum ratings, protection of switching elements. Series and parallel operation of switching elements.

Prerequisites Students must complete one of the following sets to take this course.

Set	Prerequisites
1	5670463

Schedule Tuesday , 10:40 - 11:30, EA207
Thursday , 13:40 - 15:30, EA207

Instructor Information

Name/Title Assist.Prof.Dr OZAN KEYSAN

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Office Phone

Office Hours Wednesday 15:40-16:30

Course Assistants

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Office Hours

Course Objectives

Students will be able to comprehend basic dc-dc converter topologies and their operating characteristics. Students will be able to comprehend the need for and the utilization of isolated dc-dc converter topologies and their operating characteristics. Students will be able to comprehend basic dc-ac converter topologies and their operating characteristics, harmonic characteristics.

Course Learning Outcomes

Determine the basic dc-dc converter topologies, obtain their pwm waveforms and derive their voltage transfer characteristics. Determine continuous and discontinuous operation modes and their conditions. Size filter components for mode of operation.

Determine the basic isolation requirements and derive the isolated converter topologies from the basic topologies and derive their voltage transfer characteristics. Determine continuous and discontinuous operation modes and their conditions. Size the isolation transformers and filter components for given mode of operation.

Characterize the inverter output voltage waveforms, calculate the fundamental component and for square wave mode of operation, evaluate the distortion. Characterize the inverter output voltage waveforms for pwm mode of operation, investigate the harmonic spectrum. Extend the concept from single to three-phase applications and evaluate the control and power flow issues.

Instructional Methods

- *Lectures*
- Computer Simulations
- Hardware Project
- *In class examples*

Tentative Weekly Outline

Week	Topic	Relevant Reading	Assignments
1	Introduction to forced commutated circuits, Gate Turn-Off devices, DC/DC, DC/AC, AC/AC conversion, review of basic power electronics concepts	Chapter 1-4 Mohan	
2	DC/DC Converters (Chapter 7) Basic converter topologies, Voltage input-output function derivations	Chapter 7	
3	DC/DC Converters (Chapter 7) Converter behavior (continuous/discontinous operating modes)	(Chapter 7)	
4	DC/DC Converters (Chapter 7) Converter behavior (continuous/discontinous operating modes)	(Chapter 7)	Project1
5	DC/DC Converters (Chapter 7) Full-bridge DC/DC converter, Unipolar/Bipolar Modulation	(Chapter 7)	
6	DC/DC converters (Chapter 10) SMPS: DC/DC converters with isolation (flyback, forward, isolated push-pull, half, full bridge converters)	(Chapter 10)	
7	DC/DC converters (Chapter 10) Modelling and control of DC/DC converters: state-space averaging, voltage/current mode control, cascade control (H-bridge converter controlled DC motor drive)	(Chapter 10)	Project2
8	DC/AC Converters (Inverters) (Chapter 8) Basics voltage source inverter, current source inverter, single phase half and full (H) bridge inverter	(Chapter 8)	
9	DC/AC Converters (Inverters) (Chapter 8) H-bridge inverter analysis, modulation, sinusoidal PWM, harmonic spectrum, optimal PWM, phase displacement control	(Chapter 8)	
10	DC/AC Converters (Inverters) (Chapter 8, handouts) Three phase voltage source inverters, basic topology, six step operating mode, scalar modulation, sinusoidal PWM, voltage linearity, harmonics spectrum, triplen harmonic injection PWM	(Chapter 8, handouts)	

Week	Topic	Relevant Reading	Assignments
11	DC/AC Converters (Inverters) (Chapter 8, 11, 18, handouts) Space vector modulation, switching pattern optimization, optimal PWM, PWM rectifier, single switch boost PFC rectifier, inverter and rectifier applications, industrial inverter drives, UPS systems, control of inverters.	(Chapter 8, 11, 18, handouts)	Project3
12	Hard/Soft Switching Concepts, Transistor Snubbers (Chapter 24,25,26, 27)	(Chapter 24,25,26, 27)	
13	DC/DC Converters (Chapter 9/27) Snubbers continued, Commutation techniques: Hard switching and soft switching, ZVS, ZCS, Resonant Converters (resonant load, quasi-resonant, resonant transition), other commutation techniques	(Chapter 9/27)	

Course Textbook(s)

Daniel W. Hart, Power Electronics, Mc Graw Hill

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

Course Material(s) and Reading(s)

Material(s)

R.W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, Kluwer, 2001.

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

Modern Power Electronics and AC Drives, Bimal K.Bose, Prentice Hall

Reading(s)

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Assessment of Student Learning

Assessment	Dates or deadlines
Midterm and Final Exams	
Homework assignment evaluations	
Term project evaluation	

Course Grading

Deliverable	Grade Points
Midterm Exam I	20
Final Exam	30
Simulation Projects	20
Hardware Project	25

Deliverable	Grade Points
In Class Activities	5
Total	100

Course Policies

Class Attendance

Active participation is encouraged, and there will be a few pop-quizes

Late Submission of Assignments

No late submissions, and all projects will be submitted through Github.com and ODTUClass

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/