MINISTRY OF NATIONAL EDUCATION

TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA

SYLLABUS

1. Study Program

1.1	Higher Education Institute	Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Communications
1.4	Study domain	Electronics and Telecommunications Engineering
1.5	Study level	Master of Science
1.6	Study program/ Qualification	Multimedia Technologies/ Telecommunications/ Master
1.7	Type of education	Full time
1.8	Discipline code	TM-E17.10/ TC-E14.00

2. Discipline

2.1	Discipline name					Communication Technologies for Intelligent Transportation Systems					
2.2	Subject area					Electronics and Telecommunications Engineering					
2.3	Responsible					Assistant Professor Zsuzsanna Suta, Ph.D. Zsuzsanna.Suta@com.utcluj.ro					
2.4	Titular					Assistant Professor Zsuzsanna Suta, Ph.D.					
2.5	Year of study	II	2.6	Semester	3	2.7	Evaluation	Exam	2.8	Type of discipline	DS/DO

3. Total estimated time

Year/ Sem	Discipline name	No. of weeks	Course	Applications			Course	Applications			Indiv. study	TOTAL	ECTS
			[hours/week]				[hours/week]						
			C	S	L	P		S	L	P			
II/3	SPEWCTS	14	2	0	1	0	28	0	14	0	58	100	4

3.1	Number of hours per week	3	3.2	course	2	3.3	applications	1
3.4	Total hours per curriculum	42	3.5	course	28	3.6	applications	14

Individual study	Hours
Study based on manuals, course materials, references and notes	14
Supplementary documentation in libraries, electronic platforms and on field	20
Preparation of seminars/laboratories, homeworks, essays, portfolios	10
Tutorial work	7
Assesments	3
Other activities	4

3.7	Total hours of individual study	58
3.8	Total hours per semester	100
3.9	ECTS	4

4. Prerequisites (if necessary)

4.1	Curriculum	Modulation techniques; Data transmissions; 3G, 4G and 5G mobile communications; Wireless systems
4.2	Competences	Matlab, Simulink or Labview programming; utilization of measurement equipment

5. Requisites (if necessary)

5.1	Course	Video-projector, screen, whiteboard.
5.2	Applications	PCs with Internet access, oscilloscopes, signal generators, wireless (WiFi and 3G) interfaces, SDR devices

6. Specific competences acquired

Professional competences	Theoretical knowledge (What do the student should know)	The students will know: - the basic concepts of intelligent transportation systems. - the communication technologies used by railway, aeronautical, maritime and vehicular connectivity systems. - the basic aspects of vehicle-to-vehicle, vehicle-to-infrastructure and vehicle-to-everything communications. - the basic aspects related to connected mobility. - the basic aspects related to vehicular communications security. - the basic aspects related to the integration of intelligent transportation systems into smart cities.
	Acquired skills (What the student is able to do)	The students will be able to: - develop solutions for intelligent transportation systems. - assess the quality of services offered by the connectivity systems. - develop solutions for vehicular connectivity systems. - assess the performance of various connectivity solutions. - develop solutions for connected mobility. - develop solutions for smart cities related to intelligent transportation systems.
	Acquired abilities (what equipment/ instruments/ softwares the student is able to handle)	The students will be able to use: - equipment/tools for measurement of connectivity performance. - Matlab/Simulink for fast prototyping. - radio channel emulators. - Simulation/emulation tools for wireless systems. - SDR devices for different applications.
Transversal competences		Adapting to new technologies, professional and personal development through continuing education using electronic documentation and printed sources, in Romanian and in at least one international language (English). Competencies for analysis and synthesis and optimization systems thinking. Flexibility in thinking and ability to work with interdisciplinary concepts and tools.

7. Discipline objectives (based on the grid of specific competences acquired)

7.1	General objective	Knowledge of intelligent transportation systems. Overview of connectivity solutions used for ITS. Knowledge of vehicular communication solutions.
7.2	Specific objectives	Study of railway, aeronautical, maritime and vehicular communication systems. Study of V2V and V2I solutions. Study of security issues in vehicular communications.

