SYLLABUS

1. Data about the program of study

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-E04.00

2. Data about the subject

2.1 Subject name	Antennas and RFID Sensors						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Associate Professor Nicolae CRISAN, Ph.D. Nicolae.Crisan@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Associate Professor Nicolae CRISAN, Ph.D. Nicolae.Crisan@com.utcluj.ro						
2.5 Year of study	1	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 To 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	20
Supplementary study in the library, online specialized platforms and in the field	12
Preparation for seminars / laboratories, homework, reports, portfolios and essays	20
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)

4.1 curriculum	Microwaves
4.2 competence	N. A.

5. Requirements (where appropriate)

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

6. Specific competences

Professional competences	C1. Use of the fundamental elements related to devices, circuits, systems, instrumentation and electronic technology C2. Applying the basic methods for the acquisition and processing of signals C3. Application of the basic knowledge, concepts and methods regarding the architecture of computer systems, microprocessors, microcontrollers, languages and programming techniques 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 C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks C6. Solving specific problems of the broadband communications networks: propagation in different environment, circuits and equipment for high frequencies (microwaves and optical).
Cross competences	N.A.

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

7.1 General objective	Development of professional skills in the field of designing and simulation of the antennas for microwaves
7.2 Specific objectives	1. Assimilation of the theoretical knowledge regarding the operation of antenna systems 2. Development of skills and abilities needed to design and implement of antennas using EM-CAD

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Introduction. Antennas and RFID technology.	The discipline content and the acquired skills are in agreement with the expectations of the professional	N/A
2. Antenna fundamentals. RFID tags.		
3. Using EM_CAD aided programs to analyze and design antennas.		
4. Impedance matching techniques. Antenna measurements.		
5. Impact of nanotechnologies in antenna design. Introduction in HFSS simulator.		
6. Antenna networks – Fundamentals		
7. Antenna arrays – Fundamentals. Matlab algorithms for beamforming and beamsteering		

8. Side lobes suppressing techniques and interference mitigation. Angles of arrival estimation.		
9. MIMO system with uniform linear antenna arrays. Pseudo-spectrum.		
10. Radio channel parameters assessment with uniform arrays		
11. Analog and digital beamforming		
12. Fading mitigation algorithms using beamforming (DBMF), implemented in Matlab		
13. Advanced techniques to counteract the effect of the radio channel using smart antennas. RFID components and standards.		
14. RFID technologies for deposits management		
1. N. Crisan, L. Cremene, Antene adaptive – Tehnici de reconfigurare si fundamente matematice , ISBN - 978-606-17-0051-6, 220 pg, 2011. 2. Frank B. Gross, *Frontiers in antennas- Next Generation Design & Engineering, ISBN 978-0-07-163793-0,* Biblioteca Centrală UTCN, 520 pg, 2011 3. Li Yang, Amin Rida, s.a. *Design and Developement of Radio Frequency Identification (RFID) and RFID-Enabled Sensors on Flexible Low Cost Substrate,* ISBN 978-1-59-829860-4, Biblioteca Centrală UTCN, 520 pages, 2009. **Online references** 4. Course materials (in English): https://amla.utcluj.ro		
8.2 Laboratory	Teaching methods	Notes
1. Introduction in HFSS (High Frequency Structure Simulator)	Practical experiments on physical, virtual, cloud and emulator equipment.	N/A
2. A simple dipole antenna simulation		
3. Computer aided design of a broadband antenna for UMTS		
4. Computer aided design of a microstrip patch antenna for WLAN		
5. SAR assessment for a mobile phone using HFSS		
6. Antenna measurements with antenna analyzer in L and X radio bands.		
7. Horn antenna measurements and simulation for DVB		
Bibliography 1. N. Crisan, HFSS Tutorial – Antenna Modelling – Computer-assisted antenna design, UTPRESS, 2016, ISBN 978-606-737-192-5 2. Moodle platform with laboratory tutorials (in English) – https://amla.utcluj.ro		

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

The discipline content and the acquired skills are in agreement with the expectations of the professional Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic 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	The level of acquired theoretical knowledge and practical skills	Written exam including theory and problems (10 questions)	40%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Multiple choice tests at the end of each lab and Projects	60%
10.6 Minimum standard of performance			

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ Understanding of the architecture, functionality of antennas
- ✓ Ability to perform simulations of antennas with HFSS

Minimal acquired competences:

- ✓ Ability to develop simple programs to mitigate fading
- ✓ Ability to analyze and improve the performance of antenna systems

Quantitative point of view

- ✓ Minimal mean at the exam 5
- ✓ Final mark = 0.4 x Exam + 0.6 x Mean of the marks at the lab tests and projects

Date of filling in:	Responsible	Title First name SURNAME	Signature
19.06.2023	Course	Associate Professor Nicolae CRIȘAN, Ph.D.	
	Applications	Associate Professor Nicolae CRIȘAN, Ph.D.	

Date of approval in the Department of Communications 11.07.2023	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 12.07.2023	Dean Prof. Ovidiu POP, Ph.D.