COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theory of the electromagnetic field [S1EiT1>TPE]

Course

Field of study
Electronics and Telecommunications

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Has systematic knowledge of mathematical analysis, algebra. Has a basic, structured knowledge of physics. Has structured, mathematical underpinnings, detailed knowledge of the foundations of circuit theory necessary to understand, analyze, evaluate the performance of electrical circuits. Apply the vector calculus in three basic systems of coordinates. Able to solve simple circuits with lumped and distributed parameters in steady state and transient. Knows the limits of their own knowledge and skills, understands the need for ongoing education.

Course objective

In-depth knowledge of the nature of the fields and electromagnetic waves. Knowledge and understanding of Maxwell"s equations, wave propagation in free space and the waves run along the media, as well as radiation waves by simply radiant systems. The ability of simple analytical calculations of electromagnetic fields and related waves.

Course-related learning outcomes

Knowledge:
Knows physical quantities of the electromagnetic field and the parameters of the environment. Knows

basic laws of electromagnetism. Understand the term boundary conditions and their relationship with waves on the border of two media - reflection and transmission of waves. He knows what it is the polarization of an electromagnetic wave. Understands the energy balance in the electromagnetic field, based on the Poynting vector. Has a basic understanding of the waveguides and simple radiating systems.

Skills:
Able to take the information from the literature and databases, and other sources in Polish or English; able to integrate the information, make their interpretation, draw conclusions and justify opinions. Able to solve common tasks in the area of electromagnetic field and waves analysis. Able to solve simple problems related to the propagation of electromagnetic waves.

Social competences:
Capable of self-learning (books, computer programs). Behaves actively in class, asks questions, knowingly uses the contact with the teacher (eg consultation).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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1.The exam
It consists of an oral and a written part. It is passed when the sum of points scored equals or exceeds 50% of possible points. The final grade is influenced by a positive grade from the tutorial exercises.
2. Assessment of tutorials (Classes)
It is based on: written task tests (colloquia), homework and activity during classes.

Programme content

1. Physical quantities of the electromagnetic field and environmental parameters.
2. Basic laws of electromagnetism (Gauss, Ampere, Faraday, Lorenz, ...). Maxwell"s equations in integral and differential form, wave equations.
3. Plane wave in an infinite lossless and lossy media, dielectric polarization, phenomenon of skin effect and dispersion.
4. The energy balance in the field (Poynting vector). Boundary conditions - wave on the boundary of two media, reflection and transmission of wave, the polarization of the wave.
5.Transmission line equations in the steady state and transient. Secondary parameters of lines: characteristic impedance, propagation coefficient.
6. The reflection coefficient, VSWR, Smith chart. Standing and traveling waves. The dispersion in the line, the phase and group velocity.
7. Basic types of waveguides: rectangular and circular, basic types and kinds of waves. Resonators. Retarded potentials - near and far radiation.
8. Hertz dipole, radiation pattern, directivity and gain of antenna (Hertz dipole).

Teaching methods

Lecture and Classes

Bibliography

Basic
[1] Teoria pola elektromagnetycznego, T. Morawski, W. Gwarek , WNT, Warszawa, 1985,...
[2] Pole i fale elektromagnetyczne, L. Różański , WPP, Poznań , 1997
[3] Zbiór zadań z teorii pola elektromagnetycznego, T.Morawski-redaktor, Wyd. PW, Warszaw, 1984,...
Additional
[1] Fields and Waves in Communication Electronics, S.Ramo, J.R. Whinnery, T. Van Duzer, Wiley, New York, 1994, 3rd Edition.
[2] Transmission Lines, Equivalent Circuits, Electromagnetic Theory, and Photons, R. Cpllier, Cambridge Univ. Press, 2013
[3] Electromagnetic Fields and Waves, Robert V. Langmuir, Hassell Street Press, 2021
[4]Zadania z podstaw elektromagnetyzmu, J.Kozłowski, W.Machczyński, Wyd. PP, Poznań, 1993,...

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	70	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00