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-E40.00/EA-E109.00

2. Data about the subject

2.1 Subject name	Radiocommunications						
2.2 Subject area	Electronics and Telecommunications Engineering						
2.3 Course responsible	Professor Tudor PALADE, Ph.D, Tudor.Palade@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assist. Cristian CODAU, Ph.D student, Cristian.Codau@com.utcluj.ro						
2.5 Year of study	3	2.6 Semester	6	2.7 Assessment	Exam	2.8 Subject category	DS/DI

3. Estimated total time

3.1 Number of hours per week	5	of which: 3.2 course	2	3.3 laboratory + project	3
3.4 To Total hours in the curriculum	30	of which: 3.5 course	28	3.6 laboratory + project	42

Distribution of time	hours
Manual, lecture material and notes, bibliography	14
Supplementary study in the library, online specialized platforms and in the field	-
Preparation for seminars / laboratories, homework, reports, portfolios and essays	10
Tutoring	3
Exams and tests	3
Other activities:	

3.7 Total hours of individual study	30
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 curriculum	Passive components, Electric Devices and Circuits, Integrated Circuits, Signals Circuits and Systems, Microwaves
4.2 competence	Relations and theorems for electric circuits, frequency response representation; operating principles for electronic devices: diode, operational amplifier, MOSFET and BJT transistors; use of electronic devices in electronic circuits; analysis methods for electronic circuits; voltage transfer characteristics; transfer function

5. Requirements (where appropriate)

5.1. for the course	Video-projector, screen, whiteboard/blackboard
5.2. for the seminars / laboratories / projects	Whiteboard, PCs with connection to Internet

6. Specific competences

Professional competences	C4. To design, implement and operate data, voice, video and multimedia services, based on the understanding and application of fundamental concepts from the field of communications and information transmission. C5. To select, install, configure and exploit fixed and mobile telecommunications equipment. To equip a site with common telecommunications networks. C6. To solve wide-band telecommunications networks' specific problems: propagation in various transmission media, high frequency circuits and equipment (microwaves and optical).
Cross competences	N/A

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

7.1 General objective	Developing skills in the design, simulation and measurement of circuits and radio systems
7.2 Specific objectives	1. Assimilation of theoretical knowledge for the design and simulation of radio circuits using advanced simulation programs (Microwave Office, Matlab, ADS, LabView etc.) 2. Obtaining skills and abilities necessary for measuring and testing circuits and radio systems

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. The fundamentals of electronic communication	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2. Wave propagation		
3. Antennas and transmission lines.		
4. Amplitude modulation fundamentals		
5. Amplitude modulator and demodulator circuits.		
6. Fundamentals of frequency modulation.		
7. Frequency modulation circuits.		
8. Digital communication techniques.		
9. Multiplexing and demultiplexing, transmission of binary data in communication systems.		
10. Radio transmitters		
11. Communication receivers.		
12. Satellite communication		

13. Wireless technologies		
14. Communication tests and measurements		

Bibliography
1. Palade, T, s.a – Radiocomunicatii laborator, Ed. Mediamira,99, Cluj, ISBN 973-97791-2-3
2. Palade, T., s.a. – Radiocomunicatii probleme, Ed. Mediamira, 99, Cluj, ISBN 973-97790-9-3.
3. Walke, B.H. – Mobile radio networks – Wiley&Sons, 2002, ISBN 0-471-97595-8.
4. Young, P.H.–Electronic Communication Techniques, Prentice Hall, 2003, ISBN 0-02-431201-0.
5. Karlson, B., s.a. - Wireless Foresight, Wiley&Sons, 2003, ISBN 0-471-85815-X.
6. Haykin, S. – Communication Systems, Wiley&Sons, 4th Edition, 2004, ISBN 0-471-17869-1.
7. Coleman, C.– An introduction to radio frequency engineering, Cambridge Univ. Press, 2005, ISBN 0-521-83481-3.
8. Hagen, J.B. - Radio-Frequency Electronics, Circuits and Applications, Cambridge University Press, 2009, ISBN 978-0-521-88974-2.
9. Ziemer, R.E., Tranter, W.H. – Principles of Communications – Systems, Modulation and Noise, John Wiley & Sons, 2010, ISBN 978-0-470-39878-4.
10. Palade, T., s.a. – Radiocomunicatii – Indrumator de laborator Vol I, U.T.Press, Cluj-Napoca 2012, ISBN 978-973-662-684-5.
11. Frenzel L. E. – Principles of Electronic Communication Systems – Mc Graw Hill , Fourth Edition 2016, ISBN 978-0-07-337385-0.

