Syllabus

Discipline name	Optoelectronics
Profile	Electronics and Telecommunications Engineering
Specialization	Telecommunications Technologies and Systems
Code	51323409
Course leader	Professor Emil Voiculescu, Ph.D., emil.voiculescu@bel.utcluj.ro
Collaborators	Assistant Professor Ramona Galatus, Ph.D., ramona.galatus@bel.utcluj.ro Assistant Lorant Szolga, Lorant.Szolga@bel.utcluj.ro
Department	Basis of Electronics
Faculty	Electronics, Telecommunications and Information Technology

Sem.	Type of discipline	Course	Applications			Course	Applications			Ind. study	TOTAL	Credits	Form of assessment
		[hours/week]				[hours/semester]							
			S	L	P		S	L	P				
5	**Engineering**	**2**	**-**	**2**	**-**	**28**	**-**	**28**	**-**	**64**	**120**	**4**	**Exam**

Acquired competences:

Course Description

Upon completion, the students are able to understand the propagation of light in waveguides and in birefringent materials; they have basic knowledge about optical theory, photometry and radiometry. The students will understand

- optoelectronic devices: LEDs, photosensitive devices, optocouplers, IR barriers, analog transmission using optical isolation (optical amplifier);
- how to make data transmission on UTP/STP cable with optical isolation, optical device driving, industrial applications of optical devices;
- laser diodes; optical fiber components, optical fiber communications;,
- the polarization, polarizers, optical modulators, Fabry-Perot interferometers; choosing proper parameters
- Theory and techniques of integrated optics, including optical wave guiding, coupling, modulation, grating diffraction, lasing, and integrated systems.

Course Learning Objectives

The course introduces the basics of optical field, optical parameters and their applications to LED, lasers, photodiodes, optocouplers, optical fibers, and photonic signal processing, i.e., how light is used in modern systems for encoding, manipulating, transmitting, storing, and retrieving information. It covers light propagation in isotropic and birefringent optical media, behavior at dielectric interfaces, interference, optical cavities and principles of laser action, the basics of optical waveguides (including optical fiber), and electro- and acousto-optic modulation. Emphasis is given to the design and analysis of optical devices circuits, and their applications in communications.

Prerequisites (if necessary)

Electronic Devices, optical theory based on high school manuals.

A. Lectures (titles of the courses + curricula)	
1	History. Optical frequency and wavelength ranges. Refraction indexes. Recap : main properties of the light regarded as an electromagnetic wave. Wave-particle duality.
2	Photonic sources. LEDs – characteristics, operation, drive, control, protection. White LEDs, OLEDs, Displays.
3	Lasers. Semiconductor laser diodes. Structures. Characteristics.
4	Photodetectors : *pin* (p-intrinsic-n), avalanche photodiodes. Phototransistors.
5	Analog and digital optocouplers. Characterization, performances, types of optocouplers. Industrial applications of optocouplers.
6	Isolation amplifiers.
7	Data transmission on UTP/STP links (unshielded/shilded twisted pairs). UTP / STP cables optically isolated.
8	Optical fibers. History, characteristics, specific materials, types of fibers, aperture, acceptance cone, light confinement, propagation modes, index profiles.
9	Fiber light launching, trajectories, Goos-Hanchen effect/depth, DWDM multiplexing, virtual fiber. Fiber optic cables.
10	Optical devices : couplers, multiplexers, AWG (area of waveguide gratings) routers.
11	Fiber optic devices : fiber connectors, eye diagram, fiber receivers.
12	Optical integrated circuits : 2D optical waveguides – slabs, stripe guides, devices using light waveguides.

13	Prism couplers to couple light into and out of waveguides. Difraction gratings. Microlenses : geodesic, Luneburg, Fresnel.
14	Functional optical circuits. Examples, applications.

B1. Lab activity	
1	Introduction. Optical theory review. Lab instrumentation. Work security rules. Micro-lens.
2	Directivity characteristic of photosensitive devices.
3	RGB LED.
4	Photosensitive device response to different incident wavelength
5	Optical microphone – (application of laser transmission)
6	Current-voltage photodiode response to variable optical illumination.
7	Bar-Graph response for different types drive signal
8	LED drivers analysis in Pspice
9	Fabry-Perrot Laser simulations (above, below threshold) - VPI-Photonics
10	Grating controlled Fabry-Perrot Laser, Fiber Bragg Stabilized Laser, Tunable Laser - VPI-Photonics
11	Splicer for Optical fiber (Siemens)
12	Single mode operation of Large Mode Area Fibers (LMA) – part A – Liekki Software simulation
13	Single mode operation of Large Mode Area Fibers – part B - Liekki Software simulation
14	Student's evaluation.
B2. Laboratory (Room/area, adress) Room 328, Baritiu 27, 35m^2	

C. Individual study (reference study contents, synthesis materials, projects, applications etc.)

Course slides, multimedia materials, essay (course homework)

Individual study structure	Course study	Problem solving, laboratory, project	Applications preparation	Examination time	Additional reference study	Total no. of individual study hours
Hours	28	4	20	3	9	64

References (Textbooks, courses, laboratory textbook, exercise book)

UTC-N Library

1. Emil Voiculescu, Tiberiu Marita - *Optoelectronica*, Editura Albastra, 2001, ISBN 973-9443-96-6
2. Nishihara et al. Optical integrated circuits.
http://books.google.com/books?id=jcJH7rNah_gC&pg=PA356&hl=ro&source=gbs_selected_pages&cad=01&sig=YTHvk5rFJGUGL3qMNT6g2HHf16A#PPA18,M1
3. Emil Voiculescu, Lucian Rotaru, ş.a. – *Optoelectronica. Indrumător de laborator*, U.T. PRES, 2003
4. Emil Voiculescu, Mircea Hotoleanu. *Optoelectronica. Teste.* UTCN, 1999.
5. Niculae Puscas. *Sisteme de Comunicatii Optice*, Editura Matrix, Bucuresti, 2006, ISBN (10) 973-755-021-8
6. Harry Dutton : Understanding Optical Communications, IBM, red series, 1999

Multimedia materials:

1.Voiculescu E. – PPT lecture files

Other books:

1. John Power – An Introduction to Fiber Optic Systems, McGraw Hill, Second Edition, 2000
2. Harry J.R. Dutton - Understanding Optical Communications, IBM RedBook, http://www.redbooks.ibm.com
3. Allan W Snyder, John D Love : Optical Waveguide Theory

Final evaluation	
Evaluation method	Written exam (E): problem solving (70%) and theoretical subjects (30%) (2 hours). After lecture 7 it can be sustain a partial exam-PE (1.5 hours) consists of a synthesis material.
Mark components	Exam (E: 0…10 points); Laboratory (L: 0…10 points); Partial exam (PE: 0…10 points).
Mark computation	M = 0.5E + 0.1L + 0.4PE. Pass if: E≥4.5 and L≥4.5 and M≥4.5

Course leader,

Professor Emil VOICULESCU, Ph.D.