

SYLLABUS

1. Data about the study program

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| 1.1 Institution | Technical University of Cluj-Napoca |
| 1.2 Faculty | Faculty of Electronics, Telecommunications and Information Technology |
| 1.3 Department | Communications |
| 1.4 Field of study | Electronic Engineering, Telecommunications and Information Technologies |
| 1.5 Cycle of study | Master of Science |
| 1.6 Program of study / Qualification | Telecommunications / Master |
| 1.7 Form of education | Full time |
| 1.8 Subject code | TC-E03.00 |

2. Data about the subject

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|---|--|--------------|---|----------------|---|----------------------|-------|
| 2.1 Subject name | Wireless Systems | | | | | | |
| 2.2 Subject area | Theoretical area Methodological area Analytic area | | | | | | |
| 2.3 Course responsible | Professor Tudor PALADE, Ph.D. Tudor.Palade@com.utcluj.ro | | | | | | |
| 2.4 Teacher in charge of seminar / laboratory / project | Professor Emanuel PUSCHITA, Ph.D. Emanuel.Puschita@com.utcluj.ro | | | | | | |
| 2.5 Year of study | I | 2.6 Semester | 1 | 2.7 Assessment | E | 2.8 Subject category | DA/DI |

3. Estimated total time

| | | | | | |
|---|-----|----------------------|----|----------------|-------|
| 3.1 Number of hours per week | 3 | of which: 3.2 course | 2 | 3.3 laboratory | 1 |
| 3.4 Total hours in the curriculum | 42 | of which: 3.5 course | 28 | 3.6 laboratory | 14 |
| Distribution of time | | | | | hours |
| Manual, lecture material and notes, bibliography | | | | | 28 |
| Supplementary study in the library, online specialized platforms and in the field | | | | | 12 |
| Preparation for seminars / laboratories, homework, reports, portfolios and essays | | | | | 14 |
| Tutoring | | | | | 3 |
| Exams and tests | | | | | 3 |
| Other activities: | | | | | |
| 3.7 Total hours of individual study | 58 | | | | |
| 3.8 Total hours per semester | 100 | | | | |
| 3.9 Number of credit points | 4 | | | | |

4. Pre-requisites (where appropriate)

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| 4.1 curriculum | Microwaves, Cellular Radio Communications, Radio Communications |
| 4.2 competence | N. A. |

5. Requirements (where appropriate)

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| 5.1. for the course | Amphitheatre, Cluj-Napoca |
| 5.2. for the seminars / laboratories / projects | Laboratory, Cluj-Napoca |

6. Specific competences

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|--------------------------|---|
| Professional competences | <p>C1. Use of the fundamental elements related to devices, circuits, systems, instrumentation and electronic technology</p> <p>C2. Applying the basic methods for the acquisition and processing of signals</p> <p>C3. Application of the basic knowledge, concepts and methods regarding the architecture of computer systems, microprocessors, microcontrollers, languages and programming techniques</p> <p>C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information</p> <p>C4.1. Identification of fundamental concepts related to information transmission and to analog and digital communications.</p> <p>C4.3. Explanation and interpretation of the main requirements and specific approach techniques for data, voice, video, multimedia transmissions</p> <p>C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks.</p> <p>C5.1. Defining the principles underlying the main telecommunications technologies, fixed and mobile, through various transmission media.</p> <p>C5.2. Explanation and interpretation of technologies and fundamental protocols for integrated fixed and mobile communication systems</p> <p>C5.6. Solving the problem of installation and maintenance of a communication system of small/medium complexity</p> <p>C6. Solving specific problems of the broadband communications networks: propagation in different environments, circuits and equipment for high frequencies (microwaves and optical).</p> <p>C6.1. Identifying/Defining/Presenting the laws of the electromagnetic field in addressing specific problems of propagation and transmission, as well as specific circuits.</p> <p>C6.2. Explaining the specific methods of implementing communication techniques.</p> <p>C6.3. Solving practical problems using microwave circuit design methods, planning, coverage, selection and deployment of transmission and reception equipment</p> |
| Cross competences | N.A. |

7. Discipline objectives (as results from the key competences gained)

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|-------------------------|--|
| 7.1 General objective | Developing skills in the use, analysis and (re)design of wireless systems. |
| 7.2 Specific objectives | <ol style="list-style-type: none"> 1. Application of theoretical concepts of wireless networks, use of professional software tools for design, testing and measurements (QualNet, AirMagnet Laptop Analyzer, LaView, Matlab). 2. Developing skills and competencies for planning, implementing, testing and evaluating wireless systems. |

