| Code | II.3. |
|---|---|
| Course Title (English) | . Engineering Physics-Electromagnetism |
| Course Title (Polish) | Fizyka techniczna – Podstawowe prawa elektrodynamiki i magnetyzmu |
| Credits | 4 ECTS |

*Language of instruction* **English**

*Compulsory for Profile:* Computer Modelling and Simulation (CMS), Intelligent Energy (IE), Biotechnology for Environmental Protection (BEP), Business and Technology (BT)

*Type of studies* BSc studies

*Unit running the programme* Electrotechnics and Automatic Control Division at Institute of Environmental Engineering

***Course coordinator** and academic teacher* **Zygmunt Piątek, profesor**, Zygmunt Piątek, profesor

*Form of classes and number of hours*

| Semester | Lec. | Tut. | Lab. | Proj. | Sem. | Credit points |
|---|---|---|---|---|---|---|
| II | 30 | 15 | | | | 4 |

*Learning outcomes* The introduction to atomic structure, electrostatic, electroconductive, magnetic and electromagnetic fields

*Prerequisites (mathematical tools)* Physical phenomena, vector analysis and calculus at the secondary school program level

*Course description:*

LECTURES (15 hours):

**1. Introduction**
Scalars and vectors
Algebra of vectors
Coordinate systems
Line, surface and volume integrals

**2. Coulomb forces and electric field intensity**
Electric charge
Coulomb's law
Electric field intensity
Charge distributions

**3. Electric flux and Gauss' law**
Electric flux
Flux density
Gauss' law
Relation between flux density and electric field intensity

**4. Electrostatic field: work, potential and energy**
Work done in moving a point charge
Conservative property of the electrostatic field
Electric potential between two points
Potential of a point charge and charge distribution

**5. Potential and electric field**
Equipotential lines
Gradient
Relationship between potential and electric field intensity
Energy in static electric fields

**6. Capacitance. Dielectrics and conductors**
Capacitance
Energy stored in a capacitor
Electric field in matter
Polarization
Relative permittivity
Electrostatic field inside a conductor

**7. Currents and conductors**
Charges in motion
Convention current density
Conduction current density
Conductivity
Current
Current distributions

**8. Electric potential and voltage**
Resistance and resistors
Ohm's law
Power losses
Continuity of current
Kirchhoffs's laws

**9. Magnetic field**
Permanent magnets and early ideas on magnetism
Oersted's experiments
Magnetic flux density and Biot-Savart law
Magnetic field strength

Ampère’s law

**10. Forces and work in magnetic field**
Magnetic force on particles
Electric and magnetic fields combined
Magnetic force on a current element
Definition of ampere
Torque
Work in magnetic field

**11. Inductance and magnetic properties of matter**
Magnetic flux
Inductance
Energy stored in a coil
Mutual inductance
Magnetic field in matter
Magnetic and non-magnetic materials
B-H curve

**12. Induced EMF**
Faraday’s experiments
Faraday’s law
Lenz’s law
Conductors in motion through time-independent magnetic field
Conductors in motion through time-dependent magnetic field
Induced electric field

**13. Electrical machinery using induced EMF**
Transformer
Model of inductive machine
Torque on planar coil in magnetic field
AC engine and generator
DC engine and generator

**14. Maxwell’s equations**
Maxwell’s correction
Displacement current
Ratio of displacement current and conduction current
Maxwell’s equations

**15. Electromagnetic waves**
Waves
Planar electromagnetic wave
Monochromatic planar electromagnetic wave
Skin depth

TUTORIALS AIM (15 hours): Calculating of quantities describing electric and magnetic fields according to the lecture programme.

LABORATORY (15 hours): 5 labs

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|---|---|
| *Form of assessment* | Written assessment - 1 hour (5 problems) |
| *Basic reference materials* | a) Lectures and hand notes.<br>b) Edminister J.A., **Theory and problems of electromagnetics**, Schaum's Outline Series, McGraw-Hill, 1993. |
| *Other reference materials* | a) Sibley M., **Introduction to electromagnetism**, Essential Electronics Series, Butterworth-Heinemann Ltd., 1995.<br>b) Nasar S.A., **2000 solved problems in electromagnetics**, Schaum's Solved Problems Series, McGraw-Hill, 1992.<br>c) Kraus J.D., **Electromagnetics**, McGraw-Hill Series in Electrical & Computer Engineering, McGraw-Hill College, 1991.<br>d) Cheng D.K., **Field and Wave Electromagnetics**, International Edition, Prentice Hall, 1991.<br>e) Hayt W.H., **Engineering Electromagnetics**, Electrical & Electronic Engineering Series, McGraw-Hill Science/Engineering/Math, 2005.<br>f) Hughes A., **Electric Motor and Drives: Fundamentals, Types and Applications**, Newnes (an imprint of Butterworth-Heinemann Ltd.), 1993.<br>g) Hindmarsh J., **Electrical Machines and Drives: Worked Examples**, Butterworth-Heinemann Ltd., 1996. |

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| e-mail of the course coordinator and academic teachers | zygmunt.piatek@interia.pl |
| Average student workload (teaching hours + individ. ) | 45 + 45 hrs |
| Remarks: | |
| *Updated on:* | *04.04.2012* |