# 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, Applied Electronics/ Engineer |
| 1.7 | Form of education | Full time |
| 1.8 | Subject code | TST-E34.00, EA-E34.00 |

## 2. Data about the subject

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Subject name | | | | | Optoelectronics | | | | | |
| 2.2 | Subject area | | | | | Optoelectronics and Photonics | | | | | |
| 2.3 | Course responsible/lecturer | | | | | Prof. Emil Voiculescu, PhD | | | | | |
| 2.4 | Teachers in charge of applications | | | | | Assist. Prof. Lorant Szolga, PhD | | | | | |
| 2.5 | Year of study | III | 2.6 | Semester | 1 | 2.7 | Assessment | Exam | 2.8 | Subject category | DID/DOB |

## 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 | 14 | 2 | | 2 | | 28 | | 28 | | 74 | 130 | 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 | 14 |
| 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 | 74 |
| 3.8 | Total hours per semester | 130 |
| 3.9 | Number of credit points | 5 |

## 4. Pre-requisites (where appropriate)

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|---|---|---|
| 4.1 | Curriculum | N.A |
| 4.2 | Competence | N.A |

## 5. Requirements (where appropriate)

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|---|---|---|
| 5.1 | For the course | Amphitheatre, Cluj-Napoca |
| 5.2 | For the applications | Laboratory, Cluj-Napoca |

## 6. Specific competences

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|---|---|---|
| Professional competences | Theoretical knowledge (what the student must know): | After completing the discipline, students will learn:<br>Fundamentals of optics. Photometry and radiometry. LED. LED display. Photosensitive devices. Optocouplers. Barriers infrared. Transmission of analog signals with optical separation - insulating amplifiers. Data Transmission on wires with optical separation. Devices controlled by light. Industrial applications of the devices controlled by light. Injection laser diodes. Optical fiber drives. Fiber optic components. |
| | Acquired skills (what the student is able to do): | After completing the discipline, students will be able to:<br>To know how to identify LEDs, photodiodes, laser diodes, optical fiber.<br>To know the meaning of LED parameters<br>To know how to use the applications catalog and to give the interpretation of LED parameters, photodiodes<br>To know the functioning and role optocouplers<br>To know the functioning of lasers and laser diodes<br>To know how to analyze and design some simple circuits with optical components<br>To know the characteristics of optical fibers |
| | Acquired abilities: (what type of equipment the student is able to handle) | After completing the discipline, students will be able to:<br><br>Use laboratory equipment (power supplies, spectrum analyzers, digital oscilloscopes, meters measuring voltage, current, temperature, etc.) to study and testing the optoelectronic components<br>Use specific hardware and software tools;<br>To know how to measure quantities that characterizes optoelectronic components: LEDs, photodiodes, phototransistors, photoresist, optocouplers.<br>To design simple circuits with optical components after data catalog.<br>To simulate in PSpice simple circuits with optoelectronic components. |
| | In accordance with Grila1 and Grila2 RNCIS | C1. To use the fundamental elements regarding electronic devices, circuits, systems, instrumentation and technology<br>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.<br>C5. To select, install, configure and exploit fixed and mobile telecommunications equipment. To equip a site with common telecommunications networks. |
| Cross competences (Grila1 and Grila2 RNCIS) | | N.A. |

## 7. Discipline objectives (as results from the key competences gained)

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|---|---|---|
| 7.1 | General objectives | Developing the competences regarding the use, analysis and (re)design of optoelectronic circuits. |
| 7.2 | Specific objectives | 1. Recognizing and understanding basic concepts specific to fundamental optoelectronic circuits.<br>2. Developing skills and abilities necessary for the use of fundamental optoelectronic circuits.<br>3. Developing skills and abilities for the analysis and (re)design of fundamental optoelectronic circuits. |

