

**Middle East Technical University**  
**Electrical and Electronics Engineering Department**  
**EE361 – Electromechanical Energy Conversion I**  
**Fall 2024-2025**

<b><u>Instructors:</u></b>	<b><u>Sections:</u></b>	
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**Important Notes:**

- Please check ODTUClass ( <http://odtuclass.metu.edu.tr> ) for all announcements related to the course.
- You need to attend all experiments to receive a passing grade. Otherwise, you will receive an “NA” and will not be able to take the resit exam.
- You need to attend the final exam to receive a passing grade. Otherwise, you will receive an “NA” and will not be able to take the resit exam.
- You need to have a formal excuse to get a make-up for experiments and exams.
- Please contact the course coordinator instructor and assistants in case of any problems related to the course.

### **Text Books:**

- P. C. Sen, Principles of Electric Machines and Power Electronics, Wiley, 3<sup>rd</sup> edition, 2013.
- Fitzgerald, Kingsley, and Umans, Electric Machinery, McGraw Hill, 7<sup>th</sup> edition, 2013.
- N. Mohan, Electric Power Systems: A First Course, Wiley, 2012.
- N. Mohan, Electric Machines and Drives, Wiley, 2012.

### **Lectures:**

We will have regular classroom lectures and **attendance** will be taken.

### **Laboratory:**

There will be a total of 5 experiments conducted over 4 sessions.

**Sections:** We will collect laboratory section requests during Week 1 via ODTUClass and you will be assigned to a laboratory section based on your requests. We expect you to make necessary arrangements in your course schedule so that you can select three possible lab sections. If you do not complete the laboratory sections assignment, you will be assigned randomly a section.

**Safety Quiz:** Before attending the laboratory sessions, you need to get a passing grade (minimum 70/100) on the electrical Safety Quiz. WARNING: If you fail the exam, you will not be able to attend the experiments and will receive an “NA”.

**Procedure:** All experiments will be conducted in the Electric Machinery Laboratory. For each experiment, you need to fulfill the following requirements:

- Prepare for the experiment by reviewing the lecture notes and laboratory manual
- Attend the laboratory session
- Take the quiz at the beginning of the laboratory session – your lab grade will be halved if you get less than 4/10 on the quiz
- Prepare a report as a group of 3-4 students within one week starting from your laboratory day

**Laboratory groups:** Students will be assigned to their laboratory groups of 3-4 students randomly for each experiment. Random assignment is a fair way to form groups and ensures a balanced work load share between group members.

**Retaking students:** If you have taken this course previously and received a passing grade in the laboratory (60/100), you can be considered exempt from the laboratory work. Your previous lab grade will be used to determine your letter grade. We will collect exemption requests during Week 1 via ODTUClass.

### **Tutorial on Electrical Safety:**

You will have an electrical safety tutorial and the notes regarding the electrical safety will be shared. You will be responsible for the content of that tutorial and the safety notes in the Safety Quiz, where you will be asked multiple-choice questions via ODTUClass.

You must get at least 70/100 on this quiz to attend the experiments.

**Retaking students:** If you have already taken the course before and **will not** attend the laboratories this semester, you **do not** need to take the Safety Quiz. If you have already taken the course but will attend the laboratories this semester, you **must** pass the Safety Quiz.

### **MATLAB/Simulink Tutorial:**

You will have several assignments that require the use of MATLAB/Simulink. There will be a tutorial to help you understand the basics of this tool, as indicated in the tentative schedule. If you encounter any problems, you can contact the course assistants.

### **Homework:**

You will be assigned four homework assignments. The schedule for the homework is provided in the weekly schedule.

### **Grading Policy:**

- Midterm I 15%
- Midterm II 15%
- Final 30%
- Homework (x4) 15%
- Laboratory (x5) 20%
- Attendance 5%

### **Office Hours:**

If requested by students, lecturers will announce their office hours.

### **Cheating Policy:**

If any cheating, unethical conduct, or plagiarism is identified, all associated students will receive the same penalty: their resulting grades for that assignment will be multiplied by -1.