8. Contents

8.1. Course (titles)		Teaching methods	Remarks
1	Overview	Presentation, discussions	Videoprojector
2	Intelligent transportation systems. General aspects		
3	Railway communication systems		
4	Aeronautical communication systems		
5	Maritime communication systems		
6	Vehicular communication systems		
7	Connected mobility		
8	Vehicle-to-vehicle and vehicle-to-infrastructure communications		
9	Vehicle-to-everything communications		
10	In-vehicle communications systems		
11	Security in vehicular communication systems		
12	Ubiquitous access to services		
13	Intelligent transportation systems and smart cities		

14	Follow-up, questions and answers		
8.2. Applications (laboratory work)		Teaching methods	Remarks
1	Mobile communications system emulator. Performance study.	Simulations, experiments	PC, simulator, wireless cards, oscilloscope,SDR, signal generator
2	Communication system implementation using SDR and Matlab.		
3	Air traffic monitoring solution implementation using SDR and Matlab.		
4	Communication systems implementation using SDR and GNU radio.		
5	Radio communications system performance study using SDR and GNU radio.		
6	The study of radio channels, coding and modulation schemes using SDR și GNU radio.		
7	Study of a seamless connectivity system architecture for public transport		

References:

1. Vasile Bota, *Transmisiuni de date*, Ediţia a II-a, Editura Risoprint, Cluj Napoca, 2004. (accesible at: TUCN library, laboratory).
2. Graham D. Lees, William G. Williamson, *Handbook for Marine Radio Communication 5E*, Informa, 2009, ISBN: 978-1843117971
3. Wei Song, Weihua Zhuang, *Interworking of Wireless LANs and Cellular Networks*, Springer Briefs in Computer Science, Springer, 2012, ISBN: 978-1-4614-4378-0 (accesible at: TUCN library, laboratory).
4. Dale Stacey, *Aeronautical Radio Communication Systems and Networks*, John Wiley & Sons, Ltd, 2008, ISBN: 9780470018590
5. Emilie Masson, Marion Berbineau, *Broadband Wireless Communications for Railway Applications: For Onboard Internet Access and Other Applications*, Springer International Publishing, 2017, ISBN: 978-3-319-47202-7
1. 4. Christoph Sommer, Falko Dressler, *Vehicular Networking*, Cambridge University Press, 2014, ISBN: 978-1107046719
6. Kan Zheng, Lin Zhang, Wei Xiang, Wenbo Wang, *Heterogeneous Vehicular Networks*, Springer International Publishing, 2016, ISBN: 9783319256207
7. Tao Zhang, Luca Delgrossi, *Vehicle Safety Communications: Protocols, Security, and Privacy*, John Wiley & Sons, Ltd, 2012 ISBN: 978-1-118-13272-2
8. Aleksander Sladkowski, Wiesław Pamuła, *Intelligent Transportation Systems – Problems and Perspectives*, Springer International Publishing, 2016, ISBN: 978-3-319-19150-8
9. Lukas Neckermann, *Smart Cities, Smart Mobility: Transforming the Way We Live and Work*, Troubadour Publishing Ltd, 2017, ISBN: 978-1788030540

9. Discipline content corroborated with the expectations of the epistemic community representatives, associations, professional and related program employers

Acquired skills will be needed in the following possible COR occupations: electronics engineer, telecommunications engineer, system and computer design engineer, or new occupations proposed to be included in COR (sales support engineer, developer of multimedia applications, network operating engineer, test engineer, project manager, traffic engineer, communications system consultant).

10. Assessment

Type of activity	10.1	Evaluation criteria	10.2	Evaluation method	10.3	The weight of the final grade
Course		Written test with several theoretical questions and 2-3 problems (E = 1...10)		Written test		T = 50%
Applications		Project developed during the semester in the laboratory (P = 1 ... 10) Written test with questions related to the practical applications (Ta = 1 ... 10)		Project defended at the end of semester Written test at the end of the semester		P = 30% Ta = 20%
10.4 Minimum performance standard						
The final grade (N) is calculated as the weighted sum of marks obtained in the evaluation, as presented above: N = 0.5·T + 0.3·P + 0.2·Ta. The condition for obtaining the ECTS credits is: T > 5						

and N > 5.

Date	Titular	Responsible
07.02.2020	Assistant Professor Zsuzsanna SUTA, Ph.D.	Assistant Professor Zsuzsanna SUTA, Ph.D.

Date of approval	Head of Department
1.10.2020	Professor Virgil DOBROTA, Ph.D.