COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Electronic Devices, Circuits and Architectures**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Microelectronics, Optoelectronics and Nanotechnologies

2. Date despre disciplină

2.1 Course name (ro) (en)				Dispozitive optoelectronice Optoelectronic Devices			
2.2 Course Lecturer				S.l./Lect. Dr. Ing. Alina-Elena Marcu			
2.3 Instructor for practical activities				S.l./Lect. Dr. Ing. Alina-Elena Marcu, Conf. Dr. Ing. Andrei Drăgulinescu			
2.4 Year of studies	4	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type	S		2.9 Course code	04.S.07.O.404		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	4.5	Out of which: 3.2 course	2	3.3 seminary/laboratory	2.5
3.4 Total hours in the curricula	63	Out of which: 3.5 course	28	3.6 seminary/laboratory	35
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					59
Tutoring					0
Examinations					3
Other activities (if any):					0

3.7 Total hours of individual study	62.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	• Physics 1; • Physics 2; • Materials for Electronics; • Electronic Devices; • Fundamental Electronic Circuits; • Measurements in Electronics and Telecommunications.
4.2 Results of learning	• General knowledge of optics, electromagnetism, quantum mechanics, semiconductor physics, and electronic devices (in particular the semiconductor p-n junction); • General knowledge of analysis of electronic circuits and systems.

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	Video projection system for in-person attendance and access to the Moodle/Microsoft Teams platform for uploading teaching materials.
5.2 Seminary/ Laboratory/Project	• The laboratory will take place in a room with specific equipment, which must include: a video projection system, PC systems equipped with general simulation software (OrCAD/PSpice), as well as electronic measuring instruments, and access to the Moodle e-learning platform for uploading laboratory reports; • Mandatory attendance at laboratories (according to the UPB undergraduate study regulations). • The seminar will take place in a room with a video projector and whiteboard for in-person attendance and access to the Moodle e-learning platform for online teaching. • Attendance at the seminar is mandatory (according to the UPB undergraduate study regulations).

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

- **Course**: the course studies the main optoelectronic devices and familiarizes students with the specific parameters of these devices, presenting fundamental optoelectronic circuits and exemplifying their design in specific applications. The course also familiarizes students with the main types of optical communication systems, together with their issues, emphasizing optical communication systems in the visible spectrum and typical applications.
- **Laboratory**: the laboratory applications familiarize students with techniques for analysis and simulation of optoelectronic circuits and systems, using a general simulation software environment (OrCAD/PSpice). The following aspects are mainly considered: modeling of optoelectronic devices, simulation of optoelectronic circuits and systems, and processing and interpretation of results obtained from simulation. The lab also familiarizes students with the practical use of optoelectronic devices by performing specific measurements using measuring instruments.

- **Seminar**: the seminar applications focus on the most important devices used in optoelectronics and consist of analyzing and understanding their operation.

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	• Developing the skills to apply general knowledge regarding the structure of optoelectronic devices and circuits and using them to implement optoelectronic measurement systems; • Using specific methods and tools for the design and simulation of optoelectronic devices, circuits, and systems; • Designing simple configurations of optoelectronic devices and systems; • Using simulation software environments (PSpice) for the analysis and simulation of optoelectronic circuits and systems.
Transversal (General) Competences	• Honorable, responsible, ethical behavior, in the spirit of the law to ensure the profession’s reputation; • Awareness of the need for continuous training; • Efficient use of learning resources and techniques for personal and professional development.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* • Mastery of the fundamental concepts of optoelectronics; • Mastery of knowledge about the main optoelectronic devices; • Mastery of knowledge to analyze an optoelectronic circuit; • Mastery of knowledge about the main types of optical communication systems; • Mastery of knowledge to simulate an optoelectronic circuit in a simulation program; • Mastery of knowledge for working with specialized measuring instrumentation.

Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* • Ability to analyze and simulate an optoelectronic circuit; • Ability to design the electrical schematic of an optoelectronic system; • Ability to validate the results of optoelectronic simulations in simulation programs; • Ability to perform optoelectronic measurements using specialized measuring instruments; • Ability to interpret and communicate experimental results; • Ability to prepare a laboratory report; • Ability to work productively in a team.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Ability to select and review bibliographic sources; • Ability to learn new concepts; • Ability to collaborate with other colleagues; • Ability to communicate information with other colleagues; • Developing autonomy in the learning process.

