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-E17.50/ TC-E17.50

2. Discipline

2.1	Discipline name					Cognitive Communications						
2.2	Subject area					Electronics and Telecommunications Engineering						
2.3	Responsible					Assoc. Professor Ligia Cremene, Ph.D. Ligia.Cremene@com.utcluj.ro						
2.4	Titular					Assoc. Professor Ligia Cremene, 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 [hours/week]				Applications [hours/week]				Course	Applications			Indiv. study	TOTAL	ECTS
			C	S	L	P		S	L	P							
II/3	Cognitive Communications	14	2	0	1	0	28	0	14	0	58	100	4				

3.1	Number of hours per week	4	3.2	course	2	3.3	applications	1
3.4	Total hours per curriculum	56	3.5	course	28	3.6	applications	14

Individual study	Hours
Study based on manuals, course materials, references and notes	27
Supplementary documentation in libraries, electronic platforms and on field	10
Preparation of seminars/laboratories, homework, essays, portfolios	10
Tutorial work	7
Assessments	3
Other activities	1

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	Microwaves, Mobile Communications
4.2	Competences	Telecom software simulation tools, Matlab, data research and analysis, radio network planning, English language

5. Requisites (if necessary)

5.1	Course	Video-projector, screen, whiteboard
5.2	Applications	PCs with Internet access, radio measurement devices

6 Specific competences acquired

Professional competences	Theoretical knowledge (What do the student should know)	Students will know: – The main modern telecommunication technologies – Cognitive Communications technologies and standards – Local and global spectrum allocation – Problems and solutions in radio resource management – Optimization and problem solving techniques – Computational Intelligence tools applied in Telecom – Game Theory elements, strategic interactions applied in Telecom
	Acquired skills (What the student is able to do)	Students will be able to: – Perform systemic analyses – Identify problems and solutions at systems level in telecommunications systems – Make radio resource allocation optimization decisions – Apply interdisciplinary solutions – Apply Computational Intelligence and Game Theoretical tools on Telecommunications.
	Acquired abilities (what equipment/ instruments/ software the student is able to handle)	Students will be able to use: – Spectrum analyzer in various work scenarios – Telecom simulation platforms & tools (SEAMCAT, Matlab)
Transversal competences		CT3 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	Developing professional competencies in the field of Cognitive Communications.
7.2	Specific objectives	1. Acquire theoretical and practical knowledge of Cognitive Communications techniques and technologies and the interdisciplinary tools required for this field 2. Acquiring the skills for analysis and optimization of dynamic, complex, wireless communication scenarios.

8. Contents

8.1. Course (titles)		Teaching methods	Obser-vations
1	Introduction: Cognitive Communications technologies and systems. The specifics, benefits and challenges of the interdisciplinary approach	Interactive lecture	Video projector
2	Radio Resource Management. Open issues		
3	Telecommunication Policies. Dynamic spectrum access		
4	Cognitive Communications Standards		
5	Cognitive Communications Technologies 1 – Software Defined Radio		
6	Cognitive Communications Technologies 2 – Cognitive Radio		

7	Radio environment maps		
8	Cognitive Communications Techniques 1 – Architectures. Adaptive antennas		
9	Cognitive Communications Techniques 2 – Resource allocation algorithmes		
10	Decision making support for radio resource allocation		
11	Game theory concepts applied in Telecommunications. Models, solution concepts, equilibria		
12	CR use case scenario analysis using Game Theory		
13	Performance analysis of Cognitive Communications systems		
14	Recap. Open issues.		
8.2. Applications (laboratory work)		Teaching methods	Observations
1	Introducing the types of problems and tools used in the field of Cognitive Communications	Problem solving, Simulation, experiments	PC, Matlab, dedicated simulator
2	Search algorithms /heuristics 1		
3	Search algorithms /heuristics 2		
4	Game Theory key concepts		
5	CR use case scenario analysis using Game Theory		
6	SEAMCAT interference probability simulation tool		
7	Project: planning, theme allocation, methodology, documentation.		
8	Working on the project, phase 1		
9	Working on the project, phase 2		
10	Working on the project, phase 3		
11	Working on the project, phase 4		
12	Working on the project, phase 5		
13	Project presentations		
14	Final evaluation		

References:

Peyman Setoodeh, Simon S. Haykin, *Fundamentals of Cognitive Radio*, Wiley Online Books, 2017

1. Online course contents, updated yearly: http://asl.utcluj.ro/didactic
2. Ligia Cremene, *Tehnici adaptive in sisteme de comunicații wireless*, ISBN 978-973-133-785-2, 366 pag., Ed. Casa Cărții de Știință, Cluj-Napoca, 2010
3. Bruce A. Fette, (ed.), *Cognitive Radio Technology*, ediția a 2-a, 649 pag., Elsevier, USA, 2009
4. Linda E. Doyle, *Essentials of Cognitive Radio*, Cambridge Univ. Press, 2009
5. Frank H.P. Fitzek, Marcos D. Katz, (eds.) *Cognitive Wireless Networks – Concepts, methodologies and Visions inspiring the Age of Enlightenment of Wireless Communications*, 714 pag., Springer, Netherlands, 2007
6. K-C. Chen, R. Prasad, *Cognitive Radio Networks*, 359 pag., Wiley, 2009
7. Leonhard Korowajczuk, *LTE, WiMax and WLAN – Network Design, Optimization and Performance Analysis*, 720 pag., Wiley, 2011
8. IEEE 802.22 WRAN standard, IEEE 802.22 working group on Wireless Regional Area Networks http://www.ieee802.org/22/.
9. M.J., Osborne, *An Introduction to Game Theory*, Oxford Univ. Press, 2004
10. Zhe Chen et al., *Correlative Learning: a basis for brain and adaptive systems*, 475 pag, John Wiley & Sons, Inc., NJ, 2007
11. Telecom policy and standardization bodies' recommendations (mentioned in the course contents)
12. Scientific papers and expert tutorials (mentioned in the course contents).

Online references and other information:
Links will be mentioned during lectures and available at: http://asl.utcluj.ro/didactic

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, product manager, 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, software developer for telecom applications.

10. Assessment

Type of activity	10.1	Evaluation criteria	10.2	Evaluation method	10.3	Weight in the final grade
Course		Written test with 9 questions (T = 1...10) Topics to study / Scientific papers (S = 1…10)		Written test (T=50%) + activity during the semester (S=50%) E = T + S		E = 50%
Applications		Project developed during the semester in the laboratory and at home (P = 0 ... 10)		Project presentation at the end of semester		P = 50%
10.4 Minimum performance standard						
The final grade (N) is calculated as average of marks obtained in the evaluation of ongoing activities and application type: N = (E + P) / 2. The condition for obtaining the ECTS credits is that both components of the final grade to be higher than or equal to 5 (five).						

Date
10.02.2020

Titular
Assoc. Professor
Ligia CREMENE, Ph.D.

Responsible
Assoc. Professor
Ligia CREMENE, Ph.D.

Date of approval
1.10.2020

Head of Department
Professor Virgil DOBROTA, Ph.D.