COURSE GUIDE

University year 2019 - 2020

Dean, Prof. Daniela Tărniceriu

1. Program info

1.1 Higher education institution	"Gheorghe Asachi" Technical University of Iași
1.2 Faculty / Department	Electronics, Telecommunications and Information Technology
1.3 Department	Telecommunications and Information Technologies
1.4 Field	Electronic Engineering, Telecommunications and Information Technology
1.5 Study level	Bachelor's Degree Studies
1.6 Study program / Qualification	Telecommunications Systems and Technologies

2. Course info

2.1 Course name:		**Fundamentals of radiocommunications**				Code: **EDOS302T**	2
2.2 Course organizer (lecturer)		Professor Radu Gabriel Bozomitu					
2.3 Teaching assistants		Professor Radu Gabriel Bozomitu					
2.4 Year of study	3	2.5 Semester	6	2.6 Assessement	Examen	2.7 Type of subject	ED

3. Estimated total time (hours per semester for teaching activities)

3.1 Number of hours per week	3	3.2 lecture	2	3.3 seminar/laboratory/project	1
3.4 Total number of hours in curricula	42	3.5 lecture	28	3.6 seminar/laboratory/project	14

Time distribution	hours
Textbook, course support, references and course notes study	12
Library, electronic platforms and on site documentation	10
Seminar/laboratory preparation, homework, reports, portfolios and essays	12
Tutoring	14
Assessment	6
Other activities	-

3.7 Total individual study hours	54
3.9 Total hours per semester	96
3. 10 Number of credit points	4

4. Prerequisites (where applicable)

4.1 curricula type	• Signals, Circuits and Systems, Electronic Devices, Fundamental Electronic Circuits, Analog Integrated Circuits
4.2 competence type	

5. Infrastructure (where applicable)

5.1. for lectures	Course amphitheater, video projector, board;
5.2. for laboratories	Radio lab, PC network, video projector;

6. Specific competences

Professional competences	1. To know the specific terminology of the radiocommunication systems. 2. To acquire radiocommunication systems design skills. 3. To understand the specific design methods of different modules from the radiocommunication system: radiofrequency amplifiers, matching circuits, analogue and digital modulator/demodulator circuits, emission and receiving antennas etc. 4. To acquire skills to design and implement radio transmitter and radio receiver systems, according to the design requirements. 5. To develop skills for using different CAD tools, specific for computer analysis of radio frequency circuits. 6. To acquire the ability to analyze and evaluate the performance of the designed systems, according to the design requirements, in terms of frequency bandwidth, gain, noise and maximum admission distortions. 7. Identifying and choosing the optimal methods for solving the problems related to processing and analysis of the radio frequency signals.
Transversal competences	1. To use with high efficiency the information sources and the resources of communication and professional training, both in Romanian and in an international language. 2. To demonstrate preoccupation for professional development by engaging critical thinking skills and improving training and lifelong learning. 3. To have communication skills in the field of radio-communications. 4. To be able to work in an international context.

7. Course targets (as resulting from **6. Specific competences** table)

7.1 Course main target	• The course is intended to offer theoretical, methodological and practical knowledge specific of radiocommunication systems analysis and design.
7.2 Course specific targets	• To demonstrate acquiring sufficient knowledge to understand the studied notions; • To be able to critically understand, explain and interpret the theoretical, methodological and practical developments specific to the radiocommunication systems; • To be able to apply correctly the basic methods and principles in the design and analysis of radiofrequency circuits used in the radiocommunication systems; • To provide students the necessary skills to use a computer simulation program to design electronic RF circuits used to implement the radio communications systems.