8. Contents

| 8.1 Lecture (syllabus) | Teaching methods | Notes |
|---|---|---|
| 1. The basics of radio transmission and reception | The discipline content and the acquired skills are in agreement with the expectations of the professional | The discipline content and the acquired skills are in agreement with the expectations of the professional |
| 2. Wireless communication network. | | |
| 3. The characteristics of the radio channel. | | |
| 4. Wireless transmission-multiplexing, distributed spectrum, coding. | | |
| 5. Access control to the transmission medium. | | |
| 6. WiFi access networks in the IEEE 802.11 standard – the physical layer | | |
| 7. WiFi access networks in IEEE 802.11 standard – MAC layer | | |
| 8. WiMAX radio access technology – the physical layer | | |
| 9. WiMAX radio access technology – MAC layer | | |
| 10. Mobile WiMAX technology | | |
| 11. Bluetooth networks | | |
| 12. Cordless systems | | |
| 13. Ad hoc networks | | |
| 14. Software solutions for designing wireless systems | | |
| 8.2 Laboratory | Teaching methods | Notes |
| 1. Introduction to simulating mobile wireless systems using GloMoSim | Practical demonstration, lab experiments, applications | Use of emulators, mobile phones and devices computers |
| 2. Influence of propagation models on the performance of wireless systems. | | |
| 3. Effect of multiple access techniques on communication performance. The hidden and exposed terminal problem. | | |
| 4. Performance analysis of routing protocols in ad hoc wireless systems | | |
| 5. Evaluation of access point capacity in a wireless system | | |
| 6. Influence of mobility on the performance of wireless systems | | |
| 7. Evaluation of a combined wired and wireless scenario. | | |
| 8. The effect of multiple access techniques on communication performance. Support for quality of service. | | |
| 9. The effect of upper layers on the performance of wireless systems. | | |
| 10. Evaluation of the routing protocol using NS-2 | | |
| 11. Analysis of an 802.16 network using LabView | | |
| 12. Matlab simulation of radio channel fading | | |
| 13. Performance analysis of wireless networks in the 5 GHz band using Simulink | | |
| 14. Scenarios for access networks in OPNET | | |
| Bibliography | | |
| 1. Jim Geier, Designing and Deploying 802.11 Wireless Networks, Cisco, 2015. | | |
| 2. Haesik Kim, Wireless Communications Systems Design, Wiley, 2015. | | |
| 3. Ramjee Prasad, Marina Ruggieri, Technology Trends in Wireless Communications, Artech House, 2003 | | |
| 4. Amitava Mukherjee, Somprakash Bandyopadhyay, Debashis Saha, Location Management and Routing in Mobile Wireless Networks, Artech House, 2003. | | |
| 5. Jochen H. Schiller, Mobile Communications, Addison Wesley, 2003. | | |
| 6. William Stallings, Wireless Communications and Networks, Prentice Hall, 2005. | | |

9. Bridging the course contents with the expectations of the representatives of the community, professional associations and employers in the field

The skills acquired will be used in the following COR occupations (electronic engineer; telecommunications engineer; electronic design engineer; system and computer design engineer; communications design engineer) or in the new occupations proposed to be included in COR (sales support engineer; multimedia application developer; network engineer; communications systems engineer; communications systems consultant).

10. Evaluation

| Activity type | 10.1 Assessment criteria | 10.2 Assessment methods | 10.3 Weight in the final grade |
|-----------------------------|--|---|--------------------------------|
| 10.4 Course | Answers to a set of theory questions | Oral examination | 50% |
| 10.5 Seminar/ Laboratory | Verification of skills and abilities acquired because of laboratory activities | Verification along the way through laboratory tests | 50% |

10.6 Minimum standard of performance

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ Basic concepts of microwave transmission and reception
- ✓ Radio propagation for fixed and mobile LoS and nLoS links
- ✓ Multiple access techniques for wireless networks
- ✓ Broadband characteristics, architectures, functions and services of WiFi, Bluetooth, WiMax networks.
- ✓ Cordless systems
- ✓ Ad hoc networks
- ✓ The main software tools for wireless network simulation and design

Minimal acquired competences:

- ✓ Characterization of basic wireless networks.
- ✓ Understanding the behavior of the radio channel and the calculation of the main parameters of the link.
- ✓ Understanding and evaluating the performance of different wireless access networks
- ✓ Planning access system network scenarios
- ✓ Analysis and planning of wireless ad hoc networks
- ✓ Use of professional simulators for wireless systems and network planning
- ✓ Understanding the features of the main technologies for remote system configuration
- ✓ Use of spectrum and network analyzer
- ✓ Use of signal synthesizer and vector signal analyzer to measure parameters of various wireless technologies

Quantitative point of view

- ✓ Performing all laboratory work
- ✓ The exam and laboratory grades must be at least 5.
- ✓ The subject grade is calculated with the relationship: $0.5 * \text{exam_grade} + 0.5 * \text{laboratory_grade}$

| Date of filling in: | Responsible | Title First name SURNAME | Signature |
|---------------------|--------------|-----------------------------------|-----------|
| 27.06.2024 | Course | Professor Tudor PALADE, Ph.D. | |
| | Applications | Professor Emanuel PUSCHITA, Ph.D. | |
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| Date of approval in the Department of Communications 10.07.2024 | Head of Communications Department Prof. Virgil DOBROTA, Ph.D. |
| Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 11.07.2024 | Dean Prof. Ovidiu POP, Ph.D. |