LEARNING MODULE DESCRIPTION

GENERAL INFORMATION

- 1. Module title: Electricity and magnetism
- 2. USOS code: 04-B-FIZ2-60-1L
- 3. Term: winter
- 4. Duration: lecture: 30 h and classes: 15 h
- 5. ECTS:
- 4 6. Module lecturer: dr Monika Makrocka-Rydzyk
- 7. E-mail: mrydzyk@amu.edu.pl
- 8. Language: English
- **DETAILED INFORMATION** 1. Module aim (aims)

Introduction to electricity, magnetism and circuits including concepts of electric charges, electric and magnetic fields, electric potential, conductors and insulators, currents, electromagnetic induction and electromagnetic waves

2. Pre-requisites in terms of knowledge, skills and social competences (where relevant)

Basic skills in arithmetic and algebra, geometry and trigonometry

READING LIST

- 1. Halliday D., Resnick R., Walker J., Fundamentals of Physics (volume 3), PWN Warszawa, 2005
- 2. University Physics. https://openstax.org/details/books/university-physics-volume-2

SYLLABUS

Week 1: **Electric charge and Coulomb law**

- **Electric Charge**
- Conductors, Insulators •
- Charging by Induction
- Coulomb's Law
- Electric dipole •
- **Charge Distributions**

Week 2: **Electric field**

- Electric field concept
- Superposition of electric fields
- **Electric Field Lines** •
- Calculating Electric Fields of Charge Distributions

Week 3: Gauss's law

- **Electric Flux** •
- Gauss's Law
- Applications of Gauss's Law •

Week 4: **Electric potential**

- Electric Potential Energy
- Electric Potential and Potential Difference
- Calculations of Electric Potential
- Determining Field from Potential •

• Equipotential Surfaces and Conductors

Week 5: Capacitance

- Capacitors and Capacitance
- Capacitors in Series and in Parallel
- Energy Stored in a Capacitor
- Capacitor with a Dielectrics
- Molecular Model of a Dielectric

Week 6: Current and resistance

- Electrical Current
- Model of Conduction in Metals
- Resistivity and Resistance
- Ohm's Law
- Electrical Energy and Power
- Superconductors

Week 7: Direct-current circuits

- Electromotive Force
- Resistors in Series and Parallel
- Kirchhoff's Rules
- RC Circuits

Week 8: Magnetic force and magnetic field

- Magnetic Fields and Lines
- Motion of a Charged Particle in a Magnetic Field
- Magnetic Force on a Current-Carrying Conductor
- Force and Torque on a Current Loop
- The Hall Effect

Week 9: Magnetic field sources

- The Biot-Savart Law
- Magnetic Field Due to a Thin Straight Wire
- Magnetic Force between Two Parallel Currents
- Magnetic Field of a Current Loop
- Ampère's Law and its applications

Week 10: Magnetism of matter

- Paramagnetic materials
- Diamagnetic materials
- Ferromagnetic materials
- Hysteresis loop

Week 11: Electromagnetic induction

- Faraday's Law
- Lenz's Law
- Motional Emf
- Induced Electric Fields
- Eddy Currents
- Electric Generators

Week 12: Inductance

- Inductance
- Mutual Inductance
- Self-Inductance

- Energy in a Magnetic Field
- RL Circuits
- Oscillations in an LC Circuit
- RLC Series Circuits

Week 13: Alternating-current circuits

- AC Sources
- RLC Series Circuits
- Resonance in an AC Circuit
- Power in an AC Circuit
- Transformers

Week 14: Maxwell's equations

Week 15: Electromagnetic waves

- Plane Electromagnetic Waves
- Energy Carried by Electromagnetic Waves
- The Electromagnetic Spectrum