ABDULLAH GÜL UNIVERSITY
GRADUATE SCHOOL OF ENGINEERING & SCIENCE
ELECTRICAL AND COMPUTER ENGINEERING PROGRAM
COURSE DESCRIPTION AND SYLLABUS

Course Title	Code	Semester	T+L Hours	Credit	ECTS
ADVANCED THEORY of POWER ELECTRONICS	ECE-506	SPRING	3 + 0	3	10

Prerequisite Courses	NONE

Type	Selective
Language	English
Coordinator	Prof. Irfan Alan
Instructor	Prof. Irfan Alan
Adjunt	None
Aim	Detailed analysis of selected power electronic circuits; analytical analysis, system modelling, and simulation of operation of selected power electronic circuits by means of a simulation program.
Learning Outcomes	• Learning and strengthening fundamental concepts faced in Power Electronics, • Learning and strengthening the conversion techniques, design criteria, system modeling, simulation methods to analyze DC/DC converters and DC/AC inverters, • Learning and strengthening the harmonic and loss reduction techniques in inverters, their advantages and disadvantages, selection of optimum operating frequency, new inversion techniques, • Learning and strengthening forced commutation techniques, their operation principles, design criteria, system modeling, simulation methods to analyze related DC/DC converters and DC/AC inverters, • Learning and strengthening operation principles of resonant power converters, design criteria, system modeling, analysis and simulation methods, • Learning and strengthening operation principles of power factor adjustable rectifiers, design criteria, system modeling, analysis and simulation methods.
Course Content	• Fundamental concepts in Power Electronics • DC Machine Drives • E-Class Converter Operating Principles • DC Motor Control with E-Class Converter • Operating E-Class Converter as a DC/AC Inverter • Harmonic Reduction Techniques in Inverters • Voltage Source Inverters-VSI PWM Techniques, Advantages and Disadvantages • New VSI Techniques, Advantages and Disadvantages • Forced Commutated Converters and Inverters • Forced Commutated Current Source Inverters-CSI • Resonant Power Converters

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Fundamental Concepts in Power Electronics: Fundamental component harmonics in DC and AC signals, Fourier expansion, THD, CHDF, VHDF, power factor, average-rms-peak values, operating losses of a switching device, converter losses	The relevant book chapters and materials from the literature
2	Fundamental Concepts in Power Electronics: Switching device and heat sink selection based on operating voltage, current, frequency and switching losses, selection of snubber and switching frequency	The relevant book chapters and materials from the literature
3	DC Machine Drives, DC Machine Dynamics	The relevant book chapters and materials from the literature
4	4 Quadrant DC Machine Drive with E-Class Converter	The relevant book chapters and materials from the literature
5	Speed Regulated DC Machine Control with E-Class Converter, System Modeling and Simulation	The relevant book chapters and materials from the literature
6	Operating E-Class Converter as a DC/AC Inverter, Harmonic Reduction Techniques in Inverters, Voltage Source Inverter PWM Techniques Advantages and Disadvantages	The relevant book chapters and materials from the literature

7	A New Inversion Technique utilizing a Buck Converter and a Cascaded Inverter, Advantages and Disadvantages	The relevant book chapters and materials from the literature
8	A New Inversion Technique utilizing a Buck-Boost Converter and a Cascaded Inverter, Advantages and Disadvantages	The relevant book chapters and materials from the literature
9	Forced Commutated DC/DC Choppers, Operating Principles	The relevant book chapters and materials from the literature
10	MIDTERM EXAM	
11	Forced Commutated DC/DC Choppers, Operating Principles	The relevant book chapters and materials from the literature
12	Forced Commutated DC/AC Inverters, Operating Principles	The relevant book chapters and materials from the literature
13	Forced Commutated Current Source Inverters (CSI), Operating Principles	The relevant book chapters and materials from the literature
14	Resonant Power Converters, Types and Selection of Switching Devices	The relevant book chapters and materials from the literature
15	Resonant Power Converters, Types and Power Flow, Operating Principles, Simulation and Analysis	The relevant book chapters and materials from the literature
16	FINAL EXAM	

SOURCES	
Lecture Notes	Lecture notes and slides
Other Sources	**Course Textbook:** "Power Electronics, Circuits, Devices, and Applications", M.H. Rashid, 2nd Edition, 1993, Prentice Hall, Inc. **Additional Materials:** 1. Advanced Continuous Simulation Language (ACSL) Programme User Manual

COURSE MATERIALS SHARING	
Documents	Lecture notes and slides
Homeworks	Students will be given at least total of 7 analytical or simulation homeworks
Exams	1 Midterm and 1 Final Exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
MIDTERM	1	30
Homeworks	7	35
FINAL EXAM	1	35
TOTAL		100

Course Category	
Sciences and Mathematics	50%
Engineering	50%
Social Sciences	0%

RELATIONSHIPS BETWEEN LEARNING OUTCOMES AND PROGRAM QUALIFICATIONS							
No	Program Qualifications	Contribution Level				
		1	2	3	4	5
1	Skills of using Mathematical, Science and Engineering Knowledge in Advanced Research					**x**
2	Skills of analyzing, designing and/or implementing an original system which will solve an Engineering Problem					**x**
3	Skills of using software, hardware and modern measurement instruments for advanced					**x**

	research in one's field of expertise					
4	Skills of planning, detailing and doing independent research					**x**
5	Skills of following literature, making and/or listening technical presentation, writing academic level article				**x**	
6	Skills of finding original ways by means of innovative thinking and questioning					**x**

*Increasing from 1 to 5.

ECTS / WORK LOAD TABLE			
Activities	Number	Duration (Hours)	Total Work Load
Course Length (includes exam weeks: 16x total course hours)	16	3	48
Out-of-class Study Time (Pre-study, practice)	16	5	90
Internet search, library work, literature search	16	3	48
Homework	7	13	91
Midterm	1	15	15
Final Exam	1	20	20
Total Work Load			312
Total Work Load / 30			312/30
Course ECTS Credit			10