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-E24.00/EA-E24.00

2. Data about the subject

2.1 Subject name	Microwaves						
2.2 Subject area	Electronics and Telecommunications Engineering						
2.3 Course responsible	Assist. Prof. Andra PASTRAV, PhD Andra.Pastrav@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assist. Prof. Andra PASTRAV, PhD Andra.Pastrav@com.utcluj.ro						
2.5 Year of study	2	2.6 Semester	2	2.7 Assessment	E	2.8 Subject category	DD/DI

3. Estimated total time

3.1 Number of hours per week	2	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	28
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	44
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 curriculum	Fundamentals of Electrotechnics, Passive Electronic Components and Circuits, Fundamental Electronic Circuits, Digital Integrated Circuits, Signals Theory
4.2 competence	No

5. Requirements (where appropriate)

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

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 C6. Solving specific problems of the broadband communications networks: propagation in different environment, circuits and equipment for high frequencies (microwaves and optical).
Transversal competences	N/A

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

7.1 General objective	Developing the competences regarding the use, analysis and (re)design of fundamental microwave circuits.
7.2 Specific objectives	1. Improve their understanding of wave propagation on transmission lines and expand it to include stripline and microstrip structures, as well as waveguides of rectangular and circular cross section. 2. Learn to analyze the network behavior of multiport microwave systems. 3. Be able to design impedance matching networks. 4. Be able to analyze and design passive microwave components, including microwave resonators, power dividers, hybrid junctions, and microwave filters. 1. 5. The students will, through labs, develop an intuition and physical feeling for microwave phenomenon and get first hands-on experience with microwave components and their characterization techniques.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Introduction. Microwaves applications. Recap of basic concepts that are needed for the study of Microwaves.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2. Transmission Line Theory. Field Analysis on Transmission Lines		
3. Transmission Lines and Waveguides. General Solutions for TEM, TM and TE Waves		
4. Rectangular Waveguide. TE and TM Modes		
5. Coaxial Line. TEM Modes and Higher-Order Modes		
6. Stripline and Microstrip		
7. Impedance Matching and Tuning		
8. Matching with Lumped Elements (L Network). The Quarter-Wave Transformer		
9. Microwave Resonators		
10. Power dividers and Directional Couplers		
11. Waveguide Directional Couplers. Coupled Line Directional Couplers		
12. Noise in Microwave Circuits. Diodes, Transistors, Integrated Circuits.		

13. Microwave Amplifiers		
14. Microwave Oscillators, Detectors and Mixers		

Bibliography
1. T. Palade, Tehnica Microundelor, Genesis, Cluj-Napoca, 1997, ISBN 973-98204-3-3
2. D. Pozar, Microwave Engineering, 4th Edition, John Wiley & Sons, 2012. ISBN: 978-0-470-63155-3
3. E. Nicolau, Manualul inginerului electronist–Radiotehnica I, II, III-Ed.Teh 88, ISBN973-31-0116-8
4. T. Palade, Tehnica Microundelor. Culegere de probleme, UTC-N, 1992.
5. R. Baican, Circuite integrate de microunde – Promedia Plus, Cluj, 1998, ISBN 973-97377-6-5

8.2 Seminar / laboratory / project	Teaching methods	Notes
1. Laboratory Work Regulations. Applications and Equipment Presentation. Software Tool for Wave Propagation Simulation Mefisto-2D	Didactic and experimental proof, didactic exercise, teamwork.	Use of laboratory instrumentation, experimental boards, computers, magnetic board
2. Wave Propagation on TEM Transmission Lines		
3. Microwave Propagation Along Rectangular Waveguides		
4. High-Order Propagation Modes Analysis in Rectangular Waveguides		
5. Microstrip Lines		
6. Impedance Computation using Smith's Chart		
7. Impedance Matching		
8. Power and Attenuation Measurements		
9. Directional Couplers, Power Dividers and Hybrid Junctions		
10. Microwave Antennas – Parabolic Dish		
11. Microwave Antennas - Horn Antenna		
12. Microwave Link Budget		
13. Industrial Applications of the Magnetron. Microwave Oven		
14. Make-up missed laboratory activities		

Bibliography
1. T. Palade, Tehnica Microundelor, Genesis, Cluj-Napoca, 1997, ISBN 973-98204-3-3
2. D. Pozar, Microwave Engineering, 4th Edition, John Wiley & Sons, 2012. ISBN: 978-0-470-63155-3
3. T. Palade, Tehnica Microundelor. Culegere de probleme, UTC-N, 1992.
4. N. Crisan, L. Cremene, T. Palade, E. Puschita, Microunde – Aplicaţii (Microwave – Applications), Volumul 1, U.T. Press, 2008
5. T. Palade, A. Moldovan, E. Puschita, I. Vermesan, R. Colda, Microunde – Aplicatii (Microwave – Applications), Volumul 2, U. T. Press, 2009

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	Summative evaluation written exam (theory	50 % (theory accounts for 25%, problem solving

		and problems)	accounts for 25%)
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Continuous formative evaluation – 3 tests: - practical lab test - problem solving tests	50 % (average of the 3 lab tests)

10.6 Minimum standard of performance

Qualitative:

Knowledge:

- ✓ Basic knowledge of wave propagation on transmission lines, stripline and microstrip structures, as well as waveguides of rectangular and circular cross section.
- ✓ Basic knowledge of impedance matching techniques.
- ✓ Basic knowledge regarding the design, role, and working principle of power dividers, directional couplers, passive and active microwave components.
- ✓ Main microwave applications.

Competences:

- ✓ Expand transmission line theory knowledge to include stripline and microstrip structures, as well as waveguides of rectangular and circular cross section.
- ✓ Analyze the network behavior of multiport microwave systems.
- ✓ Design impedance matching networks.
- ✓ Describe the role, functionalities and design of main passive and active microwave components.
- ✓ Analyze the link budged.

Quantitative:

- ✓ Complete the tasks for all laboratory activities
- ✓ Minimum 5 points (out of 10) for the laboratory evaluation (Lab_evaluation), minimum 2.5 points (out of 10) for the theoretical part of the Final Exam (Exam_Theory), and minimum 2.5 points (out of 10) for the problem-solving part of the Final Exam (Exam_Problems).
- ✓ The final score is: 0,5*Lab_evaluation + 0,25*Exam_Theory + 0,25*Exam_Problems

Data of filling in:	**Responsible**	**Title First name SURNAME**	**Signature**
13.09.2022	Course	Assist. Prof. Andra PASTRAV, Ph.D.	
	Applications	Assist. Prof. Andra PASTRAV, Ph.D.	

Date of approval in the Council of the Communications Department 13.09.2022	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 21.09.2022	Dean Prof. Ovidiu POP, Ph.D.