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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Technologies and Telecommunications Systems

2. Date despre disciplină

2.1 Course name (ro) (en)				Medii de transmisiune Transmission Media			
2.2 Course Lecturer				S.l./Lect. Dr. Diana Brînaru			
2.3 Instructor for practical activities				S.l./Lect. Dr. Diana Brînaru			
2.4 Year of studies	4	2.5 Semester	1	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		S	2.9 Course code	04.S.07.A.221		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3	Out of which: 3.2 course	2	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42	Out of which: 3.5 course	28	3.6 seminary/laboratory	14
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.					29
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	33.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion of the following subjects: Microwaves, Mathematical Analysis, Fundamentals of Electrical Engineering, Signals and Systems
4.2 Results of learning	Application of basic concepts related to: electrical and electronic circuit theory, electrical signal processing, electromagnetic field laws, electromagnetic wave propagation in guides.

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

5.1 Course	Room equiped with blackboard/whiteboard and video projector/multimedia.
5.2 Seminary/ Laboratory/Project	Seminar room equipped with a whiteboard and video projector and the laboratory has dedicated equipment - measuring devices in the optical field for identifying interconnection elements, measuring attenuation, dispersion on optical fibers and computing units equipped with design and simulation software in the radio and optical fields.

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)*

This discipline is studied within the Telecommunications /TST specialization field and aims to familiarize students with the main approaches, models and explanatory theories of the field of propagation in optical and radio fibers, used in solving practical applications and problems, with relevance for stimulating the learning process in students. The discipline addresses the following specific topics as basic notions, concepts and principles, all of which contribute to the formation of an overview of the methodological and procedural benchmarks related to the field: analysis of optical fibers using the theory of light rays and electromagnetic propagation, transmission on optical fibers, fiber coupling at the source and photodiode, factors affecting transmission, transmission systems on optical fibers, radio propagation and factors influencing it, metallic cables and transmission on them.

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	C1. Use of fundamental elements related to devices, circuits and electronic instrumentation specific to the field C2. Documentation of measurements made with telecommunications instruments C3. Addressing specific problems of electromagnetic field propagation, mainly in air, copper cables and fiber optic cables. and of circuits and equipment for high frequencies with application in optical communications (design of a network and simulation from the perspective of choosing telecommunications circuits, characterization of propagation in transmission media, planning, measurement of parameters when propagating through optical fiber)

Transversal (General) Competences	CT1. Methodical analysis of problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks CT3. Adaptation to new technologies, professional and personal development, through continuous training using printed documentation sources, specialized software and electronic resources in Romanian and, at least, in an international language (English). CT3. Works in a team and communicates effectively, coordinating efforts with others to solve problem situations of medium complexity. CT4. Autonomy and critical thinking: the ability to think in scientific terms, to search for and analyze data independently, as well as to draw and present conclusions and identify solutions. CT5. Capacity for analysis and synthesis: presents the acquired knowledge in a synthetic manner, as a result of a process of systematic analysis. CT6. Respect the principles of academic ethics: in the documentation activity, correctly cite the bibliographic sources used.

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.* Identifies a topology and characterizes a radio link, decides on the selection of spatial or frequency diversity, highlights the phenomena of reflection, refraction, diffraction, can design radio transmission systems in a simulation environment according to laboratory projects. Can qualify an optical fiber and a fiber optic cable, highlights the phenomena of reflection, refraction, dispersion, can design an optical transmission system in a simulation environment, can measure various parameters on fiber optic transmission systems. Minimum performance standard - knowledge of important aspects related to radio propagation and circular metallic and dielectric guides. Optical fiber applications.
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).* The discipline provides students with a thorough preparation of the physical level for communications in the field of electromagnetic wave propagation in the free environment (Wireless technologies), circular (fiber optics) and mixed (HFC - hybrid coaxial-fiber) cables.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* The specific objectives provided by the discipline refer to the knowledge of the physical phenomena specific to metallic guides (magnetic media, twisted pair cable, coaxial cable) and circular dielectrics (optical fibers with a jump or graded variation of the refractive index), as well as to the main characteristics that determine the performance of optical communication systems (dispersion and attenuation). Characterization of the propagation medium in wireless communications. Demonstrates receptivity to new learning contexts. Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities by participating in team measurements within the laboratory. Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved by solving tasks (individual measurements) given at the end of the laboratory with teaching during that laboratory. Recognizes the value of his/her contribution in the field of engineering in identifying sustainable solutions to solve problems within a possible project of a future employer. Apply principles of professional ethics/deontology in analyzing the technological impact of solutions proposed in the field of specialization on the environment - examples of building a network - steps preceding installation, approvals, technical plan. Analyzes and capitalizes on business/entrepreneurial development opportunities in the field of specialization. Demonstrates management skills in real-life situations (time management, collaboration, vs. conflict).

