SYLLABUS

1. Information about the program

1.1 Higher education institution	UNIVERSITY POLITEHNICA OF TIMISOARA
1.2 Faculty[1]/ Department [2]	ELECTRONICS, TELECOMUNICATON AND INFORMATION TECHNOLOGIES/ MEO
1.3 Field of study (name/code[3])	ELECTRONIC ENGINEERING, TELECOMUNICATION AND INFORMATION TECHNOLOGIES
1.4 Study cycle	License
1.5 Study program (name/code/qualification)	TST-ENG/20/20/10/100/10/TST-ENG

2. Information about the discipline

2.1 Name of discipline/ formative category[4]			Microwaves/DD				
2.2 Coordinator (holder) of course activities			Prof. univ. dr-habil. ing. Aldo De Sabata				
2.3 Coordinator (holder) of applied activities[5]			Conf. dr. ing. Andrei Silaghi, ş.l. dr. ing. Cora Ionică				
2.4 Year of study[6]	3	**2.5** Semester	5	**2.6** Type of evaluation	E	**2.7** Regime of discipline[7]	DI

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) [8]

3.1 Number of fully assisted hours / week	4 of which:	**3.2** course	3	**3.3** seminar / laboratory / project	0/1/0
3.1* Total number of fully assisted hours / semester	56 of which:	**3.2*** course	42	**3.3*** seminar / laboratory / project	0/14/0
3.4 Number of hours partially assisted / week	of which:	**3.5** training		**3.6** hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	**3.5*** training		**3.6*** hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	3.14 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			0.5
		hours of individual study after manual, course support, bibliography and notes			1.5
		training seminars / laboratories, homework and papers, portfolios and essays			1.14
3.7* Number of hours of unassisted activities / semester	44 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			7
		hours of individual study after manual, course support, bibliography and notes			21
		training seminars / laboratories, homework and papers, portfolios and essays			16
3.8 Total hours / week [9]	7.14				
3.8* Total hours /semester	100				
3.9 Number of credits	4				

4. Prerequisites (where applicable)

4.1 Curriculum	• Physics, 1st year 1st sem., Special Mathematics, 1st year 2nd sem., Electrical Circuits, 1st year 2nd sem., Fundamentals of Electrical Engineering, 2nd year 3rd

[1] The name of the faculty which manages the educational curriculum to which the discipline belongs
[2] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[3] The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.
[4] Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).
[5] Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] Year of studies in which the discipline is provided in the curriculum.
[7] Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).
[8] The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.
[9] The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

	sem., Measurements in Electronics and Telecommunications, 2nd year 3rd sem.
4.2 Competencies	• Complex Analysis, Vector Analysis, General Electronics Practical Abilities

5. Conditions (where applicable)

5.1 of the course	• The course is taking place in a room adequate for the number of students, which fulfills standard regulations concerning space. Presentation is sustained by video projector, while proofs and problems are solved on whiteboard. Conditions for interactivity are met.
5.2 to conduct practical activities	• The laboratory activities are taking place in a room adequate for the number of students, which fulfills standard regulations concerning space. The activity is split between a practical part relying on microwaves educational kits, generators, oscilloscopes spectrum analyzers etc. (four work groups are constituted), and a part relying on microwaves CAD software running on computers.

6. Specific competencies acquired through this discipline

Specific competencies	• Understanding distinctiveness of high frequency phenomena, equipment and devices; • Capability to propose solutions to technical and technological problems in Applied Electronics and Communications that involve high frequency effects; • Capability to propose solutions for measurement of electromagnetic quantities in specific situations involving high frequencies; • Capability of informed selection and use of high frequency equipment within fields such as Applied Electronics and Communications
Professional competencies ascribed to the specific competencies	• Use of fundamentals in terms of devices, circuits, systems, instrumentation and electronics • Selection, installation, configuration and operation of fixed and mobile equipment and equipping a site with common telecommunication networks • Solving technological problems in fields of applied electornics.
Transversal competencies ascribed to the specific competencies	• Methodical analysis of field-related problems aimed at identifying acknowledged solutions, thus ensuring the accomplishment of professional tasks • Adaptation to new technologies, professional and personal development through continuous training using printed documentation sources, specialized software and electronic resources in Romanian and at least one foreign language

7. Objectives of the discipline (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	• Acquirement of competencies concerning operation and design of modern high frequency equipment for Applied Electronics and Communications and preparation for a thorough understanding of phenomena that are relevant for Electromagnetic Compatibility.
7.2 Specific objectives	• Understanding propagation of signals on transmission lines, and connection of transmission lines to electronic equipment; • Knowledge of relevant types of transmission lines, of line parameters and electromagnetic field configuration; • Design of matching devices (simple and conjugate); • Acquirement of competencies concerning S parameters and application to high frequency devices; • Basic principles of high frequency measurements; • Understanding of basic principles of pulse propagation on transmission lines; • Understanding impact of propagation phenomena on printed circuit board design.