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

- **Course:** Teaching is based on using the video projector (covering the communication and demonstration function), with the lecture in the form of a PowerPoint/PDF presentation. The presentations use images and diagrams so that the information presented is easy to understand and assimilate. The oral communication methods used are the expository method and the problematizing method, used frontally. All course materials are available on the Moodle platform in electronic format.
- **Laboratory:** Teaching is based on using the video projector and the whiteboard (covering the communication and demonstration function) and on laboratory experimental setups. The oral communication method used is the problematizing method, used frontally. For the software component of the lab, each student has an individual computer. Students have access to the laboratory platform. The lab is preceded by short PowerPoint/PDF presentations to familiarize students with the theoretical concepts. For the hardware component of the lab, students will use experimental setups and laboratory instruments to perform specific measurements. Teamwork skills will be practiced to solve various learning tasks. All laboratory materials are available on the Moodle platform in electronic format.
- **Seminar**: Teaching is based on the problematizing method, used frontally. Students will solve problems and exercises specific to the topic addressed in each seminar session. The teaching materials are the problem statements to be solved, included in the problem book. All seminar materials are available on the Moodle platform in electronic format.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**

1	Introduction to optoelectronics. Spectral domain of signals in optoelectronics and photonics. Application areas of optoelectronic devices.	2
2	Elements of radiometry. Radiometry and photometry. Radiometric systems. Basic concepts in radiometry. Quantities used in radiometry and photometry.	3
3	Properties of optical beams. Optical coherence. Types of coherence. Degree of optical coherence. Optical polarization. Optical noise.	4
4	Optical emitting devices. Introduction. Light-emitting diode (LED). Characteristics, structure, and operation. Parameters. Circuits for measuring the parameters of light-emitting diodes. Laser diode. Principle of laser radiation generation. Types of laser diodes. Parameters. Circuits for measuring the parameters of laser diodes.	6
5	Optical receiving devices. Introduction. Photodiode. Structure and operation. Electrical and optical characteristics. Receiver noise. Parameters. Circuits for measuring the parameters of photodiodes. Photodiode bias circuits. Phototransistors. Characteristics, structure, and operation. Parameters. Circuits for measuring the parameters of phototransistors.	6
6	Optocouplers. Introduction. Characteristics, structure, and operation. Parameters. Circuits for measuring the parameters of optocouplers.	3
7	Introduction to free-space optical communication. Overview of optical communication systems. Classification of optical communication systems. Issues of optical communication systems. Optical communication systems in the visible spectrum. Applications of optical communication systems in the visible spectrum. System examples.	4
	Total:	28

Bibliography:

- A.-E. Marcu, Note de curs Dispozitive optoelectronice, suport de curs electronic, platforma Moodle ETTI.
- P. Șchiopu, O. Iancu, M. Vlădescu, Optoelectronică – Teorie si Aplicații, Editura Nautica, Constanța, 2016.
- P. Șchiopu, C. Schiopu, Optoelectronic Devices, Editura Printech, Bucharest, 2005.
- O. Iancu, Dispozitive optoelectronice, Editura Matrix Rom, Bucureşti, 2003.
- Dr. Irinel Casian-Botez, Structuri optoelectronice, Canova, 2001.
- S.O. Kasap, Optoelectronics and Photonics – Principles and Practices, Pearson, 2013.
- S. C. Zamfira, Optoelectronică, Editura Universității "Transilvania" Brașov, 2004.
- E. Voiculescu, T. Mariţa, Optoelectronică, Editura Albastră, Cluj-Napoca, 2001.
- T. Petruzzellis, Optoelectronics, Fiber Optics, and Laser Cookbook, McGraw-Hill, 1997.

LABORATORY

Crt. no.	Content	No. hours
1	Simulation of the behavior of optoelectronic emitting devices in the VIS and IR spectral ranges.	3
2	Simulation of LED behavior in the frequency domain and in the time domain.	3
3	Simulation of photodiode behavior in an optoelectronic circuit.	3
4	Simulation of optocoupler behavior in an optoelectronic circuit.	3
5	Photon signal generators.	3

6	Photon–electron converters.	3
7	Final laboratory colloquium.	3
	Total:	21
SEMINARY		
Crt. no.	**Content**	**No. hours**
1	Photon beam coherence.	2
2	Semiconductor lasers.	2
3	Electro-optic modulators.	2
4	Elasto-optic modulators.	2
5	Optical fibers.	2
6	Photon–electron converter devices.	2
7	Final seminar evaluation test.	2
	Total:	14

