STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
RF Techniques		**1010842131010842702**
Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Multimedia and Consumer Electronics	**Polish**	**elective**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**full-time**	

No. of hours					No. of credits
Lecture: **2**	Classes: **-**	Laboratory: **1**	Project/seminars: **-**		**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**from field**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**
Technical sciences	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	K1_W06, K1_W07, K1_W08, K1_W18
2	**Skills**	K1_U09
3	**Social competencies**	not required

Assumptions and objectives of the course:

Understaning of operation principles, design, construction, measurements and maintenance of RF electronic circuits.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has a systematic knowledge, with necessary mathematical background, in the area of RF circuit design, construction, measurement and maintenance as well as in the area of electromagnetic compatibility. - [-]

Skills:

1. Knows the rules of operation of Polish and international standardization bodies (ITU, ISO, ETSI, CISPR, 3GPP, etc.). Knows the standardization procedures. - [K2_U08]

2. Is able to use various measurement techniques. - [K2_U13]

3. Is able to design, construct, program and test complex, technologically advanced electronic circuits and systems, especially for telecommunication devices and systems and networks. - [K2_U15]

4. Is able to use already known mathematical models and methods to analyze and design telecommunication devices and systems. Is able to formulate a design specification of a complex electronic and telecommunication system, taking into consideration legal issues including intellectual property rights, and other non-technical issues such as environmental protection. - [K2_U18]

5. Can effectively implement the occupational health and safety principles. - [K2_U19]

Social competencies:

1. Is aware of the limitations of his/her current knowledge and skills; is committed to lifelong learning. - [K2_K04]
2. Is aware of the necessity to approach solving technical problems with responsibility and professionalism. - [K2_K05]
3. Demonstrates responsibility for designed electronic and telecommunication systems. Is aware of the hazards they pose for individuals and communities if they are improperly designed or produced . - [K2_K06]

Assessment methods of study outcomes

1. Written final exam (theory, analysis and design of selected RF circuits).
2. Design of a chosen RF circuit (elecrical diagram, description of the circuit, PCB layout, operational prototype of the circuit with basic measurements)

Course description

1. Components used in RF circuits: resistors, capacitors, inductors, RF transformers
2. LC resonant circuits, design of impedance matching circuits
3. Scattering matrix
4. Noise in electronic components and circuits
5. Hints for PCB design for RF circuits, shielding, EMC of electronic circuits
6. Block diagrams and parameters of radio receivers and transmitters
7. Analysis, parameters and design of RF amplifiers
8. Analysis, parameters and design of power RF amplifiers
9. Analysis, parameters and design of LC and crystal oscillators
10. Principle of operation and design of PLL
11. Design and parameters of mixers
12. RF measurement equipment (especially spectrum analyzer)
13. Basic RF measurements
14. ETSI (European Telecommunication Standard Institute) standards, EU direcives and national regulations for radio communication equipment, EMC standards
15. Basics of technical documentation

Basic bibliography:

1. P. Young, Electronic Communication Techniques, Prentice Hall, 2004.
2. R. Gilmore, L. Besser., Practical RF Circuit Design for Modern Wireless Systems, Artech House, 2003.
3. J. Szóstka, Mikrofale. Układy i systemy, Wyd. Komunikacji i Łączności, Warszawa 2006.

Additional bibliography:

1. T. Masewicz, Radioelektronika dla praktyków, Wyd. Komunikacji i Łączności, Warszawa, 1985.
2. Poradnik radioamatora, praca zbiorowa, Wyd. Komunikacji i Łączności, Warszawa, 1984.
3. Z. Bieńkowski, Poradnik ultrakrótkofalowca , Wyd. Komunikacji i Łączności, Warszawa,1988.
4. P. Vizmuller,, RF Design Guide. Systems, Circuits, and Equations, Artech House, London, 1995.
5. J.Baranowski, Z.Nosal, Układy elektroniczne, cz. I i II, WNT, Warszawa 1993.
6. U.L. Rohde, D.P.Newkirk, RF/Microwave Circuit Design for Wireless Applications, Artech House, 2000.
7. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, Wyd. Naukowo-Techniczne, Warszawa 1984.
8. U. Rohde, J. Whitaker, T. Bucher, Communication Receivers: Principles and Design, McGraw-Hill, 1997.
9. I. Bahl, P. Bhartia, Microwave Solid State Circuit Design, John Wiley&;Sons, 1988.
10. RF Application Reports, Motorola HB215/D, 1995.
11. S. C. Cripps, RF Power Amplifiers for Wireless Communications, Artech House 1999.
12. I. Hickman, Practical Radio-Frequency Handbook, Newnes, Oxford 2002.
13. Katalogi elementów elektronicznych i noty aplikacyjne firm wytwarzających elementy elektroniczne.

Result of average student's workload

Activity	Time (working hours)
1. Lecture	30
2. Project	15
3. Preparation of the project	30
4. Consulting	5
5. Preparation for the exam and the exam	23

Student's workload

Source of workload	hours	ECTS
Total workload	85	3
Contact hours	50	2
Practical activities	35	1