SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Telecommunications Technologies and Systems/ Engineer Applied Electronics/Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E47.00/EA-E103.00

2. Data about the subject

2.1 Subject name	Mobile Communications						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Professor Romulus TEREBES, Ph.D Romulus.Terebes@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assoc Prof. Raul MALUTAN, Ph.D Raul.Malutan@com.utcluj.ro Assist. Andreia MICLEA, Ph.D. Student, Andreia.Miclea@com.utcluj.ro						
2.5 Year of study	4	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DS/DI

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	2	3.3 laboratory	2
3.4 To Total hours in the curriculum	125	of which: 3.5 course	28	3.6 laboratory	28

Distribution of time	hours
Manual, lecture material and notes, bibliography	35
Supplementary study in the library, online specialized platforms and in the field	-
Preparation for seminars / laboratories, homework, reports, portfolios and essays	28
Tutoring	3
Exams and tests	3
Other activities:	0

3.7 Total hours of individual study	69
3.8 Total hours per semester	125
3.9 Number of credit points	5

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 seminars / laboratories / projects	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	C4.3 Explanation and interpretation of the main requirements and specific techniques for data, voice, video and multimedia transmissions C5.2 Explanation and interpretation of the fundamental technologies and protocols for the fixed - mobile integrated communication systems C6.4 Use of the QoS parameters and measurement techniques specific to the propagation and transmission channels and media 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. - use various technologies for mobile application development (web-based and native applications); - use and configure GSM pieces of equipment (BTS, BSC, OMC-R) on an fully functional GSM cell; - use and configure LTE pieces of equipment - use dedicated software for performing trace decoding and parameter tuning.
Cross competences	CT1 Methodical analysis of the problems specific to mobile communications, with identification of the elements for which there are established solutions. CT3. 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, in a international language

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

7.1 General objective	Development of professional skills in the field of mobile communications
7.2 Specific objectives	1. Assimilation of the theoretical knowledge regarding the operation of mobile communication systems 2. Development of skills and abilities needed to design and implement mobile applications and services

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 identifiers, 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, Release 4 and Release 5), multiple access scheme, functional description, specific procedures for accessing the network and providing mobility		
11.Data and voice transmission over UMTS's 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. HSPA+		
13. LTE networks: architecture, multiple access, functional description		
14. LTE sample signaling/transmission procedures. Evolution to 5G		

Bibliography

1. R. Terebes – "Mobile communication systems. Part one: GSM networks ", 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. R. Kreher, T. 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.
4. A.R. Mishra "Fundamentals of Network Planning and Optimisation 2G/3G/4G: Evolution to 5G", 2nd Edition, Wiley, 2019.
5. E. Dahlman, S. Parkvall and J. Skold, "4G, LTE-Advanced Pro and the Road to 5G", Academic Press, 978-0-12-804575-6, 2016.

Online references 1. Romulus Terebes - lecture notes: http://ares.utcluj.ro/mc/mc.html 2. ETSI/3GPP specifications http://www.3gpp.org		
8.2 Laboratory (4h modules every 2 weeks)	Teaching methods	Notes
1 The GSM radio access network. Hardware configuration using Alcatel-Lucent equipment	Practical demonstration, lab experiments, applications	Use of emulators, mobile phones and devices computers
2. The GSM AT command set. The SMS service.		
3. Mobile web applications		
4. Signaling protocols and procedures in GSM		
5. Mobile applications using JME. M2M applications		
6. Android applications		
7. LTE networks		
Bibliography 1. Lab support http://ares.utcluj.ro/mc/mc.html 2. Alcatel-Lucent and Nokia equipment manuals.		

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

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field of electronics, telecommunications and information technology, where the students carry out the internship stages and/or occupy a job (electronic engineers, telecommunications engineers, electro-technology engineers, ICT specialists), and the expectations of the national organization for quality assurance (ARACIS).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Written exam including theory and problems (25 questions)	75%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Multiple choice tests at the end of each lab	25%

10.6 Minimum standard of performance

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ Understanding of the architecture, functionality, stack of protocols and mobility support procedures in 2G,3G and 4G communication systems.
- ✓ Ability to perform O@M tasks on the laboratory 2G and LTE platforms

Minimal acquired competences:

- ✓ Ability to develop simple mobile applications
- ✓ Ability to analyze and improve performance of a mobile network

Quantitative point of view

- ✓ Minimal mean at the exam 5
- ✓ Final mark = 0.75xExam+ 0.25x Mean of the marks at the lab tests

Date of filling in:	Responsible	Title Surname NAME	Signature
13.09.2022	Course	Professor Romulus TEREBES, Ph.D	
	Applications	Professor Romulus TEREBES, Ph.D	
		Assoc. Prof. Raul MĂLUȚAN, Ph.D	
		Assist/ Andreia MICLEA, Ph.D. student	

Date of approval in the Council of the Communications Department 13.09.2022	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 21.09.2022	Dean Prof. Ovidiu POP, Ph.D.