SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Communications
1.4	Field of study	Electronics and Telecommunications Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Telecommunications Technologies and Systems/Engineer
1.7	Form of education	Full time
1.8	Subject code	TST-E47.00

2. Data about the subject

2.1	Subject name					Mobile Communications					
2.2	Subject area					Electronics and Telecommunications Engineering					
2.3	Course leader/lecturer					Assoc. Prof. Romulus Terebes, PhD eng.					
2.4	Teacher in charge of applications					Assoc. Prof. Romulus Terebes, PhD eng.					
2.5	Year of study	IV	2.6	Semester	1	2.7	Assessment	Exam	2.8	Subject category	DS/DOB

3. Estimated total time

Year/ Sem.	Subject name	No. of weeks	Course [hours/week]	Applications [hours/week]			Course [hours/sem.]	Applications [hours/sem.]			Indiv. study	TOTAL	Credits
				S	L	P		S	L	P			
IV / 1	Mobile communications	14	2	-	2	-	28	-	28	-	48	104	4

3.1	Number of hours per week	4	3.2	of which, course	2	3.3	applications	2
3.4	Total hours in the curriculum	56	3.5	of which, course	28	3.6	applications	28

Individual study	Hours
Manual, lecture material and notes, bibliography	28
Supplementary study in the library, online and in the field	-
Preparation for laboratory works and for the project	22
Tutoring	3
Exams and tests	3
Other activities	0

3.7	Total hours of individual study	48
3.8	Total hours per semester	104
3.9	Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	N / A
4.2	Competence	N / A

5. Requirements (where appropriate)

5.1	For the course	Amphitheatre, Cluj-Napoca
5.2	For the applications	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	Theoretical knowledge (what the student must know):	Architecture and functionality for 2G, 2.5G, 3G and 4G systems (GSM, GPRS, EDGE, UMTS, LTE); Signaling/transmission protocols and procedures for 2G and 2.5G systems; Digital signal processing for transmission over the radio interface; Technologies for mobile application development.
	Acquired skills (what the student is able to do):	After completing the discipline, students will be able to: - analyze various mobility scenarios and identify how they are handled by major mobile communication systems; -characterize and analyze mobile radio channels and to propose adequate solutions; -characterize and understand the architecture of major mobile communication systems ; - understand the signal processing tasks used over the radio interface to counteract the effects of the mobile radio environment ; - characterize and analyze mobile signaling and transmission protocols ; - understand the signaling procedures used as a support of terminal and service mobility.
	Acquired abilities: (what type of equipment the student is able to handle)	After completing the discipline, students will be able to: - use various technologies for mobile application development (web-based and native applications); - use and configure GSM equipments (BTS, BSC, OMC-R) on an fully functional GSM cell; - use dedicated software for performing trace decoding and parameter tuning.
	In accordance with Grila1 and Grila2 RNCIS	C4. To design, implement and operate data, voice, video and multimedia services, based on the understanding and application of fundamental concepts from the field of communications and information transmission. C5. To select, install, configure and exploit fixed and mobile telecommunications equipment. To equip a site with common telecommunications networks. C6. To solve wide-band telecommunications networks' specific problems: propagation in various transmission media, high frequency circuits and equipment (microwaves and optical).
Cross competences (Grila1 and Grila2 RNCIS)		N.A.

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

7.1	General objectives	By the end of the course, the students will be able to analyze and design mobile communication systems and mobile applications and services.
7.2	Specific objectives	1. To give the students a deep understanding of the 2G and 3G digital cellular systems (GSM,GPRS, EDGE) 2. To provide an overview of 4G systems 3. To enable the students to synthesis and analyze wireless and mobile cellular communication systems over fading channels 4. To provide the student with an understanding of advanced multiple access, diversity and channel coding techniques used in mobile communications

