GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Mathematical modeling in electrodynamics , PG_00050025 | | |
| Field of study | Electrical Engineering | | |
| Date of commencement of studies | October 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |
| Mode of study | Part-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 1 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Control Systems Engineering -> Faculty of Electrical and Control Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Mirosław Wołoszyn | |
| | Teachers | dr hab. inż. Mirosław Wołoszyn | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 20.0 | 0.0 | 20.0 | 0.0 | 0.0 | 40 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 40 | 10.0 | 50.0 | 100 |

**Subject objectives**

Advanced knowledge of electrodynamics problems and method of solving ordinary and partial differential equations.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| K7_U06 | can solve technical electrodynamics problems using the analytical and numerical methods | [SU4] Assessment of ability to use methods and tools |
| K7_W01 | Has in-depth knowledge of numerical methods, knows numerical methods for solving ordinary and partial differential equations. Has advanced knowledge of electrodynamics, can formulate a problem using Laplace and Poisson equation, can put boundary conditions. | [SW3] Assessment of knowledge contained in written work and projects |
| K7_U05 | can write a computer program that solves ordinary and partial differential equations | [SU4] Assessment of ability to use methods and tools |

**Subject contents**

Euler's, Adams Bashforth's method, Adams Moulton's method, 4th order Runge-Kutta, Merson's method, finite difference method, basics of finite element method, Maxwell's equations. Solving problems in electrostatics, magnetostatics and electromagnetic fields using the finite difference method and the finite element method (1D and 2D). Poynting's vector. Wave equation. The propagation of waves in material centers. Introduction to the theory of wave systems. Basics of the theory of antenna systems and waveguides (basic features and parameters, zones and radiation conditions, reciprocity principle). : Discussion of integral methods for solving field problems - the method of boundary elements and the method of moments. Basics of electromagnetic compatibility and radiated disturbances.

**Prerequisites and co-requisites**

Knowledge of electrodynamics in the scope of this first degree. Basic knowledge of numerical methods

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Tests and work in laboratory | 60.0% | 100.0% |

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|---|---|---|
| Recommended reading | Basic literature | Griffiths D.J.: Podstawy elektrodynamiki. PWN Warszawa 2001<br><br>Bolkowski S. i inni: Komputerowe metody analizy pola elektromagnetycznego. WNT Warszawa 1993<br><br>Jackson J.D.: Elektrodynamika klasyczna. PWN Warszaw 1982<br><br>Leon o. Chua, Pen-Min Lin. Komputerowa Analiza Układów Elektronicznych, WNT, Warszawa 1981 |
| | Supplementary literature | M. Sadiku. Elements of electromagnetics<br><br>K. Chari. S. Salon. Numerical methods in electromagnetism |
| | eResources addresses | Adresy na platformie eNauczanie:<br>MODELOWANIE MATEMATYCZNE W ELEKTRODYNAMICE [Niestacjonarne][2023/24] - Moodle ID: 32269<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32269 |
| Example issues/ example questions/ tasks being completed | For a given system solve the Laplace or Poisson equation. Check if the vector field has a vector potential. Find the potential distribution in the system. Calculate the vector's magnetic potential in the system. Examine the skin effect abd proximity effect. Assign the distribution of the electromagnetic field of the elementary radiating dipoles. Design simple antenna systems. | |
| Work placement | Not applicable | |