8. Contents

8. 1 Lectures	**Teaching methods**	**Notes**
Introduction - Radio-communication system. Modulation; - Source, load, matching;	Combined procedures are used, i.e.: • lectures; • using the video projector; • explanation on the board; • debate; • case study; • connections with the content of other specialized disciplines, with previously transmitted information within the discipline, or practical applications discussed in the laboratory. The student will actively participate in the course, answering questions and solving the proposed exercises.	2 hours
Passive components used in radiofrequency - Components and circuit elements. Models. Passive and active components; - RF resistors; - RF capacitors - RF inductors;		2 hours
Narrowband matching networks		2 hours
Radiofrequency power amplifiers - Transmitter transistors; - Functional features of ARFP with bipolar transistors; - The equivalent schematic of the ideal transistor. Variation of current gain with frequency; - Class A RF power amplifier. Signals. Input impedance and output admittance		2 hours
Noise in RF amplifiers		2 hours

Oscillation sources in radio-communications - Introduction. Local exciters and oscillators; - Oscillation sources signals perturbations; - Harmonic oscillators with transistors; - Quartz controlled oscillators;	2 hours
Signals and modulations used in radiocommunications - Telecommunication signals; - Principle of analog modulations; - Principle of digital modulations;	2 hours
Phase locked loops (PLL)	2 hours
Principle of radio-receiving - analog radio receiver; - digital radio receiver; - software defined radio;	4 hours
Low noise RF amplifiers (LNA)	2 hours
Spectral analysis and power in RF - Frequency scanning spectrum analyzers; - Measurement of power in RF; - powers in RF; - power measurement in RF by bolometric methods; - power measurement in RF by calorimetric methods; - power measurement in RF by envelope detection; - power measurement in RF with Hall transducer;	2 hours
Emission and receiving antennas - Elementary data about antennas; - Operating principles of emission antennas; - Radiation diagram of emission antennas; - Antennas gain; - Asymmetric dipole type emission antennas. Earth influence; - Radiation variation with dipole length. Complex dipoles; - Phase and antiphase dipole antennas. Reflectors and directors; - Loop antennas; - Reflective antennas; - Slot antennas, wave-guide and horn antennas; - Receiving antennas;	4 hours

References:

1. D. F. Bartlett and T. R. Core, *„Measuring Maxwell's Displacement Current Inside a Capacitor"*, Physical Review Letters, Vol. 55, No. 1, July, 1985;
2. D. F. Bartlett and Glenn Gengel, *„Measurement of quasistatic Maxwell's displacement current"*, Physical Review A, vol. 39, No. 3, February 1, 1989;
3. Sophocles J. Orfanidis, *„Electromagnetic Waves and Antennas"*, Rutgers University, 2008;
4. Robert E. Collin, *„Antennas and Radiowave Propagation"*, McGraw-Hill Book Company, 1985;
5. Constantine A. Balanis, *„Antenna theory: Analysis and design"*, John Wiley & Sons, Inc., 1997;
6. T. Lee, *„The Design of CMOS Radio-Frequency Integrated Circuits"*, Cambridge, Cambridge University Press, 1998;
7. Grebennikov, A., Sokal, N. O., *„Switch mode RF Power Amplifiers"*, Elsevier Inc., 2007;
8. Kazimierczuk, M. K., *„RF Power Amplifiers"*, J. Wiley & Sons, 2008;
9. Steve C. Cripps, *„Advanced Techniques in RF Power Amplifier Design"*, Artech House, Inc., 2002;
10. J. Sewick, *„Transmission Line Transformers"*, American Radio Relay League, 1990;
11. Paul R. Gray, Robert G. Meyer, *„Circuite Integrate Analogice - Analiză şi Proiectare"*, Editura Tehnică, Bucureşti, 1999;
12. David Johns, Ken Martin, *„Analog Integrated Circuit Design"*, John Wiley & Sons, Inc., 1997;
13. Kenneth R. Laker, Willy M. C. Sansen, *„Design of Analog Integrated Circuits and Systems"*, McGraw-Hill, New York, 1994;
14. C. Toumazou, F. J. Lidgey, and D. G. Haigh (eds.), *„Analogue IC Design: The Current-Mode Approach"*, London: Peter Peregrinus Ltd., 1990;
15. Jack R. Smith, *„Modern Communication Circuits"*, McGraw-Hill Companies, Inc., 1998;
16. W. Alan Davis, Krishna Agarwal, *„Radio Frequency Circuit Design"*, John Wiley & Sons, Inc., 2001;