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.)*

The teaching (definitions, demonstrations, properties) of the main theoretical notions is carried out using the classical method (at the blackboard).

To facilitate the understanding of physical phenomena, certain properties/characteristics are presented using the video projector, thus covering the function of demonstrative communication.

The oral communication methods used are the expository method and the problem-solving method.

Lectures will be used in the teaching activity, based on Power Point presentations or various videos that will be made available to students. Each course will begin with a recapitulation of the chapters already covered, with an emphasis on the notions covered in the last course.

The presentations use images and diagrams, so that the information presented is easy to understand and assimilate.

Teamwork skills will be practiced to solve various learning tasks.

Materials in electronic format are available on the subject website.

This discipline covers information and practical activities designed to support students in their efforts to learn and develop optimal collaborative and communicative relationships in a climate conducive to learning through discovery.

10. Contents

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

1	Wireless Communications Radio Transmission Propagation in Free Space Atmospheric Effect Terrain Characteristics Propagation Modes Propagation over Various Surface Types Effect of Terrain Unevenness Fresnel Ellipsoid Phenomena Occurring during Propagation: Attenuation and Diffraction Propagation Models Radio Channel in Mobile Communications Radio Channel Characterization Dispersion Effect Local and Large-Scale Fluctuations Channel Variant Character Propagation within Space Systems Calculation of Propagation Attenuation Effects on Spatial Propagation: Faraday and Doppler	10
2	Cable communications 1. Circular dielectric guide (optical fiber) Determination of axial and transverse components of the electromagnetic field Modes of propagation Threshold frequencies Phase shift constant Multimode and singlemode optical fibers Intermodal dispersion for jump and graded refractive index fibers Intramodal dispersion and total dispersion Excitation of optical fibers; numerical aperture Attenuation of optical fibers Coupling losses between light source and optical fiber 2. Metallic guide Twisted cable Coaxial cable Hybrid cables – coaxial-fiber optic (HFC)	18
	Total:	28

Bibliography:

Brînaru Diana Elena, Medii de transmisiune, suport de curs electronic. T. Petrescu, Fibre optice pentru telecomunicaţii, Ed. AGIR, Bucureşti, 2006 P.Ciotîrnae, R.D. Raicu, D. Brînaru, Sisteme digitale de comunicaţii pe fibră optică, Ed. Academiei Tehnice Militare, Bucureşti 2017 J. Senior, Optical fiber communications: principles and practice, 2009, Pearson Ed.Ltd. M. Săvescu, Radiorelee şi radiocomunicaţii spaţiale, Ed. Didactică şi Pedagogică, 1976

LABORATORY		
Crt. no.	**Content**	**No. hours**

1	Calculation of the parameters of a radio transmission system Students calculate a series of elements of a radio transmission system depending on terrain characteristics, Tx-Rx characteristics, antenna gain, total losses, different configurations for Fresnel ellipsoids, depending on the type of spatial or frequency diversity determine the optimal parameters	2
2	Designing a Wireless Transmission System Students design a radio system using professional high-frequency circuit design and analysis programs - Wireless transmission - characterization of specific parameters.	2
3	Optical fiber parameters. Analysis and measurement of losses and dispersion on optical fibers Students calculate optical fiber parameters for various situations. Interconnect optical fibers using connectors and then measure using the analysis and measurement instruments from the laboratory through various algorithms the specific parameters of the fibers and interconnection elements in the transmission chain. The measurements are documented by interpreting the experimental results obtained in relation to the fundamental concepts presented in the course and applied in the seminar and finding optimal solutions to meet the requirements of the current work. The measurements are evaluated and subjected to analysis together with other colleagues, identifying and quantifying any errors that may have occurred in the measurement process. The optical fibers are spliced.	8
4	Designing a fiber optic transmission system Using professional high-frequency circuit design and electromagnetic analysis programs, students design a fiber optic communications system and evaluate specific parameters by graphically representing the curves of interest in the software programs installed in the laboratory and interpreting the results obtained.	2
	Total:	