Bibliography:

- A.-E. Marcu, Platformă de laborator Dispozitive optoelectronice, suport de laborator electronic, platforma Moodle ETTI.
- A. Drăgulinescu, Note de seminar Dispozitive optoelectronice, suport de seminar electronic, platforma Moodle ETTI.
- V. Feieş, A. Drăgulinescu, Optoelectronică. Probleme, Editura Matrix ROM, Bucureşti, 2006.
- N. Codreanu, C. Ionescu, M. Pantazică, A. Marcu, Tehnici CAD de realizare a modulelor electronice: suport de curs și laborator, Editura Cavallioti, București, Editura PIM, Iași, ISBN: 978-606-551-092-0, 978-606-13-4164-1, 2017.
- P. Șchiopu, O. Iancu, M. Vlădescu, Optoelectronică – Teorie si Aplicații, Editura Nautica, Constanța, 2016.
- Karl F. Renk, Basics of Laser Physics – For Students of Science and Engineering, Springer, 2017.
- S.O. Kasap, Optoelectronics and Photonics – Principles and Practices, Pearson, 2013.
- Dr. Irinel Casian-Botez, Structuri optoelectronice, Canova, 2001.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade

11.4 Course	Knowledge of fundamental theoretical concepts; Knowledge of how to apply theory to specific problems; Knowledge of how to design and optimize different types of optoelectronic circuits.	Midterm exam with multiple-choice questions, held in weeks 7–10. The topics cover the entire material, providing a synthesis between the traversal of the theoretical concepts presented and exemplification through typical applications.	20%
	Knowledge of fundamental theoretical concepts; Knowledge of how to apply theory to specific problems; Knowledge of how to design and optimize different types of optoelectronic circuits.	Final exam with multiple-choice questions, held during the exam session. The topics cover the entire material, providing a synthesis between the traversal of the theoretical concepts presented and exemplification through typical applications.	30%
11.5 Seminary/laboratory/project	Knowledge of how to analyze and simulate optoelectronic circuits and systems to solve a given problem; Knowledge of how to process and interpret results obtained from simulation. Developing skills to apply theoretical concepts to applications and to working with various experimental setups.	Ongoing assessment of laboratory activity is done by checking the results in the reports prepared for the laboratory works, with a weight of 15%. Final assessment in the laboratory is done based on a test taken on the Moodle platform, which includes application-oriented questions from the laboratory works carried out during the semester, with a weight of 10%.	25%
	Knowledge of how to apply theory to the analysis of the operation of optoelectronic devices.	Final evaluation of seminar activity is based on a test that includes calculation problems regarding optoelectronic devices.	25%
11.6 Passing conditions			

- Participation in laboratory works.
- Obtaining at least 50% of the total laboratory score.
- Obtaining at least 50% of the total course score.

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

Optoelectronics has become a mature market with a rapid growth rate. The transition of consumers to optoelectronic applications is complete, and the industry closely follows this trend. The industry has a significant demand for qualified engineers, with specializations related to optoelectronics and with a solid foundation in electronics, telecommunications, and information technology, so that they can keep up with the development of new hardware products and software applications.

The course syllabus directly responds to these current development and evolution requirements, aligned with the European service economy in Optoelectronics. In the context of current technological progress in optoelectronic devices, the targeted fields of activity are practically unlimited, from "consumer" applications (displays for electronic equipment, remote controls, voice-data-video communications over optical fiber, large display systems, road signaling, indoor and street lighting) to applications in "hi-tech" fields such as: medical (products and technologies for diagnosis and treatment), military (products and technologies for remote detection and for free-space optical communications), security (surveillance systems and biometric identification systems), industrial automation (marking/identification and product inspection systems), robotics (optical/optoelectronic sensors), and others.

Thus, graduates are provided with skills appropriate to current qualification needs and with modern, high-quality, and competitive scientific and technical training that will allow them to be quickly employed after graduation.

Date	Course lecturer	Instructor(s) for practical activities
24.09.2025	S.l./Lect. Dr. Ing. Alina-Elena Marcu	S.l./Lect. Dr. Ing. Alina-Elena Marcu

Date of department approval	Head of department
	Prof. Dr. Claudius Dan

Date of approval in the Faculty Council	Dean
	Prof. Mihnea UDREA