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)				Tehnici si sisteme de transmisiuni multiplex Multiplex Systems and Transmission Techniques			
2.2 Course Lecturer				Conf. Dr. Alexandru Rusu, Conf. Dr. Ing. Madalina Berceanu			
2.3 Instructor for practical activities				Conf. Dr. Alexandru Rusu, Conf. Dr. Ing. Madalina Berceanu			
2.4 Year of studies	4	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		S	2.9 Course code	04.S.08.A.213		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	2.00	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	49.00	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.					41
Tutoring					4
Examinations					4
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 subjects/courses: Circuit Analysis and Synthesis, Analog and Digital Communications, Fundamental Electronic Circuits
4.2 Results of learning	General knowledge of communication and access network architectures, as well as simulation in the OPNET Modeler environment.

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 video projector and a computer.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a specifically equipped room, which must include, besides computers with the relevant software for the studied applications, specific measuring and analysis equipment for transmissions on metallic and fiber optic media, and a fiber optic section with an external outlet. Mandatory attendance for laboratory hours (in accordance with the university's internal 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 course aims to study:

- current technologies concerning digital transmissions via subscriber, coaxial, and fiber optic cables;
- methods and techniques for protecting digital signals against disturbances;
- techniques and systems for time, frequency, and wavelength multiplexing;
- network architectures and network protection methods.

Another objective is to achieve:

- understanding of the methods for measuring and testing communication equipment;
- understanding of the design elements for a transmission network on metallic or optical cable;
- analysis, through simulation with specialized software tools, of the parameters that define the quality of different types of transmission

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 basic knowledge in the field of analog and discrete signal and system theory. Correlates the knowledge assimilated in this course with that from other courses. Applies the knowledge assimilated in the course in practice. Applies methods and tools specific to the field of transmission systems for carrying out the process of evaluating a situation encountered in practice and identifies solutions. Argues and analyzes coherently and correctly the context of applying basic knowledge in the field, utilizing key concepts of the discipline and specific methodology. Oral and written communication in the Romanian language: utilizes the scientific vocabulary specific to the field for effective communication, both written and oral. Oral and written communication in a foreign language (English): demonstrates understanding of the vocabulary related to the field, in a foreign language.

Transversal (General) Competences	Works in a team and communicates effectively, coordinating efforts with others for solving problem situations of medium complexity. Autonomy and critical thinking: the ability to think in scientific terms, to independently search for and analyze data, as well as to formulate and present conclusions / identify solutions. Capacity for analysis and synthesis: presents acquired knowledge synthetically, as a result of a systematic analysis process. Respects the principles of academic ethics: correctly cites the bibliographic sources used in documentation activities. Applies elements of emotional intelligence in the adequate socio-emotional management of situations from real life, academic, or professional settings, demonstrating self-control and objectivity in decision-making or in stressful situations.

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.* Global perspective on data, voice, video, and multimedia services, based on the understanding and utilization of fundamental concepts in the field of communications and information transmission. Selecting, installing, and operating fixed or mobile telecommunications equipment and designing the provision of a location with standard telecommunications networks. The ability to adapt to new technologies and to document oneself in Romanian and, at least, in an international language, for professional and personal development through continuous training.
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).* **Selects and groups** relevant information within a given context.**Works in a team**.**Develops** a **scientific text** in the field of **signals**. **Experimentally verifies** identified solutions and **solves practical applications**.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Selects appropriate bibliographic sources and analyzes them. Respects the principles of academic ethics, correctly citing the bibliographic sources used. Demonstrates receptivity to new learning contexts. Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities

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 didactic materials used are the course notes and presentations, also available in electronic format.

Starting from the analysis of the students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition), problem-solving and conversational-interactive teaching methods, based on action-based learning models, such as exercise, practical activities and problem solving. Interactivity with students through the associated applied activities. Intervals are reserved for presentation, analysis and solving of some practical problems (reality modeling).

Lectures will be used in the teaching activity, based on Power Point presentations, which will be presented in front of the students as far as is technically possible, or/and through a videoconferencing environment such as Teams. These will be made available to students. Each course will start with a short recap of the previous lesson to ensure continuity of the concepts covered.

The presentations use, as far as possible, examples of real-life application of the concepts taught, so that the information presented is easy to understand and assimilate.

In the applied section, teaching is based on the use of the expository method (covering the communication and demonstrative function). The dialogue during the course is also extended during the application sessions. These are necessary to prepare students for homework and verification tests along the way.