8. Content [10]

8.1 Course	Number of hours	Teaching methods [11]
Introduction. Trends in modern communication systems. Advantages brought by using higher frequencies. Frequency bands allocation.	2	The course is presented by means of a video projector; however, proofs and problems are solved on the whiteboard. Interactivity is encouraged.
Propagation Media. Electromagnetic Waves.	4	
Transmission Lines and Waveguides.	12	
Normalization and the Smith Chart	6	
Simple and Conjugate Matching Techniques	4	
Power Transfer on Transmission Lines	6	
S Parameters for Passive and Active Devices	6	
Time Domain Reflectometry	2	

Bibliography [12] Aldo De Sabata, High Frequency Technique, Lecture Notes available on Virtual Campus, 2021, cv.upt.ro (in English)
Aldo De Sabata, High Frequency Techniques, Timişoara: "Orizonturi Universitare", 2001 (in Romanian)
Ladislau Matekovits, Electromagnetic Fields and Electromagnetic Compatibility, Timişoara: "Politehnica", 2005 (in Romanian)
R. E. Collin, Foundations for microwave engineering, McGraw-Hill, New York, 1992
D. M. Pozar, Microwave Engineering, Second Edition, John Wiley and Sons, New York, 1998
Video recordings on Virtual Campus cv.upt.ro

8.2 Applied activities [13]	Number of hours	Teaching methods
Complex Amplitudes, Transmission Lines and Waveguides	2	Practical work and problem solving
Frequency Measurement in the Microwave Domain	2	
Design of Matching Circuits with the Smith Chart	2	
Power Measurement in the Microwaves Domain	2	
Measurement of the Standing Wave Pattern	2	Practical work
Numerical Methods of High Frequency Circuit Analysis by means of the HFSS Ansys Package	4	CAD software on computers

Bibliography [14] Laboratory works (text) and video presentations on the Virtual Campus (in English) cv.upt.ro, 2021
Agilent Application Notes, various years
NVIS, Microwaves Kit, documentation, https://www.nvistech.com/microwave-technology, accessed 2022
Ladislau Matekovits, Electromagnetic Fields and Microwave Circuits – a problems book, Timişoara: „Politehnica", Timişoara, 2001 (in Romanian)
Claudiu Suma, Laboratory Guide for Microwaves, Lit. UPT, 1995 (in Romanian)
Adrian Vârtosu, Microwaves and Optoelectronic Measurements, Lit. UPT, 1996 (in Romanian)

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- At a scientific level, the high frequency technology is very dynamic, maybe the most dynamic field in hardware technology. This is due to the constant increase of the speed of the circuits, to widespread of wideband communications, of outer space exploration, and of more severe regulations concerning electromagnetic emissions.
- At an economics level, several multinational companies are present in the area of Timişoara with activities in Electronics and Communications. These companies are the main potential employers for our graduates. High frequency technologies are used within these companies, and products integrate high frequency techniques.
- Discussions with Electromagnetic Compatibility Engineers are frequent, leading to updating of the course contents;

[10] It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".
[11] Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).
[12] At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.
[13] Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".
[14] At least one title must belong to the discipline team.

- Several training sessions have been organized for the benefit of participants from industry with topics from Microwaves and Electromagnetic Compatibility, which is tightly related.

10. Evaluation

Type of activity	**10.1** Evaluation criteria [15]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Capability of creative rendering of four theoretical subjects from the lecture topics, and of proposing solutions for technical issues.	Written examination	50%
10.5 Applied activities	**S:**		
	L: Ability to solve application-oriented problems and to propose design solutions for matching; Ability to apply measurement methods in the high frequency field and to present and interpret measurement results	Two written tests on problem solving; Supervision of work in laboratory, tests of degree of preparation for the particular practical topic.	50%
	P[16]**:**		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [17])			
• The amount of knowledge necessary to pass the examination is 0.5 of the total amount of knowledge that has been presented at lectures. Concerning practical work, experimental results are assessed at the end of each meeting, and oral and written tests are proposed to assess preparation for practical work and problem solving abilities. To pass the exam, the mean of the grades awarded must be superior to 4.5.			

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
20.06.2023		

Head of Department (signature)	**Date of approval in the Faculty Council** [18]	**Dean (signature)**
	14.09.2023	

[15] Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)

[16] In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.

[17] It will not explain how the promotion mark is awarded.

[18] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.