17. Chris Bowick, *„RF Circuit Design"*, Elsevier's Science & Technology, Inc., 1982;
18. Vlad Cehan, *„Bazele radioemiţătoarelor"* – Editura MatrixRom, Bucureşti, 1997;
19. Radu Gabriel Bozomitu, *„Radioemiţătoare şi radioreceptoare"*, ISBN 978-973-7742-86-5, 297 pag., Editura Fundaţiei Academice AXIS, Iaşi, 2010;
20. Radu Gabriel Bozomitu, *„Tehnici de liniarizare pentru circuitele integrate de radiofrecvenţă"*, Editura Fundaţiei Academice AXIS, Iaşi, 2009;
21. Věnceslav F. Kroupa, *„Direct Digital Frequency Synthesizers"*, IEEE Press, Piscataway, NJ 08855-1331 U.S.A., 1999;
22. Simon Haykin, *„Digital Communications"*, John Wiley & Sons, Inc., 1988.

8. 2. a) Laboratory	**Teaching methods**	**Notes**
LCR series and parallel resonant circuits	Combined methods: • lecture, using the video projector; • explanation on the board, discussion, exemplification; • identification on the block diagram, study of the documentation; • use of computer analysis programs for electronic radio frequency circuits; • practical demonstration, use of laboratory equipment;	2 hours
RF matching circuits		2 hours
Class A radiofrequency power amplifier design		2 hours
Quartz oscillators		2 hours
Low noise radiofrequency amplifiers (LNA)		2 hours
Software defined radio – Matlab implementation		2 hours
Phase look loops (PLL)		2 hours
8. 2. b) Project	**Teaching methods**	**Notes**

References:

1. Radu Gabriel Bozomitu, *„Radioemiţătoare şi radioreceptoare – Îndrumar de laborator"*, ISBN 978-973-7742-79-7, 255 pag., Editura Fundaţiei Academice AXIS, Iaşi, 2009;

9. Course contents corroboration with the expectations of the epistemic community representatives, professional associations and relevant employers in the field of the program

- In determining the content of the discipline and the methods of teaching/examination, the discipline holder has been consulted with both Romanian and foreign academic counterparts, with whom we have links through the Erasmus/Socrates exchange program. It also takes into account the opinion and expectations of the main industrial electronics companies in Romania, with whom we have constant collaborations.
- The objectives of the discipline are in perfect concordance with the faculty curricula, transmitting information and forming skills necessary for future specialists in the field of electronics, telecommunication and information technology.
- The program was realized in order to integrate the discipline into the curricula of the Telecommunication Technologies and Systems specialization, and also by consulting the curricula of the prestigious universities in the country and abroad.

10. Assessment

Activity type	**10.1 Assessment criteria**	**10.2 Assessment methods**	**10.3 Percentage of final grade**
10.4 Lectures	• Theoretical knowledge acquired (quantity, correctness, accuracy)	Tests:	-
		Homework:	-
		Final evaluation (oral and/or written)	60% (minimum 5)
10.5 Laboratory	• knowledge of the devices, how to use specific instruments; evaluating tools or achievements, processing and interpreting results	• written questionnaire; • oral response; • laboratory book (experimental works, scientific reports); • practical demonstration;	40% (minimum 5)
10.6 Minimum performance standard			
• knowledge of fundamental elements, knowledge of terminology; • capability to develop an application of medium complexity.			

Completion date:

12.09.2019

Course organizer signature,

Professor Radu Gabriel Bozomitu

Teaching assistant signature,

Professor Radu Gabriel Bozomitu

Department approval date,

16. SEP. 2019

Department director signature,
Associate professor Luminița Scripcariu