Feedback will also be used, as a way of adapting the pedagogical approach to the students' learning needs.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Basic notions regarding communication systems: Transmission systems; Transmission levels; Criteria and parameters that define the quality of telephone voice transmission; Two- or four-wire transmissions. Separation of transmission directions in the case of two-wire operation	4
2	Bidirectional digital transmissions: Digital transmissions on the subscriber line; Symmetrical lines in interurban cable: twisted pair copper cables (UTP and STP); Main and secondary parameters of symmetrical subscriber lines; Ways of adapting the information content to the characteristics of the transport medium; xDSL voice, data, video transmissions via subscriber cable Bidirectional digital transmissions via coaxial cable: Constructional characteristics of coaxial cable; Main and secondary parameters of coaxial cable; Ways of adapting video streams (digital TV) to the characteristics of the transport medium. Digital transmissions via optical fiber: Constructional characteristics of optical fiber from the point of view of transport capacities; Methods of transporting data streams with high throughput over long distances; Planning a fiber optic link Line equipment performance measurement: BER measurement with the system taken out of service; BER measurement with the operating system	8

3	Time-division multiplexing transmission systems: Statistical properties of the telephone signal. MIC and MDIC. Plesiochronous digital system hierarchy; Primary multiplex structure with MIC. Frame and multiframe signaling transmission; Higher-order multiplexing; Plesiochronous digital hierarchy (PDH); Synchronous digital hierarchy (SDH). Frame structure for STM-1, STM-N. Role of the address pointer in synchronous multiplexing. Mapping of 140Mbps, 34 Mbps and 2 Mbps multiplex in VC-4.	6
4	SDH transmission networks. Equipment used. SDH network protection mechanisms	4
5	Wavelength Division Multiplexing (WDM). Equipment used. DWDM in metropolitan networks	4
6	Asynchronous Transport Technology (ATM).	2
	Total:	1

Bibliography:

cea Răducanu, Tehnici şi sisteme de transmisiuni multiplex, suport de curs electronic, https://curs.upb.ro/2021/course/view.php?id=9671
Dragoş Ciurea -Transmisiuni telefonice, Ed. Matrix Rom, Bucuresti, 2004
Dragoş Ciurea – Transmisiuni numerice multiplex pe cablu şi fibră optică, Ed. Electronica 2000, Bucureşti 2006.
T. Rădulescu - Rețele de telecomunicații, Ed.Thalia, București, 2005
V. Dobrotă - Rețele digitale de telecomunicații, vol II: B-ISDN, ATM, CCS (Common Channel Signalling), Ed. Mediarama,Cluj 1998

LABORATORY

Crt. no.	Content	No. hours
1	Modulation for voice lines	4
2	Multiplex techinques used in transmissions	4
3	Attenuation measurements in optic fibres	4
4	Configuration of an E1 transmission system	4
5	Laboratory practical test	6
	Total:	1

Bibliography:

Mircea Răducanu, Tehnici şi sisteme de transmisiuni multiplex, suport de curs electronic, https://curs.upb.ro/2021/course/view.php?id=9671
Dragoş Ciurea, Ruxandra Ţapu –*Îndrumar de Laborator* (Foi de platformă)

D. Ciurea, M. Răducanu, R.Tapu – „*Tehnici şi sisteme de transmisiuni multiplex*” – Aplicaţii, Constanţa, Editura Nautică, ISBN 978-606-6810-27-2, 2014.
Ioan Duma, Îndrumar de transmisiuni multiplex, Editura Electronica 2000, 2005.

11. Evaluation

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

11.4 Course	Cunoaşterea noţiunilor teoretice fundamentale	Course Knowledge of fundamental theoretical notions Written test during the semester	30
	Knowing how to apply theory to specific problems	Course Knowledge of fundamental theoretical notions Written test during the semester	20
	Differential analysis of theoretical techniques and methods	Course Knowledge of fundamental theoretical notions Written test during the semester	20
11.5 Seminary/laboratory/project	Knowledge of how to use measuring equipment specific to transmission systems	Final laboratory colloquium, comprising a theoretical component and a practical component	10
	Knowledge of how coding is performed on transmission lines	The theoretical component is verified by a grid test	10
	Knowing how to compare experimental results with theoretical ones.	The practical component is evaluated by checking the solution method	10
11.6 Passing conditions			
Obtaining 50% of the total score or the minimum score provided by the regulation.			

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 telecommunications have become an important factor in our modern society development. In this context the information broadcasting at important distances is one of the most important elements of any telecommunication system.

For this reason, at the present time, the industry requires qualified telecommunication engineers, with a solid background in electronics, systems and information technology that are able to keep track with the development rate of the domain.

In this way we provide the future engineers with adequate competences, very competitive scientific training and modern technologies that allow them to be quickly hired in a modern and international environment. The course is perfectly adapted to the University “Politehnica” of Bucharest policy, respecting from one side the subject content and structure and on the other side the international opening offered to students.

Date Course lecturer Instructor(s) for practical activities

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Conf. Dr. Alexandru Rusu 

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Date of department approval Head of department

Date of approval in the Faculty Council Dean