Course title: **Fundamentals of Electrical Engineering I**

Type of study program: Academic studies, 180 ECTS
Study programs:
Electrical power engineering and automatics
Electronics, telecommunications and computers
ECTS: 7.5
Course status: core
Year of study: first
Semester: first (fall)
Lesson hours per week: 3+2+1 (lectures + computational exercises on the board + laboratory exercises)
Prerequisite: none
Language of instructions: Montenegrin, English

COURSE OUTLINE:

This course will introduce and explain the fundamental concepts of basic electrical engineering. The basic concepts of electrostatics and DC network analysis will be introduced.

COURSE CONTENT:

Week 01. Basic concepts of electricity. Coulomb's law. Electric field and electric field vector
Week 02. Electrostatic potential energy, electric potential and potential difference.
Week 03. Electric flux, Gauss's law with examples
Week 04. Conductors in electrostatic field (electric influence), Capacitance and capacitors
Week 05. Dielectrics in electrostatic field (polarization, boundary conditions).
Week 06. Energy in electrostatic field. Introductory concepts of DC currents
Week 07. Basic laws of electric circuit - Ohm's and Kirchhoff's laws. Equivalent resistance.
Week 08. Basic electric circuit. Electric power, work and energy
Week 09. Linear DC circuit analysis – voltage and current dividers, superposition
Week 10. Methods for linear DC circuit analysis - nodal and loop analysis
Week 11. Thevenin and Norton theorem, maximum power transfer theorem
Week 12. Capacitors in DC circuits

ASSESMENT:

Four laboratory exercises during the semester are obligatory – precondition for the final exam

During the semester one mid-term (written) exam will be organized with a possible 40% of the total number of points for the whole course.

At the end of the semester final (written) exam will be organized with a possible 60% of the total number of points for the whole course.

PERFORMANCES AND THE GRADES:

Percentage: 90-100%, Grade 'A' - excellent;

Percentage: 80-89%, Grade 'B' - very good;
Percentage: 70-79%, Grade 'C' - good;
Percentage: 60-69%, Grade 'D' - satisfactory;
Percentage: 50-59%, Grade 'E' - sufficient.

ADDITIONAL INFORMATIONS:

All necessary teaching materials for students (scripts, exercise collections, examples of solved exercises), current information and all other data are available by the MOODLE system to all students.

Course title: **Fundamentals of Electrical Engineering II**

Type of study program: Academic studies, 180 ECTS
Study program: Electronics, telecommunications and computers
ECTS: 7.5
Course status: core
Year of study: first
Semester: second (spring)
Lesson hours per week: 3+2+1 (lectures + computational exercises on the board + laboratory exercises)
Prerequisite: none
Language of instructions: Montenegrin, English

COURSE OUTLINE:

This course will introduce and explain the fundamental concepts and laws of stationary magnetic field and electromagnetic field as well as alternating current (AC) electrical circuits.

COURSE CONTENT:

Week 01. Magnetic field and magnetic flux density vector: Biot-Savart law
Week 02. Magnetic flux, Ampere's law with examples
Week 03. Generalized form of Ampere's law, magnetic circuits
Week 04. Faraday's law, inductance, energy in the magnetic field
Week 05. First order electrical circuits
Week 06. Alternating currents, graphical representation, rotating vector, phasor
Week 07. Power in AC circuits, complex notation
Week 08. Complex power, apparent, active and reactive power
Week 09. Methods for linear AC circuit analysis
Week 10. Analysis of simple resonant circuits
Week 11. Inductively-coupled circuits
Week 12. Three-phase circuits – basic idea, wye and delta connection

ASSESMENT:

Four laboratory exercises during the semester are obligatory – precondition for the final exam

During the semester one mid-term (written) exam will be organized with a possible 40% of the total number of points for the whole course.

At the end of the semester final (written) exam will be organized with a possible 60% of the total number of points for the whole course.

PERFORMANCES AND THE GRADES:

Percentage: 90-100%, Grade 'A' - excellent;
Percentage: 80-89%, Grade 'B' - very good;
Percentage: 70-79%, Grade 'C' - good;

Percentage: 60-69%, Grade 'D' - satisfactory;
Percentage: 50-59%, Grade 'E' - sufficient.

ADDITIONAL INFORMATIONS:

All necessary teaching materials for students (scripts, exercise collections, examples of solved exercises), current information and all other data are available by the MOODLE system to all of the students.

**Course:** Power Quality

**ECTS points:** 5 ECTS

**Number of classes per week:** 3+1+0

**Lecturer:** Prof. Saša Mujović

**Assistant:** Lazar Šćekić

**Learning outcomes:**

- Understanding of the underlying power quality principles and how to apply them to the grids of different voltage levels.
- Distinguishing of the main power quality disturbances (variation of frequency, harmonics, slow and rapid voltage variations, flickers etc.) and how they affect consumers.
- Assessment of the power quality and knowing of the fundamental power quality indices (Individual harmonic distortion, Total harmonic distortion, Crest factor, Power factor...).
- Performing of harmonic analysis.
- Knowing of the leading international and national rules and regulations pertained to power quality.
- Application of the provisions for improving of power quality in the power systems.

**Syllabus:** Introduction to power quality. Basic terms and definitions, importance and suitability of the subject matter, type of studies. Voltage variations during normal operating modes - over-voltage and under-voltage and voltage flicker. Definitions, sources and consequences. Voltage sags. Definitions, characteristics and types of voltage sags, voltage sag propagation and representation, consequences, voltage sag simulation, procedure review for performance assessment, effects of transformation and connection of consumers to the propagation of the voltage sag and features. Voltage sag testing and comparison. Equipment sensitivity to voltage variations. Expected financial losses from voltage sags. Harmonics. Definitions, sources and consequences. Fourier analysis, harmonic resonance, design of harmonic filters. Voltage unbalance. Sources of unbalance. Consequences from voltage unbalance. Recommended measures that are used to solve the problem of quality of supply, device types and their basic characteristics. Review of national and international norms and standards.

**Software:** MATLAB/Simulink

**Demonstration of the syllabus:**

a) Lectures: Interactive exhibition and demonstration method;

b) Practical Classes: Solving problems with relevant interest

c) Laboratory Classes: experimental method applied to the development of circuits and systems based on the knowledge acquired in the theoretical and practical lessons.

**Demonstrations of the teaching methodology:**

Realization of laboratory work (L)

The lab grade is assigned based on the analysis and discussion of the reports and in the performance demonstrated by each student in the laboratory classroom.

Realization of a theoretical work with presentation in class (P)

Assessment by exam (T).

**Literature:**


1. E.F. Fuchs,M.A.S. Masoum: Power Quality in Power Systems and Electrical Machines, Elsevier, 2008.
2. A.M. Muñoz: Power Quality – Mitigation Technologies in a Distributed Environment, Springer, 2007.
3. R.C. Dugan, M.F. McGranahan, S. Santoso, H.W. Beaty: Electrical Power Systems Quality, McGraw – Hill, 2004.