SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computers and Information Technology**
1.5 Study cycle	**Bachelor**
1.6 Study programme / Qualification	**Information Engineering**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Microwaves** **Microunde**				
2.2 Course coordinator			Prof. Dr. Daniel Aurelian Andreica				
2.3 Seminar coordinator			Prof. Dr. Daniel Aurelian Andreica				
2.4. Year of study	**III**	2.5 Semester	**VI**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**Optional DS**
2.8 Code of the discipline		MLE7033					

3. Total estimated time (hours/semester of didactic activities)

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

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	10
Additional documentation (in libraries, on electronic platforms, field documentation)	10
Preparation for seminars/labs, homework, papers, portfolios and essays	14
Tutorship	8
Evaluations	2
Other activities:	-

3.7 Total individual study hours	44
3.8 Total hours per semester	100
3.9 Number of ECTS credits	4

4. Prerequisites (if necessary)

4.1. curriculum	The student must have successfully passed the following exams: Physics (semester I), Electronic Devices and Analog Electronics

	(semester III), and Digital Electronics (semester IV).
4.2. competencies	Fundamental knowledge and practical abilities gained during the following courses: Physics (semester I), Electronic Devices and Analog electronics (semester III), and Digital Electronics (semester IV).

5. Conditions (if necessary)

5.1. for the course	Classroom with blackboard and video projector.
5.2. for the seminar /lab activities	Laboratory classroom which contains the necessary equipment for the study of microwaves and UHF/microwave circuits (components, oscilloscopes, spectrum analyzers and vector network analyzers).

6. Specific competencies acquired

Professional competencies	C3.2 Using interdisciplinary knowledge, solution patterns and tools, making experiments and interpreting their results. C3.3 Applying solution patterns using specific engineering tools and mehods. C3.4 Comparatively and experimentaly evaluation of the alternative solutions for performance optimization. C5.1 Appropriate use of the operating principles of electronic devices and circuits, as well as methods of measuring electrical quantities. C5.2 Analysing, designing, executing and measuring of electronic circuits of low/ medium complexity. C5.4 Use of electronic tools to characterize and evaluate the performance of electronic circuits.
Transversal competencies	CT1. Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the professional reputation. CT3. Demonstrating initiative and pro-active behavior for updating professional, economical and organizational culture knowledge.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	The study of microwaves technology and UHF/microwave circuits and devices.
7.2 Specific objective of the discipline	O1. Acquiring of theoretical notions in the field of microwaves. O2. Solving problems specific to the field of microwaves using knowledge gained in objective O1. O3. The application of general notions of analog and digital electronics along with the notions gained in objectives O1 and O2 in order to design and analyze microwave/UHF circuits.

8. Content

8.1 Course	Teaching methods	Remarks
Introduction. Electromagnetic theory. Maxwell's equations. The Helmholtz equations. Microwaves.		2 h

Transmission line analysis. The telegrapher's equations. Energy and power. Input impedance. Wave reflection. Losses.	Lecturing, exposition, demonstrations, discussions and debates.	2 h
The Smith chart. Resistance. Reactance. Impedance. Admittance. Conductance. Susceptance. Reflection coefficient. Impedance matching.		5 h
Wave propagation and characteristic parameters. TE, TM, and TEM modes. Waveguides. Striplines and Microstrip lines.		4 h
Microwave networks. S, Y, Z and hybrid matrices. The ABCD transmission matrix.		2 h
Linear electric circuits. UHF filters. Filter types. Specific parameters.		4 h
Active microwave/UHF components. UHF diodes. UHF transistors. UHF amplifiers. Microwave oscillators.		4 h
UHF and microwave systems. Antennas. Wireless communications. Radar systems. Radiometry. The effects of microwaves on the environment.		5 h

Bibliography

1. Reinhold Ludwig and Pavel Bretchko, *RF Circuit Design: Theory and Applications*, Prentice Hall, 2000.

2. D. Pozar, *Microwave Engineering*, 4th Ed., Wiley, 2012.

3. N. Crişan, T. Palade, L. Cremene, E. Puşchiţă, *Microunde - Aplicaţii, Vol. 1*, Ed. U. T. Press, Cluj-Napoca, 2008.

4. T. Palade, A. Moldovan, E. Puşchiţă, I. Vermeşan, R. Colda, *Microunde - Aplicaţii, Vol. 2*, U. T. Press, Cluj-Napoca, 2009.

5. G. Rulea, *Bazele Teoretice şi Experimentale ale Tehnicii Microundelor*, Ed. Ştiinţifică şi Enciclopedică, Bucureşti, 1989.

8.2 Seminar / laboratory	Teaching methods	Remarks
Laboratory safety rules and guidelines. Familiarization with laboratory equipment.	Active participation (experimental realization and analysis of circuits, performing measurements, the interpretation and presentation of obtained results)	2h
Specific measurements at high frequencies. The Vector Network Analyzer (VNA).		2h
Reflection measurements. The reference plane.		2h
Determination of transmission line parameters. Microwave reflectometry.		3h
Transmission measurements. The study of passive components at high frequencies.		3h
Filter characterization using the VNA. The construction of UHF filters using microstrip lines.		4h
The study of UHF oscillators using the VNA. The determination of specific parameters.		2h
The study of UHF amplifiers using the VNA. Determination of specific parameters.		3h
The study of antennas. Impedance matching.		3h
Completion/clarification of laboratory work. Questions, answers and discussions.		2h
Evaluation of laboratory activity.		2h

Bibliography

1. Reinhold Ludwig and Pavel Bretchko, *RF Circuit Design: Theory and Applications*, Prentice Hall, 2000.

2. D. Pozar, *Microwave Engineering*, 4th Ed., Wiley, 2012.

3. Gerfried Palme, *Measurements With the DG8SAQ VNWA 2/3 Vector Network Analyzer,* 2nd English Edition,

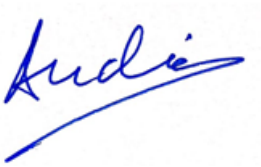
Dortmund, Germany, 2016.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The content of the discipline is in accordance with the subjects which are studied in the same field in Romanian and foreign universities and with the specific demands of research institutes, the economy and the labour market.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Mastery and understanding of basic concepts, theories and methods in the field of microwaves. The application of basic knowledge in the field of microwaves in order to solve specific problems.	Final exam	75 %
10.5 Seminar/lab activities	The preparation and practical realization of laboratory experiments and data analysis. The content of the laboratory reports, quality of writing, and corectness of the data analysis and the conclusions drawn.	The observation of the student during laboratory work, discussions and grades of the laboratory reports.	10 %
		Laboratory exam	15 %
10.6 Minimum performance standards			
• Mastery and understanding of basic concepts in the field of microwaves and their correct usage in order to perform measurements and specific characterizations: distributed elements, transmission lines, quantities specific to high frequencies. • Correctly solving problems of medium difficulty in the field of microwaves. • The correct use of the Smith chart in circuit analysis and impedance matching. • The correct use of laboratory equipment in order to perform measurements. • Course attendance is optional. • In order to participate in the final exam, the student must have a minimum laboratory attendance of 90 %. • The student must obtain a minimum passing grade (5) during the laboratory exam as well as for each laboratory report.			

Date	Signature of course coordinator	Signature of seminar coordinator
13.05.2022		

Date of approval

Signature of the head of department

Prof. dr. Laura Dioşan

24.05.2022