COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electromagnetic waves [S1EiT1E>FE]

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
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

A student should have a basic knowledge on physics, circuit theory, and electric metrology (measurement uncertainty). He should also be able to perform calculations of simple DC and AC circuits, to acquire information from suggested literature sources, and should be ready for teamwork.

Course objective

Learning and understanding the transmission line and antenna parameters, the most popular antenna types, learning how to choose the optimal antenna for a given radio system, learning and understanding the principles of feeder and antenna measurements, learning and understanding radio wave propagation in free space and Earth"s atmosphere for various frequency bands, learning the principles of antenna mounting and maintenance.

Course-related learning outcomes

Knowledge:
After completing the course a student:
1. has a systematic knowledge, together with necessary mathematical background, of the theory of EM fields, EM wave propagation, and of antenna construction and properties

2. has a systematic knowledge, together with necessary mathematical background, of the fundamentals of measurement methods and measurement equipment for antenna, feeder, and propagation measurements
3.knows the latest antenna development trends
4. knows occupational health and safety principles
5. is able to notice non-technical (environmental, economic, legal) aspects of the feeder, antenna and radio system design process.

Skills:
After completing the course a student:
1. is able to extract information from English language literature, databases and other sources, is able to synthesize gathered information, draw conclusions, and justify opinions
2. is capable of studying autonomously
3. is able to solve typical problems related to EM wave propagation and design of antennas
4. Can implement the occupational health and safety principles
5. is aware of professional and aethical behaviour importance, feels responsible for designed radio systems and is aware of potential threats coming from their improper use, can assess the risk of the threats.

Social competences:
After completing the course a student:
1. is aware of the limitations of his/her current knowledge and skills; is committed to further self-study
2. demonstrates responsibility and professionalism in solving technical problems, is able to participate in collaborative projects and has teamwork skills.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
- lecture knowledge - written and/or oral exam (60-90 minutes, 3-5 questions, 50% threshold - grade 3.0, the list with the exam problems is available as an e-mailon the e-Kursy platform)
- laboratory skills - the average grade from lab reports and the written test (60-90 minutes, 3-4 numerical problems, 50% threshold - grade 3.0); the report requirements are presented during introductory classes, the report grade comprises the assesment of the formal agreement with the report template, the assessment of measurement data processing and presentation, and written explanation of problems.

Programme content

Lectures
Electrostatics and magnetostatics, plane wave, transmission lines, antennas, measurements of antenna parameters, EM wave propagation.

Laboratory classes
Calculation of transmission line parameters, design of a radio system using the free space propagation model, lab exercises illustrating the chosen wave phenomena, measurement of basic transmission line and antenna parameters.

Course topics

Lectures
Fundamentals of electrostatics and magnetostatics, Maxwell’s equations, plane wave, wave equation, wave velocity, polarization, skin effect , E and H fields on media boundary, standing wave, VSWR, RL, transmission lines – basic types, parameters, characteristic impedance, input impedance of a loaded transmission line, the Smith chart; antenna in a radio link, basic antenna parameters, simple antennas – short dipole, halfwave dipole, wire antennas, monopoles; broadband, aperture, reflector, and microstrip antennas, antenna installation and maintenance, environmental and occupational EM safety standards, measurements of VSWR/RL, measurements of antenna parameters, EM wave spectrum, basic propagation formulae (free space, Fresnel zones), propagation of long, medium, short, VHF/UHF waves and microwaves.

Laboratory classes
Calculation of numerical problems (6 classes).
Execution of lab exercises:
1. Doppler effect
2. Free space propagation
3. Radiation pattern measurements of selected antennas
4. Coaxial cable attenuation measurements
5. Measurements of characteristic impedance and RL/VSWR of antenna feeder.

Teaching methods

1. Lectures - multimedia presentations, board examples, educational movies.
2. Laboratory classess - solving numerical problems on the board (recitations), practical exercises and experiments.

Bibliography

Basic
1. Szostka J., Waves and Antennas. Lecture materials (each student obtains a personal copy).

Additional
1. D.Pozar, Microwave Engineering, Addison-Wesley Publishing Comp., New York 2005 (chapters 1, 2, 13.5, and 13.6).
2. W. Stutzman, G. Thiele, Antenna Theory and Design, John Wiley & Sons, 2011.
3. M. Hall et al. (ed.), Propagation of Radiowaves, The Institute of Electrical Engineers, London 1996 (chapter 1).
4. S. Ramo, J. Whinnery, T. van Duzer, Fields and Waves in Communication Electronics, John Wiley & Sons, 1994.
5. P. Young, Electronic Communication Techniques, Pearson Prentice Hall, 2004 (chapters 14 and 15).
6. J.D. Kraus, Antennas, McGraw – Hill Book Company, 1988.
7. A. Balanis, Antenna Theory and Design, John Wiley & Sons, 2011.
8. J. Carr, G. Hippisley, Practical Antenna Handbook, McGraw-Hill, 2011.
9. The ARRL Antenna Handbook, The American Radio Relay League (www.arrl.org).
10. J. Szóstka, Fale i anteny (in Polish), Wyd. Komunikacji i Łączności, Warszawa 2006.
11. J. Szóstka, Miernictwo radiokomunikacyjne (in Polish), Wyd. Politechniki Poznańskiej, Poznań 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00