## Faculty of Science and Mathematics / Physics /

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| Prerequisites | None. |
| Aims | The primary goal of this course is to understand the physical properties of basic electric, magnetic and electromagnetic phenomena and show how these are described by advanced vector analysis. A good understanding of the physical phenomena and mathematical apparatus used in the theory of electromagnetism provide the knowledge and skills which required for further education in physics. |
| Lecturer / Teaching assistant | Prof. dr Nataša Raičević, dr Gordana Jovanović |
| Metdod | Lectures, tutorials, 5 homework assignments, 2 midterm exams, final exam. |
| Week 1, lectures | Electrostatic interaction. Coulomb’s law. The electric field in vacuum. The electric potential. Voltage. |
| Week 1, exercises | Elements of vector analysis: vector algebra, differential calculus, integral calculus, spherical polar and cylindrical coordinates. |
| Week 2, lectures | Electrostatic energy. Gauss’ law. Poisson’s equation. Electric dipole. Dipole in an electric field. |
| Week 2, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 3, lectures | The multipole expansion for the molecular electrostatic potential. Polarization of (polar and nonpolar) dielectric in an applied electric field. Distribution of bound charge. |
| Week 3, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 4, lectures | The displacement field. Dielectric boundary conditions. Electret. Conductors in electrostatic equilibrium. |
| Week 4, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 5, lectures | Electrostatic induction. Electric field energy. Electrostatic pressure on a conducting surface. Electrostatic pressure on a dielectric surface. |
| Week 5, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 6, lectures | Electrostatic force by virtual displacement method. Electric currents. Electric current density. Steady current. Electromotive force. Ohm’s law. Kirchhoff’s law. Joule-Lentz law. |
| Week 6, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 7, lectures | Ohm’s law. Kirchhoff’s law. Joule-Lentz law. Interaction betweem mooving charges. Lorentz force. Magnetic field in vacuum. The Biot-Savart law. |
| Week 7, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 8, lectures | I midterm exam. The divergence and curl of vector B. Ampere’s law. The vector potential. |
| Week 8, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 9, lectures | Magnetic field due to a circular current loop. Current loop in a magnetic field. Multipole expansion of the vector potential. |
| Week 9, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 10, lectures | The magnetic field of a solenoid and toroidal coil. The magnetic moment of a molecule. Magnetization. Bound currents. Magnetization surface current. |
| Week 10, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 11, lectures | Magnetic field strength vector and Ampere’s law in magnetized materials. Magnetostatic boundary conditions. Diamagnets, paramagnets and ferromagnets. |
| Week 11, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 12, lectures | Electromagnetic induction. Faraday’s law. Self-inductance. Mutual inductance. Magnetic field energy. Quasi-stationary current. |
| Week 12, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 13, lectures | Free oscillations in LC circuit. Two coupled LC circuits. Damped oscilations in RLC circuit. |
| Week 13, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 14, lectures | II midterm exam. Alternating current. Forced oscilations in RLC circuit. Power in alternating-current circuits. Rezonance curves. |
| Week 14, exercises | Problems related to the previous week's and/or this week's lectures. |
| Week 15, lectures | Transformers. Three-phase current. Eddy current. The displacement current. The Mawxell equations. |
| Week 15, exercises | Problems related to the previous week's and/or this week's lectures. |

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| Student obligations | Students are required to attend school regularly, as well as doing home exercises, both midterm exams and final exam. |
| Consultations | Every week. |
| Workload | Weekly: 10 ECTS x 40/30=13 hours and 20 min. ~ 13.5 hours. 4 hours of lectures,4 hours exercises,5.5 hours additional work including consultations. In semester: Teaching and final exam: (8 hours) x 16 = 128 hours The necessary preparations before the start of the semester (administration, enrollement, certification) 2 x 13.5 hour = 27 hour. Total hours for the course 10x30 = 300 hours. |
| Literature | |
| Examination metdods | Each homework assignment is worth 2 points (all together 10 points), each midterm exam is worth 25 points (all together 50 points) and the final exam is worth 40 points. A student needs 51 points in order to pass the exam. |
| Special remarks | |
| Comment | |
| Learning outcomes | On completion of this course the student shall be able to: 1. define the basic laws of electrostatics; 2. define the basic laws of magnetostatics; 3. define the basic laws of time-varying electric and magnetic fields; 4. analyse DC and AC circuits; 5. interpret physically the basic concepts and theorems from vector analysis necessary for the theory. |