EEE403 Power Electronics

Course Code	Course Name	Semester	
EEE403	Power Electronics	Fall ☒ Spring ☐ Summer ☐	
Hours		**Credit**	**ECTS**
Theory	**Practice** / **Lab**	3	4
3	0 / 0		

Course Details	
Department	Electrical Electronics Engineering
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Lecturer(s)	Dr. Hüseyin KÖSE
Course Objectives	The objective of this course is to learn the operation principles of the line frequency power converters and power devices, and analysis and design of these converters.
Course Content	Basic characteristics and operation principles of thyristors and diodes. Single phase and three phase rectifiers. Uncontrolled, semi-controlled and controlled rectifiers. Non-idealities in rectifiers. Harmonics at the input and output of the converters. Input power factor. Transformer utilization and unbalances. AC voltage controllers. Line frequency rectifier applications. DC-DC converter topologies and working principle.
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☒ Discussion ☒
Prerequisites/ Corequisites	Electrical Circuits1, Electronic1

Work Placement(s)	Classroom

Textbook/References/Materials

- 1. Power Electronics: circuits, devices, and applications; M. Rashid, Prentice-Hall, 2013
- 2. Power Electronics: Converters, Applications, and Design; N. Mohan, Tore Undeland, William P. Robbins.
  3. Lecturer Presentations and notes.

Course Category				
Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☐
Engineering Design	☒		Health	☐
Social Sciences	☐		Profession	☒

Weekly Schedule

No	Topics	Materials/Notes
1	Application areas of power electronics and introduction basic principles	Presentations, Lecturer notes
2	Review of basic techniques used in power electronics (Fourier analysis, transient circuit analysis)	Presentations, Lecturer notes
3	Operation principles and characteristics of diodes and thyristors	Presentations, Lecturer notes
4	Analysis of single phase diode rectifier topologies	Presentations, Lecturer notes
5	Analysis of single phase thyristor rectifier topologies	Presentations, Lecturer notes
6	Analysis of three phase rectifiers: Uncontrolled rectifiers	Presentations, Lecturer notes
7	Analysis of three phase rectifiers: Controlled rectifiers	Presentations, Lecturer notes
8	Midterm Exam	
9	DC-DC conversion theory and circuits	Presentations, Lecturer notes
10	Analysis of Buck type DC-DC converters	Presentations, Lecturer notes
11	Analysis of Chopper circuits	Presentations, Lecturer notes
12	Analysis of Boost type DC-DC converters	Presentations, Lecturer notes
13	Analysis of Boost type DC-DC converters	Presentations, Lecturer notes
14	Analysis of Flyback type DC-DC converters	Presentations, Lecturer notes
15	Analysis of other isolated type DC-DC converters	Presentations, Lecturer notes
16	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance		
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework		
Presentation / Seminar		
Project		
Report		
Seminar		
Midterm Exam	1	40
Final Exam	1	60
	Total	**100%**
Contribution of Midterm Studies to Success Grade		
Contribution of End of Semester Studies to Success Grade		
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	14	3	42
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time			
Quiz/Studio/Criticize			
Homework			
Presentation / Seminar			
Project			
Report			
Midterm Exam and Preparation for Midterm	1	30	30
Final Exam and Preparation for Final Exam	1	30	30
Total Workload			**102**
Total Workload / 25			**102/25**
ECTS Credit			**4.08**

Course Learning Outcomes	
No	**Outcome**
L1	Understand the concept of power control through switching.
L2	Understand the basic operation principles of power semiconductors used in line frequency power conversion circuits and can perform basic calculations.
L3	Can identify the basic rectifier topologies used in line frequency converters and can analyze these converters.
L4	Can design rectifier circuits to meet certain requirements and can select power devices considering realistic conditions
L5	Know the meaning and ideal values of certain parameters to evaluate the performance of converters.
L6	Can identify the basic dc-dc converter topologies used in converters and can analyze these converters.
L7	Can design dc-dc converter circuits to meet certain requirements and can select power devices considering realistic conditions.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	5	4	4	4	3											20-
L2	5	4	4	4	3											20-
L3	5	4	4	4	3											20
L4	5	4	4	4	3											20
L5	5	4	4	4	3											20
L6	5	4	4	4	3											20
L7	5	4	4	4	3											20
															Total	-140

i. Sufficient knowledge in the fields of mathematics, natural sciences, and related engineering disciplines; the ability to apply theoretical and practical knowledge in solving complex engineering problems.

ii. The ability to identify, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.

iii. The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

iv. The ability to select and use modern techniques and tools required for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.

v. The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or discipline-specific research topics.

vi. The ability to work effectively in intra-disciplinary and multidisciplinary teams; the ability to work independently.

vii. The ability to communicate effectively both orally and in writing; proficiency in at least one foreign language; the ability to write effective reports, understand written reports, prepare design and production reports, make effective presentations, and give and receive clear and understandable instructions.

viii. Awareness of the necessity of lifelong learning; the ability to access information, track developments in science and technology, and continuously renew oneself.

ix. Acting in accordance with ethical principles, knowledge of professional and ethical responsibilities, and the standards used in engineering applications.

x. Knowledge of business practices such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge of sustainable development.

xi. Knowledge of the impact of engineering practices on health, environment, and safety at global and societal levels, and awareness of contemporary engineering issues; awareness of the legal consequences of engineering solutions.