Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

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)				Senzori şi traductori fotonici Photonic sensors and transducers			
2.2 Course Lecturer				Assoc. Prof. Dr. Marian Vlădescu			
2.3 Instructor for practical activities				Lect. Dr. Ionuţ-Romeo Şchiopu			
2.4 Year of studies	4	2.5 Semester	2	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	04.S.08.O.412		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3.5	Out of which: 3.2 course	2	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	49	Out of which: 3.5 course	28	3.6 seminary/laboratory	21
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.					45
Tutoring					0
Examinations					6
Other activities (if any):					0

3.7 Total hours of individual study	51.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion and/or passing of the following courses: • Physics 1 & 2 • Materials for Electronics • Electronic Devices

4.2 Results of learning	Acquiring the following knowledge: • general knowledge of optics, electromagnetism, quantum mechanics, semiconductor physics and electronic devices (in particular semiconductor p-n junctions)

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

5.1 Course	The course will take place in a room equipped with a whiteboard, video projector, and a computer connected to the Internet
5.2 Seminary/ Laboratory/Project	The laboratory will take place in the optoelectronics lab (room A210), with specific equipment. Attendance at lab sessions 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)*

The general objective of the course is to familiarize students with different types of photonic detectors and optoelectronic sensors based on optical fibers, in the context of their applicability especially within optoelectronic measurement systems.

It aims at understanding the operating principle and the performance of photonic detectors and optoelectronic sensors based on optical fibers with applications in optoelectronic measurement systems, as well as developing students' ability to correctly choose a certain type of detector or optical sensor suitable for a given application, using the information available in manufacturers' data sheets.

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	Demonstrates possession of basic knowledge in materials with applications in electronics Coherently and correctly argues and analyzes the application context of the basic knowledge in the field, using key concepts of the subject and specific methodology Oral and written communication in Romanian: uses scientific vocabulary specific to the field, for effective written and oral communication
Transversal (General) Competences	Works in a team and communicates effectively, coordinating efforts with others to solve moderately complex problem situations Autonomy and critical thinking: the ability to think scientifically, to search for and analyze data independently, as well as to extract and present conclusions / identify solutions

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 fundamental concepts related to photonic detectors and optoelectronic sensors Ability to correctly define notions specific to the field of photonic detectors Mastery of the particularities related to the use of photodetectors and optical sensors
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).* Application of basic knowledge, concepts and methods regarding photonic detectors and optoelectronic sensors for their use in applications in the field of optoelectronic measurement systems Solving specific practical applications Ability to interpret experimentally obtained results and to formulate conclusions regarding them Correct preparation of a laboratory report Efficient performance of teamwork activities
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 in carrying out didactic activities Ability to communicate information to other colleagues Developing autonomy within 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.)*

In the course, teaching is based on the use of the video projector (covering the communication and demonstrative function). Lectures are in the form of PowerPoint presentations, using 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 problematization method, used frontally. The teaching materials are the course notes and presentations, also available in electronic format.

Regarding laboratory activity, the preferred teaching method is the expository one (covering the communication and demonstrative function) together with experimental laboratory setups. Students carry out the measurements specified in the laboratory assignment, then must prepare a report with the measurement results and their interpretations, accompanied by personal comments. The teaching materials are the laboratory platforms available in printed and electronic format.

Teamwork skills will be practiced for solving different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Ch. 1 – Introduction 1.1. Role and place of transducers in measurement systems 1.2. Static characteristics of photonic transducers 1.3. Dynamic characteristics of photonic transducers	2
2	Ch. 2 – Quantum photonic detectors with external photoelectric effect 2.1. Vacuum photodiode 2.2. Photomultiplier	6
3	Ch. 3 – Quantum photonic detectors with internal photoelectric effect 3.1. Photoconductive detectors 3.2. p-n junction photodiode 3.3. Phototransistor 3.4. Avalanche photodiode	6
4	Ch. 4 – Thermal photodetectors 4.1. Bolometers 4.2. Pyroelectric detectors 4.3. Photothermistors 4.4. Photothermocouples	6
5	Ch. 5 – Optoelectronic sensors with optical fibers 5.1. Flux-modulation sensors 5.2. Phase-modulation sensors	4
6	Ch. 6 – Interferometric sensors	2
7	Ch. 7 – Optochemical sensors	2
	Total:	28