### **Tentative Schedule:**

Topic		Week	Assignments	Labs
<b>Introduction to Power Engineering</b>				
<b>Introduction</b>	Introduction to Power Systems	1		
	Recent Trends in Power Systems			
<b>Lab Section Requests</b>				
<b>Tutorial on Electrical Safety</b>				
<b>AC Electric Circuits</b>	RMS Value, Power, and Energy: Definition and Calculation	2		
	Single-Phase Systems and Phasor Representation			
	Complex Power and Power Factor Correction	3		
	Three-Phase Systems			
Power Calculation in Three-Phase Systems				
<b>Tutorial on MATLAB/Simulink Basics</b>		3	HW #1: 3-phase power calculations	
<b>Safety Quiz (October 25 - 18:00)</b>		4		

<b>Magnetic Circuits</b>				
<b>Simple Magnetic Circuits</b>	Introduction to Electromagnetic Systems	4		
	Introduction to Magnetic Circuits			
	Soft Magnetic Materials			
<b>Inductor</b>	Flux Linkage, Inductance and Energy	5	HW #2: Magnetic circuit	
	Properties of Magnetic Materials			
<b>AC Excitation</b>	Magnetics Circuits Excited with AC Voltages and Currents	6		Lab #1 Groups 1/2
	Losses with AC Excitation			
<b>Transformers</b>				
<b>1-phase Transformer</b>	Ideal Transformer	7		Lab #1 Groups 2/2
	Practical Transformer			
	Transformer Tests			
	Voltage Regulation	8		Lab #2 Groups 1/2
	Efficiency			
<b>3-phase Transformer</b>	Why Do We Use 3-Phase Power?	9	HW#3: Transformers	Lab #2 Groups 2/2
	3-Phase Transformers			
	Per-Phase Equivalent Circuit of Transformers			
<b>Electromechanical Energy Converters Basics</b>				
<b>Introduction Electric Machines</b>	Force and Torque Calculations	10		Lab #3 Groups 1/2
	Lorentz Force and Torque Calculations			
	Basics of Brushed DC Machine			
<b>Brushed DC Machine</b>	Induced Voltage Derivations	11		Lab #3 Groups 2/2
	Types of Brushed DC Machine			
	Speed Control of DC Machines	12		
<b>Power Electronics</b>				
<b>Introduction to power electronics</b>	Introduction to Power Electronics	12		Lab #4&5 Groups 1/2
<b>Basic DC-DC converters</b>	Step-Down (Buck) Converters	13	HW #4: DC machine drive	Lab #4&5 Groups 2/2
	Step-Up (Boost) Converters			
<b>Electric drives</b>	DC Machine Drives	14		
<b>Final</b>		TBA		

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the instructors.

## Frequently Asked Questions

**1. I am retaking this course, should I attend the laboratory sessions again?**

You don't have to attend the laboratory sessions again, if your previous score from the laboratory was above 60/100. Please apply to the coordinator assistant to verify.

**2. What is the electrical safety exam?**

Before attending to the laboratory sessions, you need to achieve a passing grade (minimum 60/100) on the electrical safety exam. Handouts will be provided and students are expected to study the notes before the exam.

**3. I have overlapping lectures. Can I attend a different section?**

No everybody must attend their own section. Your attendance will only be counted if it is taken in your assigned section. You can change your section during the add-drop week.

**4. When will you announce the laboratory groups?**

You will receive electronic forms in the next few days to select your laboratory sessions. You are expected to make 3 choices of 4-hour slots.

**5. I don't have any 4-hour slot available for laboratory sessions. What should I do?**

It's your responsibility to arrange a suitable time slot for laboratory work. Please make necessary changes during the add/drop week.

**6. Will everyone be assigned to their first choice of laboratory session?**

Unfortunately, no. The selection will be made in the most optimal manner, placing as many as possible students in their first choice.

**7. I have a part time job. I need to leave some days free. Do you take this into consideration when assigning sections?**

No. We do not take this into consideration.

**8. How many experiments are there?**

There will be 5 laboratory experiments conducted over 4 sessions.

**9. I missed one laboratory session. Can I take a make-up experiment?**

Provided that you have an official excuse, you can take a make-up.

**10. Why are we assigned MATLAB homeworks?**

Please visit: <http://keysan.me/okst/>

**11. I have a problem not listed above. Who should I contact?**

For minimum hassle, please follow the following order to resolve your problems.

- First inform the course assistant by email (Yusuf Basri Yılmaz: [ybyilmaz@metu.edu.tr](mailto:ybyilmaz@metu.edu.tr) )
- Visit the course assistant in person during office hours.
- Email the course coordinator (Ozan KEYSAN: [keysan@metu.edu.tr](mailto:keysan@metu.edu.tr) )
- Contact the course coordinator (Ozan KEYSAN, C-113)