

Middle East Technical University
Electrical and Electronics Engineering Department
EE361 – Electromechanical Energy Conversion I
Fall 2026-2027

<u>Instructors:</u>	<u>Sections:</u>	
Keyvan FİRUZİ (Coordinator) keyvan@metu.edu.tr	Section 1 – EA306	Tuesday 15:40 – 17:30 Thursday 12:40 – 13:30
Murat GÖL mgol@metu.edu.tr	Section 2 – EA310	
Ulaş KARAAĞAÇ ulaskar@metu.edu.tr	Section 3 – EA312	
Ozan KEYSAN keysan@metu.edu.tr	Section 4 – EA310	Tuesday 09:40 – 11:30 Thursday 11:40 – 12:30
İlker ŞAHİN silker@metu.edu.tr	Section 5 – EA312	

<u>Assistants:</u>	<u>Office:</u>	<u>Office Hour</u>
İsmail MACİT (Coordinator) ismacit@metu.edu.tr	C-114	
Elif TOPALOĞLU elifto@metu.edu.tr	C-114	
Sefer İdacı seferi@metu.edu.tr	C-114	
Işık Emir ALTUNKOL alisik@metu.edu.tr	C-114	
Ogün Altun ogun@metu.edu.tr	C-114	
Kemal PARLAKTUNA kemalp@metu.edu.tr	E-101	

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. For **office hours**, contact your course instructor directly.

Textbook:

- P. C. Sen, Principles of Electric Machines and Power Electronics, Wiley, 3rd edition, 2013.

References:

- Fitzgerald, Kingsley, and Umans, Electric Machinery, McGraw Hill, 7th edition, 2013.
- N. Mohan, Electric Power Systems: A First Course, Wiley, 2012.
- N. Mohan, Electric Machines and Drives, Wiley, 2012.

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, lab session may include different components, such as::

- Prepare for the experiment by reviewing the lecture notes and laboratory manual
- Attend the laboratory session
- Pre-work assignments (e.g., MATLAB or Simulink tasks),
- A 10-minute pre-lab quiz,
- A post-lab quiz,

The required activities and their respective grading weights may vary between lab sessions. Detailed information will be provided before each lab. Please follow the course announcements regularly to stay informed.

Laboratory groups: Students will be assigned to their laboratory groups of 3-4 students randomly for each experiment. Random assignments are a fair way to form groups and ensure a balanced workload 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 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:

MATLAB/Simulink will be used throughout this course, both during laboratory work and as part of course instruction, to support and enhance understanding of the concepts covered. The Simscape Electrical module will be used for modeling and simulation activities. Further details and guidance on how to use these tools will be provided during the course.

Quiz:

There will be five (5) announced quizzes during the semester. The anticipated dates and contents are marked on the Tentative Schedule. Exact dates will be announced later.

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.

Generative AI Policy:

Generative AI Policy is published separately as a document on ODTUClass. All students must read this policy and confirm that they understood it on ODTUClass by the end of Week-3. Take-home assignments, reports and quizzes of those who have not confirmed that they understood the Generative AI Policy will NOT be graded.

Grading Policy:

- Midterm I 15%
- Midterm II 15%
- Final 30%
- Quiz (x5) 15%
- Laboratory (x5) 25%

Tentative Schedule:

Topic		Week	Quizzes	Labs	
Chapter I: Introduction to Power Systems					
Introduction to Power Engineering		1	Quiz #1		
DC Systems	Power and Energy Calculation				
Single-Phase AC Systems	Power Calculation and RMS Values				
	Phasor Representation and Phasor Diagrams				
	Complex Power and Power Factor Correction				
Tutorial on Electrical Safety		2			
Three-Phase AC Systems	Balanced Three-Phase Systems				
	Y- and Δ-Connected Sources and Loads Line and Phase Voltages and Currents				
	Three-Phase Power Calculations				
	Per-Phase Equivalent Circuit Line Model and Voltage Regulation				
	Power Factor Correction				
Lab Section Requests		3			
Safety Quiz (TBA)					
Chapter II: Magnetic Circuits					
Magnetic Fields and Materials	Introduction to Electromagnetic Systems	4	Quiz #2		
	Magnetostatic Fields: (H), (B), Magnetic Flux, and Flux Linkage				
	Properties of Magnetic Materials B–H Characteristics, Magnetization, Permeability, and Saturation				
Magnetic Circuits under DC Excitation	Magnetomotive Force (MMF), Reluctance, and Magnetic Equivalent Circuits	5			
	Air Gaps, Fringing, and Leakage Flux				
	Flux Linkage and Self Inductance				
	Mutual Inductance and Magnetically Coupled Circuits				
	Energy Stored in Magnetic Fields				
Magnetic Circuits under AC Excitation	Saturation, Hysteresis, and Eddy Currents	6		Lab #1 Groups 1/2	
	Core Losses and Core Lamination				
	Faraday’s Law of Electromagnetic Induction				
	Single-Phase and Three-Phase Inductors				
Midterm I (TBA)					

Chapter III: Transformers					
Single-phase Transformer	Ideal Transformer and Transformation Ratio	7	Quiz #3	Lab #1 Groups 2/2	
	Practical Transformer and Equivalent Circuit				
	Transformer Tests				
	Transformer Losses and Efficiency	8		Lab #2 Groups 1/2	
	Voltage Regulation of Transformers				
Three-phase Transformer	Three-Phase Transformer Connections	9	Quiz #3	Lab #2 Groups 2/2	
	Voltage and Current Transformation Ratios				
	Per-Phase Equivalent Circuit				
	Efficiency and Voltage Regulation				
Chapter IV: Electromechanical Energy Converters Basics					
Fundamentals of Electromechanical Energy Conversion	Principles of Electromechanical Energy Conversion	10	Quiz #4	Lab #3 Groups 1/2	
	Lorentz and Reluctance Forces				
	Force Calculation in Linear Electromagnetic Systems				
	Torque Calculation in Rotating Electromagnetic Systems				
	Motor and Generator Operating Principles				
DC Machines	Construction and Operating Principles	11	Quiz #4	Lab #3 Groups 2/2	
	Generated EMF and Electromagnetic Torque				
	Equivalent Circuit of DC Machines				
	Separately Excited DC Generators and Motors	12			
Midterm II (TBA)					
Chapter V: Power Electronics					
Introduction to Power Electronics	Power Semiconductor Switching Devices	13	Quiz #5	Lab #4&5 Groups 1/2	
	Principles of Switching Power Conversion				
	Applications of Power Electronics				
Basic DC-DC Converters	Step-Down (Buck) Converters	14		Quiz #5	Lab #4&5 Groups 2/2
	Step-Up (Boost) Converters				
Diode Rectifiers	Single-Phase Diode Rectifier		14		
	Three-Phase Diode Rectifier				
Final (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 the laboratory sessions, you need to achieve a passing grade (minimum 70/100) 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 students as possible 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. 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 (İsmail Macit: ismacit@metu.edu.tr)
- Visit the course assistants in person during office hours.
- Email the course coordinator (Keyvan FIRUZI: keyvan@metu.edu.tr)
- Contact the course coordinator (Keyvan FIRUZI, E-111)