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	Bases of Electronics
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-E47.20

2. Data about the subject

2.1	Subject name						Optoelectronics Systems in Telecommunications (SOT)				
2.2	Subject area						Optoelectronics and Photonics				
2.3	Course responsible/lecturer						Prof. Emil Voiculescu, PhD				
2.4	Teachers in charge of applications						Assoc. Prof. Ramona Galatus, PhD				
2.5	Year of study	IV	2.6	Semester	1	2.7	Assessment	Exam	2.8	Subject category	DS/DOP

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	Optoelectronics Systems in Telecommunications (SOT)	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	18
Supplementary study in the library, online and in the field	4
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	20
Tutoring	3
Exams and tests	3
Other activities	0

3.7	Total hours of individual study	48
3.8	Total hours per semester	120
3.9	Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	Optoelectronics Lectures
4.2	Competence	Optoelectronics Lab

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):	After completing the discipline, students will learn: - phenomenology governing optical transmissions. - Most optoelectronic devices used in telecommunications. - Specific information related to the optical networks, optical system installation, measurement, operations, and specific design software.
	Acquired skills (what the student is able to do):	After completing the discipline, students will be able to: - To use a specific simulator (ex. Liekki Application Designer, Zemax, Matlab applications) - They will know the HFC network equipment (communication system hybrid fiber-coaxial) installed in the laboratory - Can interpret a map of power levels for optical components (Power budget) - Can choose components, parts, equipment; can design an optical system integrated for a wide range of applications - Can implement optical components in communication systems, networks design process - They will know the types of optical fibers and their characteristics, optical connectors - They will know how to use optical fiber welding machine - splicer - Can interpret data derived from measurements with the OTDR - To set up an optical connection between two computers / network.
	Acquired abilities: (what type of equipment the student is able to	After completing the discipline, students will be able to: – Use laboratory equipment (power supplies, digital oscilloscopes), the fiber cleaver, and welding equipment fiber optic node installed in the laboratory. – Use the specific hardware and software tools; – To know how to measure and interpret experimental results.
	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	Development of professional skills in analysis, design, simulation and testing of optoelectronic systems for telecommunications.

7.2	Specific objectives	1. Obtain the theoretical knowledge for the design and simulation of optoelectronic systems using advanced simulation programs (Liekki Application Designer, Zemax, Optiwave, Comsol). 2. Obtaining skills and abilities required for the analysis, implementation, measurement and operation of telecommunications optoelectronic systems.

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Presentation discipline. Recap of the main topics in Optoelectronics.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2	Studies of propagation: Optical fibers.		
3	PCF fibers, bend resistant Fibers.		
4	Studies of propagation: flat optical guides.		
5	Fiber optic components for telecommunications.		
6	Optoelectronic integrated circuits (OEICs) for telecom: a. Simple passive: integrated lenses, splitters, couplers, optical switches, resonators. b. Advanced: optical isolators, polarizers, circulators, multiplexers, demultiplexers, routers AWG. Diffraction gratings inscribed in fiber IFG (In-Fiber Gratings). IFG diffraction grating filters. Guides diffraction gratings 2D / 3D. Structure, operation, achievement. Applications.		
7	Functional OEICs: electro-optical, acousto-optical, magneto-optical, opto-optical, thermo-optical. Manufacture of integrated optoelectronic circuits. Optoelectronic systems for telecommunications.		
8	Emitting fiber lasers for telecommunications. Allocation of lambda DWDM ITU Grid.		
9	Optical Amplifiers: fiber doped with semiconductor SOAS schemes. DWDM EDFA for GA-GA2430 2130.		
10	Fiber receivers. Transceivers for fiber optic communications, catalogs.		
11	Fiber communication systems. Point to point links. Shipping. Distances inter-repeater regenerator. Flow Budget, SNR, BER. Sizing attenuation and dispersion based link (Ericsson).		
12	Optical networks. CATV access networks, hybrid HFC - hybrid fiber-coax, FTTH - Fiber to the home. Gigabit Ethernet.		
13	Advanced Software for optical telecommunications: Zemax, Liekki Application Designer, Optiwave, Comsol.		
14	Advanced Software for optical telecommunications. Examples and applications.		
8.2. Applications (lab)		Teaching methods	Notes
1	Introduction- Recap of main topics in optoelectronics, instrumentation laboratory presentation, work safety rules. 2D optical Guides : simulations using ray mathematical formalism implementation	Simulations with Matlab applications, Optiwave and practical implementation (Educational Kits) and devices.	
2	3D step-index - TE and TM modes study: a. simulations using ray mathematical formalism implementation b. simulations using Beam Propagation Method, implemented in Optiwave or/and FEM implemented in Comsol		
3	Coupling parallel guides: a. simulations using ray mathematical formalism implementation b. simulations using Beam Propagation Method, implemented in Optiwave or/and FEM implemented in Comsol		
4	Mach Zender interferometer as a modulator electro-static and dynamic optic: a. simulations using ray mathematical formalism implementation b. simulations using Beam Propagation Method, implemented in Optiwave or/and FEM implemented in Comsol		

