

Course title: Introduction to electric machines and transformers

Course code	Course status	Semester	Number of ECTS credits	Lecture hours
131005028	Mandatory	V	6	3+1.5+0.5

Study program:

Basic academic studies, ELECTRICAL ENGINEERING, study program: Power systems and Control (studies last for 6 semesters, 180 ECTS credits).

Prerequisites:

Passed final exam in course **Electric circuit theory** desirable.

Course aims:

Introduction to basic elements of electric machines as most widely used devices in the field of electrical engineering. By exploring basic and mutual electric, magnetic and mechanic phenomena and properties, students will be able to implement that knowledge on special types of electric machines. Learning about transformers is focused on its function as electric device which is very frequently used in a process of distribution and power consumption. Exploring its static and dynamic characteristics will enable students to understand its behaviour in electro-energetic systems.

Teacher(s) and assistant(s) first and last names:

Ph.D. Momir Đurović – teacher
M.Sc. Milanka Žugić – assistant

Studying method:

Lectures, exercises, laboratory exercises, individual work on practical tasks, consultations.

Course synopsis:

Preliminary weeks	Preparation and semester enrolment.
I week	Electromagnetic energy conversion. Electromagnetic induction and EMF generating.
II week	Basic forms and dimensions of electrical machines, division, rotating machines. Other forms of electrical machines. Power balance and losses in steady state.
III week	Magnetic circuit. Coils. Magnetostriction. Electromotive and magnetomotive force.
IV week	Electromotive and magnetomotive force and magnetic fields in rotating electric machines. Tesla's rotating field.
V week	Heating and cooling. Transformers, construction and basic principles.
VI week	First test
VII week	Free week
VIII week	Basic equations, vector diagram and electric equivalent circuit. Losses in copper and ferromagnetic materials, utility factor.
IX week	Magnetization current and three phase transformers.
X week	Three phase transformers. Transformer connections and corresponding notations. Commonly used connections.
XI week	Voltage regulation and parallel operation: voltage variation, phasor diagram. Different cases of parallel operations.
XII week	Second test
XIII week	Parallel operation and asymmetric load: power distribution depending on a relative short-circuit voltage.
XIV week	Transient states: phenomena induced by switching, short-circuit, mechanic forces in short-circuit, calculation of forces in short-circuit, coils fixing.
XV week	Special types of transformers and coils.
XVI week	Final exam
Final week	Administrative procedures.
XVIII-XXI week	Additional lessons, correction of the final exam and administrative procedures.

STUDENT WORKLOAD

<u>per week</u>	<u>per semester</u>
Working hours: 6 credits x 40/30 = 8 hours.	Teaching and the final exam: (8 hours) x 16 = 128 hours.
Working hours structure: 2 hours for teaching 1 hour for exercises 2 hours for laboratory exercises 3 hours for individual work, including consultations.	Necessary preparation (before semester): 2 x (8 hours) = 16 hours. Total work hours for the course: 6 x 30 hours = 180 hours Additional hours for preparing correction of the final exam, including the exam taking: up to 36 hours. Work hours structure: 128 hours (lectures) + 16 hours (preparation) + 36 hours (additional work)

Lessons attendance is mandatory for students, as well as doing home and laboratory exercises and both tests.

Literature:

- Basic:** Momir Đurović: Uvod u teoriju električnih mašina, DOB, Podgorica 2003.
Momir Đurović: Transformatori, treće izdanje, Unireks, Podgorica 1996.
M.Saveljić, M.Đurović: Zbirka zadataka iz transformatora.
- Additional:** B. Mitraković: Asinhrona mašine, Građevinska knjiga, Beograd 1980.
B. Mitraković: Transformatori, Građevinska knjiga, Beograd 1972.
R. Wolf: Osnovi električnih strojeva, Školska knjiga, Zagreb 1985.

The forms of knowledge testing and grading:

- Home exercises carry 5x1 points.
- Laboratory exercises test carries 5 points.
- Each test carries 20 points (40 points total).
- Final exam carries 50 points.

Student gets the passing grade by collecting 51 points at least.

Special remarks for the course: If needed, the course can also be taught in English.

Teacher(s) who provided the information: Ph.D. Momir Đurović

Remark:

