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	Bachelor of Science
1.6 Program of study / Qualification	Telecommunications Technologies and Systems / Engineer Applied Electronics/ Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E49.20/EA-E102.00

2. Data about the subject

2.1 Subject name	Cellular Radio Communications						
2.2 Subject area	Methodological area / Analytic area						
2.3 Course responsible	Professor Emanuel PUSCHITA, PhD. Habil. (Emanuel.Puschita@com.utcluj.ro)						
2.4 Teacher in charge with seminar / laboratory / project	Assistant Cristian CODAU, Cristian.Codau@com.utcluj.ro						
2.5 Year of study	4	2.6 Semester	1	2.7 Assessment	Exam	2.8 Subject category	DS/DO

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	2	3.3 seminar / laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar / laboratory	28

Distribution of time	hours
Manual, lecture material and notes, bibliography	20
Supplementary study in the library, online specialized platforms and in the field	16
Preparation for seminars / laboratories, homework, reports, portfolios and essays	4
Tutoring	1
Exams and tests	3
Other activities:	

3.7 Total hours of individual study	44
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 curriculum	Microwaves, Radiocommunications, Modulation techniques
4.2 competence	N/A

5. Requirements (where appropriate)

5.1. for the course	The Technical University of Cluj-Napoca

	(Video-projector, screen, whiteboard, MS Office 365/MS Teams account for online classes)
5.2. for the seminars / laboratories / projects	The Technical University of Cluj-Napoca (PCs with Internet access, video-projector, screen, dedicated software and hardware tools, QualNet simulator licenses, instituriional MatLab account, MS Office 365/MS Team account for online classes)

6. Specific competences

Professional competences	**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** C4.3 Explanation and interpretation of the main requirements and specific approach techniques for data, voice, video, multimedia transmissions **C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks** C5.2 Explanation and interpretation of the fundamental technologies and protocols for the fixed - mobile integrated communication systems **C6. Solving specific problems of the broadband communications networks: propagation in different environment, circuits and equipment for high frequencies (microwaves and optical).** C6.3 Solving practical problems using design methods of the microwave circuits, planning, coverage, selection and location of transmission and receiving equipment
Cross competences	N.A.

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

7.1 General objective	To develop professional competences in the field of planning and testing Cellular Radiocommunications systems
7.2 Specific objectives	1. To apply the theoretical concepts of Cellular Radiocommunications systems while using professional software tools for design, test and measurements (QualNet, Rohde&Schwarz Instrumentation). 2. To develop skills and abilities to analyze and evaluate the Cellular Radiocommunications systems

8. Contents

8.1 Lecture (syllabus)		Teaching methods	Notes
1	Cellular Radiocommunications Systems Overview	Presentation, exemplification, problem presentation, case	Use of .ppt presentation, video-projector, whiteboard, MS Office 365/MS
2	Cellular Concept. Channel allocation strategy		
3	Cellular System Planning. Interference and System Capacity		
4	Cellular Network Traffic Strategies		

5	Trunking and Grade of Service. Handover	study, discussions, formative evaluation	Teams account for online classes
6	Measures of spectral efficiency in cellular networks		
7	Spectral efficiency of multiple access techniques and modulation techniques		
8	Evolution of cellular wireless networks from 1G to 5G. Characteristics of representative networks		
9	GSM cellular network. GSM architecture. Subsystems and entities		
10	GSM radio systems. Access bursts. GSM physical and logical channels		
11	GSM frames and GSM frames hierarchy. Mapping of GSM channels		
12	3G/IMT-2000 requirements and architecture. UMTS cellular network		
13	+3G HSDPA/HSUPA and 4G LTE cellular networks.		
14	Instruments for test and measurements of 2G to 5G cellular networks		

Bibliography

1. T. Rappaport, Wireless Communications Principles and Practice, 2nd edition, Prentice Hall, ISBN 0-13-042232-0, 652 pag., 2002.
2. Randy L. Haupt, Wireless Communications Systems: An Introduction, Wiley-IEEE Press, ISBN: 9781119419174, 2020
3. Mishra, Ajay R., Fundamentals of network planning and optimisation 2G/3G/4G : evolution to 5G, ISBN: 9781119331704, Wiley, 2018.
4. Nishith Tripathi, Jeffrey H. Reed, Cellular Communications: A Comprehensive and Practical Guide, Wiley-IEEE Press, IEEE Series on Digital & Mobile Communication, 2014
5. Ekram Hossain, Long Bao Le, Dusit Niyato, Radio Resource Management in Multi-Tier Cellular Wireless Networks, Wiley, ISBN 978-1-118-50267-9, 2013.
6. V. K. Garg, Wireless communications and networking, Elsevier, 1st ed., ISBN: 978-0-12-373580-5, 2007.
7. J. Olenewa, Guide to Wireless Communications, 3rd edition, Cengage Learning, ISBN-13 987-1-111-54569-7, 2013.

8.2 Laboratory		Teaching methods	Notes
1	Description of the laboratory structure. Fundamentals of the cellular wireless networks.	Didactic and experimental proof, didactic exercise, simulations, teamwork	Use of laboratory instrumentation, cellular network simulators, computers, MS Office 365/MS Teams account for online classes
2	Radio propagation in cellular wireless networks.		
3	Fundamentals of the transmission losses in radio networks.		
4	Propagation models in cellular wireless networks.		
5	Multiple access techniques in cellular wireless networks.		
6	Introduction of the QualNet simulation environment.		
7	Modeling of GSM cellular wireless networks using QualNet simulator.		

8	The capacity of GSM cellular wireless network. Voice calls in GSM network.		
9	GSM network planning. Cell ID, neighbor cells, LAI and GSM cellular traffic.		
10	GSM handover.		
11	Modeling of UMTS architecture. UMTS handover.		
12	+3G (HSDPA) handover.		
13	Modeling of 4G/LTE architecture. LTE handover.		
14	Laboratory practical evaluation		

Bibliography

1. E. Puschita, s.a., Radiocomunicatii Celulare - canalul radio - antene - proiectarea sistemelor – Manual de laborator, Editura U.T. PRESS, ISBN 978-973-662-496-4, 170 pag., 2009.
2. F. Perez Fontan, P. Marino Espineira, Modelling the Wireless Propagation Channel: A simulation approach with MATLAB, John Wiley & Sons Ltd, ISBN 978-0-470-72785-0, 2008

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 organizations and the employers in the field, where the students carry out the internship stages and/or occupy a job (in the field of *Electronics Engineering, Telecommunications Engineering; Electronics Design Engineering; System and Computer Design Engineering; Communications Design Engineering*), and the expectations of the national organization for quality assurance (ARACIS).

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	Exam evaluation: theoretical questions and problems	50%
10.5 Laboratory	The level of acquired knowledge and abilities	Practical evaluation (individual): to design a cellular network scenario in QualNet	50%

10.6 Minimum standard of performance

Qualitative:

Knowledge:

- ✓ Concepts associated to the cellular mobile communications systems: the cell, the mobile radio channel characteristics, cell splitting, co-channel and adjacent channel interference;
- ✓ Techniques in cellular network planning: radio cell concept, cell geometry and cell splitting, co-channel and adjacent channel interference reduction techniques, cell coverage, measures of spectral efficiency;
- ✓ Propagation mechanisms and radio channel characteristics for mobile environments; indoor and outdoor propagation models; fading models for mobile channel modeling;
- ✓ Duplexing techniques and multiple access techniques;
- ✓ GSM, UMTS, HSDPA, HSUPA and LTE system architecture: interfaces, functions, signaling and protocols for cellular mobile communications systems

Competences:

- ✓ Use professional simulation tools for cellular network planning (QualNet Simulator)
- ✓ Use professional instrumentation (Rohde&Schwarz) for test and measurements of the cellular mobile communications systems
- ✓ Use the hardware infrastructure of the laboratory (spectrum analyzer, digital oscilloscope, signal generators etc.) for cellular mobile communications system analysis and planning
- ✓ Analyze specific characteristics of the cellular mobile communications systems;
- ✓ Apply the corresponding propagation model according to the environment specifics;
- ✓ determine co-channel and adjacent interference and to apply corresponding mitigation techniques;
- ✓ Evaluate cellular mobile communications systems based on the measures of spectral efficiency;
- ✓ Determine cellular network traffic and to optimize the network traffic;
- ✓ Analyze the network performances through simulation and to optimize the network planning process

Quantitative:

- ✓ Complete the tasks for all laboratory activities
- ✓ Minimum 5 points (out of 10) for the laboratory Practical evaluation and minimum 5 points (out of 10) for the theoretical part of the Exam evaluation.
- ✓ The final score is: 0,5*Laboratory practical evaluation + 0,5*Exam evaluation

Date of filling in:	Responsible	Title First Name SURNAME	Signature
27.09.2021	Course	Professor Emanuel PUSCHITA, PhD. Habil.	
	Applications	Assistant Cristian CODAU	

Date of approval in the Department of Communications 27.09.2021	Head of Department Professor Virgil DOBROTA, PhD
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 27.09.2021	Dean Professor Gabriel OLTEAN, PhD