5	Basics on optical fiber propagation		
6	Methods of designing an optical system with catalog data - flow budget equation. Statistical Design methods implementation.		
7	Effects of polarization – Matlab Simulations		
8	Bragg diffraction gratings: a. Simulation and b. Mosaic diffraction – practical experiment with - Educational Kit from Industrial Fiber Optics.		
9	Application with spectrometer (Transmitance)		
10	Application with spectrometer (Reflectance)		
11	Audio A/D Transmission System over plastic optical fiber- Educational Kit from Industrial Fiber Optics. System of LED matrix display, including Arduino board		
12	OTDR monitoring device events as the optical transmission networks using TraceView Tool.		
13	HFC networks – C-cor components study of the Lab virtual implemented network		
14	Evaluation students. Study visit OTDR.		

Bibliography

1. Harry J R Dutton - Understanding Optical Communications, IBM http://www.redbooks.ibm.com.
2. Stefan Nilsson-Gistvik – Optical Fiber Theory for Communication Networks, EN/LZT 199210/R1, Ericsson 2002.
3. Bahaa E A Saleh, Malvin Carl Teich – Fundamentals of Photonics, Wiley, ISBN : 0471213748 (Electronic), 0471839655 (Print).
4. Hiroshi Nishihara, Masamitsu Haruna,Toshiaki Suhara - Optical Integrated Circuits, ISBN 0 – 07 – 046092-2.
5. Google Reader : http://books.google.com/books?id=jcJH7rNah_gC&pg=PA356&hl=ro&source=gbs_selected_pages&cad=0_1&sig=YTHvk5rFJGUGL3qMNT6g2HHf16A#PPA18,M1
6. Safa O Kasap - Optoelectronics Devices and Photonics: Principles and Practices. Prentice Hall ISBN 0-201-61087-6.
7. William S C Chang – Fundamentals of Guided-Wave Optoelectronic Devices, Cambridge University Press, New York, E-book ISBN-13 978-0-511-64183-1.
8. David Large, James Farmer – Broadband Cable Access Networks, Morgan Kaufman Publishers 2009, ISBN 978-0-12-374401-2.
9. Cataloage telecom : Arris, C-COR, Scientific Atlanta, Cisco, JDSU s.a.

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

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

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		- after 7 courses, preliminary exam (problem solving) - Summative evaluation written exam (theory and problems)		- T, max 10 pts. 35% - E, max 10 pts. 60%

Applications		The level of acquired abilities		- Continuous formative evaluation - practical lab test		- L, max. 10 pts. 15%
10.4 Minimum standard of performance						
The presence of the course is considered activity and chronic absenteeism requires further verification of material lost. Presence in all laboratories, obtaining a minimum of 4.5 notes in laboratory activities, and partly written exam. $L \geq 4.5$ and $E \geq 4.5$ and $0,6E+0,15L+0,35T \geq 4.5$						

Date of filling in
1.10.2018

Course responsible
Prof. Emil Voiculescu, PhD.

Teachers in charge of applications
Assoc. Prof. Ramona Galatus, PhD