Bibliography:

. P. Şchiopu, *Senzori şi traductoare*, Editura URANIUS, Bucureşti, 2006
. W.R. McCluney, *Introduction to radiometry*, Artech House, 1994
. P. Şchiopu, *Optoelectronics* Editura MATRIX ROM, Bucureşti, 2009
. P. Şchiopu, C. Şchiopu, *Electronic Materials*, Editura AETERNITAS, Alba Iulia, 2009
. P. Şchiopu, C. Şchiopu, *Optoelectronic Devices*, Editura Printech, Bucharest, 2005
. O. Iancu, *Dispozitive optoelectronice*, Editura Matrix Rom, Bucureşti, 2003
M. Chiţă, P. Şchiopu, B. Pantelimon, C. Ilieşan, *Senzori şi traductoare. Curs*, Editura Universităţii Piteşti, 2001

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Determination of the response speed of semiconductor photodiodes	3
2	Determination of the sensitivity of TGS pyroelectric transducers	3
3	Determination of operating parameters of optical-fiber sensors for electric and magnetic fields	3
4	Determination of operating parameters of optical-fiber sensors for position and displacement	3

5	Determination of operating parameters of Mach–Zehnder interferometric pressure sensors	3
6	Effect of amplifier noise on the performance of detection systems	3
7	Final laboratory colloquium	3
	Total:	21

Bibliography:

Şchiopu, P., Grosu, N., Cristea, I., *Optoelectronică – Îndrumar de laborator*, Editura Matrix Rom, Bucureşti, 2008
M. Chiţă, P. Şchiopu, *Senzori şi traductoare. Îndrumar de laborator*, Editura Universităţii Piteşti, 1999

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 notions related to photonic detectors and optoelectronic sensors - Knowledge of how to apply theory to specific problems of design and operational analysis of these devices	Written mid-semester evaluation test	50%
11.5 Seminary/laboratory/project	- Knowledge of the characteristics and performance of the studied photonic detectors	Final laboratory colloquium, with assessment based on a test containing questions (both theoretical and applied) from the laboratory work done during the semester	30%
11.6 Passing conditions			
Obtaining 50% of the total 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)

The science of measurement plays today, increasingly, a fundamental role in the development of modern industrial activities. More and more quantities have become measurable, which highlights measurement as an indispensable stage in the cognitive process and thus as a defining factor in the progress of all sciences. For a quantity to become measurable, a sensor must be present, representing the element sensitive to the measured quantity; thus, sensors are instruments that allow obtaining information about objects or phenomena.

Photonic sensors constitute a special category of sensors, due to the diverse characteristics of electromagnetic radiation in different spectral regions. Hence, the diversity of quantities that can be measured by means of changes in reflection, transmission and absorption of electromagnetic radiation.

Industry has a significant demand for qualified electronics engineers with competencies in the field of photonic sensors and transducers. The contents of this course concretely address these current development and evolution requirements, subscribed to the European services economy in the field of Electronic Engineering and Telecommunications (ETC). Thus, future graduates of the MON specialization are provided with appropriate competencies in photonic sensors and transducers, along with a modern, high-quality and competitive scientific and technical training, enabling rapid employment after graduation and offering real professional opportunities both nationally and internationally.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Assoc. Prof. Dr. Marian Vlădescu	Lect. Dr. Ionuţ-Romeo Şchiopu

Date of department approval	Head of department
26.09.2025	Prof. Dr. Claudius Dan

Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea