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	51315110

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					Conf. eng Ramona Voichita Galatus, PhD eng.					
2.4	Teachers in charge of applications					Conf. eng Ramona Voichita Galatus, PhD eng. Lecturer Lorant Szolga, PhD eng., Drd Loredana Buzura Drd Adriana Potarniche					
2.5	Year of study	IV	2.6	Semester	1	2.7	Assessment	Exam	2.8	Subject category	O/DF

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			
III / 1	Optoelectronics Systems in Telecommunications (SOT)	14	2		2		28		28		64	120	5

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	4
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	26
Tutoring	3
Exams and tests	3
Other activities	0

3.7	Total hours of individual study	64
3.8	Total hours per semester	120
3.9	Number of credit points	5

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, Optiwave, Matlab applications) - they will know to make the data interpretation using setup for Polarization effects, using He-Ne Laser, Double and multiple slit and holes diffraction, Holograms, Interferometry for data modulation, Doppler effect, Spatial filtering - make interpretation of a power levels map for optical components (Power budget) - to choose components, parts, equipment to design an optical system integrated for a wide range of applications - to 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 - to interpret data derived from measurements with the OTDR - they will know the HFC/all-optical network equipment - to set up an optical connection between two computers / network.
	Acquired abilities: (what type of equipment the student is able to handle)	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	[se completeaza de coordonatorul programului de studiu]
Cross competences (Grila 1 and Grila2		[se completeaza de coordonatorul programului de studiu]

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 practical abilities required for the analysis, implementation, measurement and operation of telecommunications optoelectronic systems.

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	**Overview of the lectures:** **"Why SOT?" - Introduction to photonics and optical communications. Economic impact in Europe** Recap of the main topics in Optoelectronics. Optical communication: a 1rst encounter. Optical communication components overview	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2	**Studies of propagation:** **"How?"-Optical communication: Studies of propagation** Optical fibers: materials, absorption, fiber loss and fabrication; light propagation		
3	**Types of optical fibers and their characteristics**: Special optical fibers Linear and Nonlinear effects (intermodal, chromatic dispersion, Kerr nonlinearities)		
4	**Optoelectronic integrated circuits (OEICs) for telecom**: Studies of propagation: waveguides 2D and 3D optical guides. Simple Passive components for telecommunications (modulators, filters, splitters). How to manufacture them.		
5	**Active and Passive Fiber optic components – part 1:** 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.		
6	**Emitters.**		

	Emitting fiber lasers for telecommunications. Allocation of lambda DWDM ITU Grid. Optical filters (microrings)		
7	**Fiber receivers.** Receivers. Transceivers for fiber optic communications, catalogs.		
8	**Fiber communication systems.** Network troubleshooting: OTDR technique. Point to point links. Shipping. Distances inter-repeater regenerator. Flow Budget, SNR, BER. Sizing attenuation and dispersion-based link (Ericsson). Examples and applications		
9	**Passive and Active components – part 2:** Optical Amplifiers - fiber doped, EDFA. Optical components for WDM: AWG, MUX, DMUX, ADMUX (Add-Drop MUX), Tunable filters, star couplers, Wavelength converters		
10	**Application examples**: success story in Europe (Horizon2020-Actphast)		
11	**POF – plastic optical fibers**: short distance (intranet, automotive)		
12	**Advanced Software for optical telecommunication**: Component based software. System based software. (Zemax, Liekki Application Designer, Optiwave, Comsol. Applications examples.)		
13	**Optical networks.** WDM. LiFI. FTTH - Fiber to the home. LIDAR. SmartCity.		
14	**Review of the lectures:** diagrams. Partial exam (Oral exam) – individual project		
8.2. Applications (lab)		Teaching methods	Notes
1	Introduction- Recap of main topics in optoelectronics, instrumentation laboratory presentation, work safety rules. General – basic knowledge about optics and optoelectronics	Simulations with Matlab applications, Optiwave and practical implementation (Educational Kits) and devices.	
2	2D optical Guides : simulations using ray mathematical formalism implementation 3D step-index - TE and TM modes study: a. simulations using ray mathematical formalism implementation simulations using Beam Propagation Method, implemented in Optiwave /VPIPhotonics Coupling parallel guides: a. simulations using ray mathematical formalism implementation simulations using Beam Propagation Method, implemented in Optiwave or/and FEM implemented in Comsol		
3	Interferometer – Michelson (setup Educational Kit from Industrial Fiber Optics.) and Mach-Zehnder (design). Mach-Zehnder interferometer as a		

	modulator electro-static and dynamic optic: a. simulations using ray mathematical formalism implementation simulations using Beam Propagation Method, implemented in Optiwave or/and FEM implemented in Comsol		
4	Effects of polarization – setup Educational Kit from Industrial Fiber Optics.		
5	Basics on optical fiber propagation		
6	Methods of designing an optical system with catalog data - flow budget equation. Statistical Design methods implementation.		
7	Holograms setup with He-Ne Laser, Educational Kit from Industrial Fiber Optics and LitiHolo.		
8	Bragg diffraction gratings: a. Simulation and b. Mosaic diffraction – practical experiment with - Educational Kit from Industrial Fiber Optics.		
9	Application with Spectrometer (Transmittance, Reflectance)		
10	Application with Photometer (Industrial Fiber Optics equipment)		
11	Audio A/D Transmission System over plastic optical fiber- Educational Kit from Industrial Fiber Optics. Application with VR glasses (distance monitoring)		
12	OTDR monitoring device events as the optical transmission networks using TraceView Tool.		
13	OTDR equipment for optical network maintenance		
14	Evaluation of the students.		

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.
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http://books.google.com/books?id=jcJH7rNah_gC&pg=PA356&hl=ro&source=gbs_selected_pages&cad=0_1&sig=YTHvk5rFJGUGL3qMNT6g2HHf16A#PPA18,M1

5. Safa O Kasap - Optoelectronics Devices and Photonics: Principles and Practices.
Prentice Hall ISBN 0-201-61087-6.
6. William S C Chang – Fundamentals of Guided-Wave Optoelectronic Devices, Cambridge University Press, New York, E-book ISBN-13 978-0-511-64183-1.
7. David Large, James Farmer – Broadband Cable Access Networks, Morgan Kaufman Publishers 2009, ISBN 978-0-12-374401-2.
8. 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

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field, where the students carry out the internship stages and/or occupy a job, and the expectations of the national organization for quality assurance (ARACIS).

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 (oral examination) -optional - Summative evaluation written exam (theory and problems) – 14 subjects, one from each lecture (for the students with preliminary exam – 8 subjects)		- T, max 10 pts. 20% - E, max 10 pts. 60%
Applications		The level of acquired abilities		- Continuous formative evaluation - practical lab test		- L, max. 10 pts. 20%
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. Lab (L) ≥ 4.5 and Essay (E) ≥ 4.5 and Exam (T) ≥ 4.5 : 0,6E+0,20L+0,20T ≥ 4.5						

Date of filling in
30.09.2019

Course responsible
Associate prof Ramona Galatus, PhD eng.

Teachers in charge of applications
Associate prof Ramona Galatus, PhD eng
Lecturer Lorant Szolga, PhD eng
Drd Loredana Buzura
Drd Adriana Potarniche

Date of approval in the department
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Head of department
Prof. Sorin Hintea, PhD eng.