8.2 Laboratory	Teaching methods	Notes
1. Safety measures. Introduction. Link budget analysis	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers.
2. The transmitter		
3. The receiver		
4. The PLL circuit		
5. Automatic gain control		
6. Amplitude Modulation		
7. Demodulation of amplitude modulated signals		
8. Amplitude modulation: DSB and SSB		
9. Demodulation: MA, DSB		
10. Demodulation SSB		
11. Frequency modulation		
12.Demodulation of frequency modulated signals		
13. Encoder remote control		
14. Make-up the missed laboratory activities		

Bibliography
1. Palade, T, s.a – Radiocomunicatii laborator, Ed. Mediamira,99, Cluj, ISBN 973-97791-2-3
2. Palade, T., s.a. – Radiocomunicatii probleme, Ed. Mediamira, 99, Cluj, ISBN 973-97790-9-3.
3. Palade, T., s.a. – Radiocomunicatii – Indrumator de laborator Vol I, U.T.Press, Cluj-Napoca 2012, ISBN 978-973-662-684-5.

8.3 Project	Teaching methods	Notes
1. Introduction. Presentation of project activity. Topic selection P1 - physical models for MIMO channel P2 - channel models based on stochastic geometry P3 - analytical models based on the propagation channel P4 - channel models based on correlations P5 – broadcasting radio channel modeling P6 - modeling wideband MIMO channel P7 - capacity of MU-MIMO and MIMO channel	Didactic and experimental proof, teamwork	Use of laboratory instrumentation, computers, software simulators

P8 - MIMO transmission algorithms - STBC P9 - MIMO transmission algorithms - V, H, D BLAST P10 - diversity techniques P11 – space diversity P12 - techniques for radiation lobe synthesis P13 - estimation techniques for angles of arrival - DoA P14 - channel state estimation methods		
2. Paper Structure. Bibliographical study on the selected topic.		
3. Content selection and outline of paper		
4. First draft of the paper.		
5. Review of the first draft of the paper		
6. Draw conclusions. Write the Abstract. Finish the paper.		
7.Evalutaion: presentation of final projects		

Bibliography

3. Walke, B.H. – Mobile radio networks – Wiley&Sons, 2002, ISBN 0-471-97595-8.
4. Young, P.H.–Electronic Communication Techniques, Prentice Hall, 2003, ISBN 0-02-431201-0.
5. Karlson, B., s.a. - Wireless Foresight, Wiley&Sons, 2003, ISBN 0-471-85815-X.
6. Haykin, S. – Communication Systems, Wiley&Sons, 4th Edition, 2004, ISBN 0-471-17869-1.
7. Coleman, C.– An introduction to radio frequency engineering, Cambridge Univ. Press, 2005, ISBN 0-521-83481-3.
8. Hagen, J.B. - Radio-Frequency Electronics, Circuits and Applications, Cambridge University Press, 2009, ISBN 978-0-521-88974-2.
9. Ziemer, R.E., Tranter, W.H. – Principles of Communications – Systems, Modulation and Noise, John Wiley & Sons, 2010, ISBN 978-0-470-39878-4.

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*	*50%*
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Continuous formative evaluation and practical laboratory test	*50%*
10.6 Minimum standard of performance			

Qualitative:

Knowledge:

- ✓ *Fundamentals of wave propagation and wireless communications*
- ✓ *Basic transmitter and receiver block diagrams and working principle.*
- ✓ *Fundamental modulation techniques*
- ✓ *Features of main radiocommunication systems*

Competences:

- ✓ *To solve link budget analyses*
- ✓ *To describe the working principles of radio transmitters and receivers*
- ✓ *To solve specific modulation/demodulation problems*

Quantitative:

- ✓ *Complete the tasks in all laboratory activities*
- ✓ *Present a final paper for the project evaluation*
- ✓ *Minimum 5 points (out of 10) for the lab activity evaluation, minimum 5 points (out of 10) for the project evaluation, and minimum 5 points (out of 10) for the final Exam.*
- ✓ *Final score: 0.5*Final_Exam+0.3*Lab_evaluation+0.2*Project_evaluation*

Date of filling in:	**Responsible**	**Title Surname NAME**	**Signature**
27.09.2021	Course	Prof. Tudor PALADE, PhD	
	Applications	Assist. Cristian CODAU, Ph.D student,	

Date of approval in the Department of Communications 27.09.2021	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 27.09.2021	Dean Prof. Gabriel OLTEAN, Ph.D.