Bibliography:

Brînaru Diana Elena, Medii de transmisiune, Îndrumar laborator P.Ciotîrnae, R.D. Raicu, D. Brînaru, Sisteme digitale de comunicaţii pe fibră optică, Ed. Academiei Tehnice Militare, Bucureşti 2017 J. Senior, Optical fiber communications: principles and practice, 2009, Pearson Ed.Ltd.

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 - Analysis of theoretical techniques and methods	Written test – chapter 1 - Radio propagation The topics cover the entire analytical syllabus of the discipline, achieving a synthesis between the comparative theoretical examination of the course and the explanation of the application models through exercises and problems	30%
	- Knowledge of fundamental theoretical concepts - Knowledge of how to apply theory to specific problems - Analysis of techniques and methods	Written test – chapter 2 - Optical fibers and metallic cables The subjects cover the entire analytical curriculum of the discipline, achieving a synthesis between the comparative theoretical examination of the course and the explanation of the application models through exercises and problems	30%
11.5 Seminary/laboratory/project	Laboratory: - Knowledge of optical fiber parameters - Measurement of optical fiber loss and optical fiber dispersion - Design of wired/wireless communication systems	- The evaluation is carried out at the end of each laboratory and is completed by the final colloquium at the end of the laboratory. The theoretical component consists of the written and oral response of each student to individual questions; the practical component consists of measuring the parameters of interconnected optical fibers according to individual requirements and calculating the power budget.	40%
11.6 Passing conditions			
Obtaining 50% of the total score. Participation and passing the laboratory, minimum 50% of the laboratory 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)

Currently, the use of various transmission media such as optical fibers represents an important, rapidly growing market, playing an essential role both in mobile and/or satellite communication systems, and in other scientific or consumer applications. The industry has a significant demand for qualified engineers, with specializations in the fields of radio, microwaves and optical fibers and with a solid foundation in electronics, systems and information technology, so that the pace of development of new products and applications/services can be maintained. The course curriculum specifically responds to these current development and evolution requirements, subscribed to the European service economy in the field of Electronic Engineering and Telecommunications, the study program Telecommunications Technologies and Systems (TST) and Telecommunications Networks and Software (RST). In the context of the current

technological progress of RF/Microwave/Optics equipment, the targeted fields of activity are practically unlimited, such as consumer applications and goods, the medical field (imaging), the military field (integrated special communications systems, radar and radio guidance systems), the security field (surveillance systems), the extremely current field of professional communications and others.

Through the activities carried out, students develop skills to provide solutions to problems and to propose ideas to improve the situation of existence in the field of wireless propagation and through fiber optic networks.

In developing the content of the discipline, knowledge / aspects / phenomena described by the specialized literature were taken into account.

The course has a similar content to the courses carried out by MIT University in Boston, Stanford in California or TU in Warsaw - Faculty of Electronics and Information Technology or TU Munich - Faculty of Electrical Engineering and Information Technology.

This ensures that graduates of the undergraduate education cycle have skills in line with current qualification requirements, as well as modern, quality and competitive scientific and technical training, which will allow them to find employment quickly after graduation. This is in accordance with the policy of the POLITEHNICA University of Bucharest, both in terms of content and structure, and in terms of the skills and international openness offered to graduates.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	S.l./Lect. Dr. Diana Brînaru	S.l./Lect. Dr. Diana Brînaru

Date of department approval	Head of department
26.09.2025	Conf. Dr. Serban Georgica Obreja

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