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Mobility specific concepts. Evolution of mobile communications. Standards for mobile communications. The mobile radio channel	Presentation, exemplification, problem presentation, exercises and case studies, formative evaluation	Use of overhead projector and of simulation platforms
2	The GSM system. Standardization phases. Categories of services in GSM. The architecture of a GSM network. Functional description of a GSM network		
3	Addresses and identifiers in GSM. Call routing in GSM intra(inter)-PLMN calls, MT calls, MO calls, calls between GSM users		
4	The GSM's radio interface. Signal processing for transmission over the radio interface (voice codecs, ciphering, channel coding, channel equalization, modulation)		
5	The GSM's radio interface. Logical and physical channels. Mapping logical channels onto physical channels		
6	The stack of signaling protocols. Signaling protocols for transmission over the radio, the A and the Abis interfaces. Signaling protocols inside NSS. The SS7 signaling system		
7	Signaling procedures. RR, MM and CM procedures		
8	GSM/GPRS networks: architecture, functional description, GPRS identifier: logical and physical GPRS channels, temporal multiplexing of logical channels, radio resource sharing between GSM and GPRS, MM and PDP contexts		
9	GSM/GPRS networks: the stack of signaling and transmission protocols, GPRS signaling and transmission procedures. EDGE: GPRS limitations, classification (ECSD and EGPRS), the architecture of EDGE networks, mechanisms for increased data rates (modulation, link adaptation, incremental redundancy)		
10	Introduction to UMTS: architecture (release 99, Rel 4 and Rel5), multiple access scheme, functional description, specific procedures for accessing the network and providing mobility		
11	Introduction to UMTS: data and voice transmission over the radio interface: transport channels and bearers. Examples of CN-CS and CN-PS procedures		
12	UTRA evolution – HDSPA, HSUPA: architecture, key enabling technologies, channels, data transmission, mobility support		
13	LTE networks: architecture, multiple access, functional description		
14	LTE sample signaling/transmission protocols and procedures		
8.2. Applications (lab) – 4h modules		Diversity tech	Notes
1	The GSM radio access network. Hardware configuration using Alcatel equipment	Practical demonstration, lab experiments, applications	Use of emulators, mobile phones and devices computers
2	The GSM AT command set. The SMS service.		
3	M2M applications		
4	Mobile web applications		
5	Mobile applications using JME		
6	Signaling protocols and procedures in GSM		
7	Android applications		

Projects

Individual applications based on the technologies covered at the lab. Each student will design and implement a mobile application or service.

Bibliography

1. R. Terebes – "Mobile communication systems. Part one: GSM networks", Editura UTPRES, Cluj-Napoca, 2006, ISBN 978-973-662-221, 978-973-622-222-9.
2. C. Kappler – "UMTS networks and beyond", John Wiley and sons, 2009
3. Ralf Kreher, Torsten Ruedebusch, "UMTS Signaling: UMTS Interfaces, Protocols, Message Flows and Procedures Analyzed and Explained" [Hardcover], Wiley; 2 edition (March 19, 2007), ISBN-10: 0470065338 ISBN-13: 978-0470065334

On-line references

1. Terebes Romulus. Mobile communications (lecture notes, lab guides), http://ares.utcluj.ro/cm_2014.html
2. ETSI/3GPP specifications http://www.3gpp.org

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The acquired skills and competencies could be employed by professionals working on the following occupations according to COR (Classification of Occupations in Romania): electronic engineers, telecommunications engineers, electro-technology engineers, ICT specialists.

10. Evaluations

Activity type	10.1	Assessment criteria	10.2	Assessment methods	10.3	Weight in the final grade
Course		The level of acquired theoretical knowledge and practical skills		- written exam including theory and problems (25 questions)		-E max 10 pts. 70%
Lab		The level of acquired abilities		- project – application based on the studied technologies to be presented at the last lab		- P, max. 10 pts. 30%
10.4 Minimum standard of performance						
$E \geq 5$, and $0.7E+0.3P \geq 4.5$						

Date of filling in 19.01.2015

Course leader
Assoc. Prof. Romulus Terebes PhD eng.

Teacher in charge of applications
Assoc. Prof. Romulus Terebes PhD eng.

Date of approval in the department
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Head of department
Prof. Virgil Dobrota, PhD eng.