## 8. Contents

| 8.1. Lecture (syllabus) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Optoelectronics today : subject presentation, course references, literature. Recap of the main optical notions. Images, phenomena, experiments. | Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation | Use of .ppt presentation, projector, blackboard |
| 2 | Advanced optics. Reflection, refraction, wave interference, difraction, other properties of wave optics. | | |
| 3 | Photonic sources. LEDs, applications – lighting, displays, car lighting, headlights etc. | | |
| 4 | LED Drivers. Basic concepts on lasers. Semiconductor lasers. Modelling, operation, oscillation modes. | | |
| 5 | Lasers – industrial and telecom applications. Characteristics, performances, technology. Pulsed lasers and drivers. | | |
| 6 | Photodetectors. Photodiodes, APD – Avalanche photodiodes, phototransistors, voltaic cells, solar pannels, solar vechicules. | | |
| 7 | Transmission media : Optical Fibers. Fundamentals, numerical aperture, guiding light, propagation modes, manufacturing fiber optics. Special fibers : PCF – photonic crystal fibers, bend-resistant fibers, manufacture. Characterization. FO Cables. Industrial and telecom applications. | | |
| 8 | Transmission media: Optical Waveguides: slabs and stripes. Structure, propagation modes, aperture, typical applications. | | |
| 9 | Optocouplers : generic presentation, industrial and telecom applications. | | |
| 10 | Isolation amplifiers and applications. | | |
| 11 | Nanotechnologies. Optoelectronic sensors. Fundamentals, operation, implementation examples, applications. | | |
| 12 | Distributed optoelectronic sensors. | | |
| 13 | Other optoelectronic components : couplers, isolators, circulators, multiplexers, de-multiplexers, modulators, optical switches, semiconductor optical amplifiers – SOAs. | | |
| 14 | LED and LCD flat screen displays, inclouding portable AMOLED displays.<br>Recapitulation. Preparation for the final exam. | | |
| 8.2. Applications (lab) | | Teaching methods | Notes |
| 1 | Introduction-labour protection laws. Basic optical concepts. | Didactic and experimental proof, didactic exercise, team work | Use of laboratory instrumentation, experimental boards, computers, white/magnetic board |
| | | | |
| 2 | LEDs – Light emitting diodes. | | |
| 3 | The visible spectrum. The white (RGB) LED. | | |
| 4 | Semiconductor laser diodes. | | |
| 5 | The photo-resistance response to various wavelengths. | | |
| 6 | Voltage and current response of the photodiode and phototransistor to | | |

| | | | |
|---|---|---|---|
| | various IR light. | | |
| 7 | Measuring the characteristic of directivity for photosensitive devices. | | |
| 8 | The optical fiber. Application: fiber optic splicing. | | |
| 9 | Study of the index-profiles of rectangular optical waveguides and fiber optics. | | |
| 10 | Photo-interrupters and isolation amplifiers. | | |
| 11 | Optoelectronic components. Application : unguided transmission system for an AF signal, the same on optical fiber. | | |
| 12 | LED drivers. Linear drivers and switch-mode to strobe the displays. | | |
| 13 | Bar-graph displays. | | |
| 14 | Lab recovery and finalization of laboratory activity. Assessing students. | | |

Bibliography


1. Emil Voiculescu, Tiberiu Marita - *Optoelectronica*, Editura Albastra, 2001, ISBN 973-9443-96-6
2. Lorant A. Szolga, Ramona Gălătuș, Emil Voiculescu : "Optoelectronică – Îndrumător de laborator", Editura UTPRESS, 2013, ISBN 978-973-662-858-6.
3. Safa O Kasap - Optoelectronics Devices and Photonics: Principles and Practices.
4. Prentice Hall ISBN 0-201-61087-6, Kasap Book Images.
5. Stefan Nilsson-Gistvik – Optical Fiber Theory for Communication Networks, EN/LZT 199210/R1, Ericsson 2002.
6. 6. Bahaa E A Saleh, Malvin Carl Teich – Fundamentals of Photonics, Wiley, ISBN : 0471213748 (Electronic), 0471839655 (Print).
7. Harry J R Dutton - Understanding Optical Communications, IBM http://www.redbooks.ibm.com.
8. Catalog Thorlabs, vol 21. Titlu : V21_Catalog_web Site : http://www.thorlabs.com/images/Catalog/V21/V21_Catalog_web.pdf

Electronic material

1. Voiculescu E. – fisiere prezentari, format PPT, pentru curs
2. Voiculescu E – fisiere audio cu Talk-ul cursurilor, inregistrate live la predare ( narrated slide-shows).
3. VPIPhotonics – User Guide
4. Liekki – User Guide.


## 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)<br>- Summative evaluation written exam (theory and problems) | | - T, max 10 pts. 35%<br>- E, max 10 pts. 60% |
| Applications | | The level of acquired abilities | | - Continuous formative evaluation<br>- 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.<br>$L \geq 4.5$ and $E \geq 4.5$ and $0,6E+0,15L+0,35T \geq 4.5$ |

| Date of filling in | Course responsible | Teachers in charge of applications |
| --- | --- | --- |
| 19.01.2015 | Prof. Emil Voiculescu, PhD | Assist. Prof. Lorant Szolga, PhD |

| Date of approval in the department | Head of department |
| --- | --- |
| 19.01.2015 | Prof. Sorin Hintea, PhD |