University Politehnica of Bucharest
Facultyof Electronics, Telecommunications andInformation Technology

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	University Politehnica of Bucharest
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Telecommunications
1.4 Domain of studies	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	License
1.6 Program of studies/Qualification	Technologies and Systems of Telecommunications (TSTeng)

2. Course identification information

2.1 Name of the course				Multiplex Transmission Techniques and Systems			
2.2 Lecturer				Assoc. Prof. PhD. Eng. Ruxandra Ţapu			
2.3 Instructor for practical activities				Assoc. Prof. PhD. Eng. Ruxandra Ţapu			
2.4 Year of studies	IV	2.5 Semester	8	2.6 Evaluation type	Verification	2.7 Course choice type	Mandatory

3. Total estimated time (hours per semesterfor academic activities)

3.1 Numberofhours perweek,out of which	3.5	3.2 course	2	3.3 practical activities	1.5
3.4 Total hoursin the curricula, out of which	49	3.5 course	28	3.6 practical activities	21
Distributionof time					hours
Study according to the manual, course support, bibliography and hand notes					32
Supplemental documentation (library, electronic access resources, in the field, etc)					12
Preparation for practical activities, homework, essays, portfolios, etc.					8
Tutoring					0
Examinations					3
Other activities					0

3.7 Total hoursof individual study	55
3.9 Total hours per semester	104
3. 10 Number of ECTS credit points	4

4. Prerequisites (if applicable)

4.1 curricular	- Circuits Analysis and Synthesis; - Analog and Digital Communications; - Transmission Mediums; - Basic Electronic Circuits.
4.2 competence-based	Basic knowledge of access and telecommunication networks architecture. Network simulation using OPENT modeler.

5. Requisites (if applicable)

5.1 for running the course	Not applicable
5.2 for running of theapplications	Mandatory attendance at laboratories (according to the UPB regulation for bachelor and master studies).

6. Specific competences

Professionalcompetences	Solving problems for broadband communication networks: propagation in different transmission media, high frequency circuits and equipment (microwave and optical). Selection, installation and operation of fixed and mobile telecommunication equipment and network design to ensure a common telecommunication site.
Transversal competences	-

7. Course objectives (as implied by the gridof specific competences)

7.1 General objective of the course	The course aims to study: - current technologies regarding the digital transmission over: digital subscriber line, coaxial cable and optical fiber; - coding techniques to ensure digital signal protection against interference; - techniques and systems for time multiplexing, frequency and wavelength; - networking technologies and protection mechanisms.
7.2 Specific objectives	The specific objectives aim understanding: -methods of measurement and testing of the communication equipment; - design elements of a communication network that uses metallic and optical cable; - analysis through simulation, using specialized software equipment, of the parameters that define the quality of various types of transmission.

8. Content

8.1 Lectures	Teaching techniques	Remarks
1. Basic knowledge regarding the communication systems: - Transmission systems. Levels of transmission. - Criterions and parameters that define the quality of a telephonic transmission. - Transmission through two or four wires. The separation between the transmission directions when working on two wires.	Teaching is based on using the video projector (covering both communication and demonstration function); The oral communication methods employed are: the expository (narration, description and training) and the problematical method frontal used. Learning methods based on direct action (exercise, problems and practical work). The course materials are the lectures notes and presentations, collections of problems set.	4 hours
2. Bidirectional digital transmissions 2.1. Digital transmission over the subscriber line - Interurban symmetrical cable lines: copper twisted pair cables (UTP and STP). - The primary and secondary parameters of the digital subscriber lines. - Ways to adapt information content to the transport characteristics. - xDSL systems for voice, data and video transmission over the digital subscriber line. 2.2. Bidirectional digital transmission on the coaxial cable. - Constitutive elements of the coaxial cable. - The primary and secondary parameters of the coaxial cable. - Ways to adapt information content (digital television) to the transport characteristics. 2.3. Digital transmission over optical fiber - Constitutive elements of the optical fiber in terms of transport capacity. - Methods for data streams transmission with high flow rates over long distances.		8 hours
3. Time multiplexing transmission systems: - The statistical proprieties of the telephonic signal. Pulse code modulation (PCM) and differential pulse code modulation (DPCM). The digital plesiochronous system hierarchy. - The primary PCM multiplex structure. Frame and multi-frame signaling transmission. - Higher order multiplexing. - Plesiochronous digital hierarchy (PDH) - Synchronous digital hierarchy (SDH). STM-1, STM-N frame structure. Pointer functionality in the synchronous multiplexing. Mapping the 140Mbps, 34Mbps and 2 Mbps in VC-4 multiplex.		6 hours
4. SDH transmission network. Equipment used in real networks architectures. SDH network protection mechanisms.		4 hours

5. Wave division multiplexing (WDM) transmission. Equipment used in real networks architectures. DWDM in metropolitan networks.		4 hours
6. Asynchronous transfer mode (ATM).		2 hours

Bibliography

1. Matthias Seimetz, "High-Order Modulation for Optical Fiber Transmission", Springer Science & Business Media, 24 iun. 2009 - 252 pages.
2. Enrico Forestieri, "Optical Communication Theory and Techniques", Springer Science & Business Media, 21 oct. 2004 - 216 pages.
3. Paul France, "Local Access Network Technologies", Institution of Electrical Engineers IET, 2004 - 366 pages.
4. David R. Smith, "Digital Transmission Systems", Springer Science & Business Media, 6 dec. 2012 - 808 pages.
1. Dragoş Ciurea – Transmisiuni telefonice , Ed. Matrix Rom, Bucureşti, 2004.
2. Dragoş Ciurea – Transmisiuni numerice multiplex pe cablu şi fibră optică, Ed. Electronica 2000, Bucureşti 2006.
3. T.Rădulescu : Retele de telecomunicatii, Ed.Thalia, Bucuresti, 2005
4. V. Dobrotă Retele digitale de telecomunicatii, vol II: B-ISDN, ATM, CCS (Common Channel Signalling), Ed. Mediarama,Cluj 1998.

8.2 Practical applications - Laboratory	Teaching techniques	Remarks
1. Instrumentation specific to the transmission systems: - Switching systems from two wires to four wires in low and high frequency. - Practical simulation of the noise types that can occur in a voice communication system.	Teaching is based on using the video projector (covering both communication and demonstration function); The oral communication methods employed are: the expository (narration, description and training) and the problematical method frontal used. Students simulate, implement, test and evaluate independently the same problems by continuously using the equipment specific to transmission systems and through computer simulation. The didactical materials are the laboratory platform.	6 hours
2. xDSL access networks: - Determine the signalingtransmitted over the digital subscriber lines by using the network tester and the Q931 standard.- Simulate the xDSL access networks using the OPNET modeler.		6 hours
3. The Alcatel SDH equipment configuration: - Simulation of the SDH transmission networks and their protection mechanisms using the OPNET modeler.		6 hours
4. Laboratory colloquium		3 hours

Bibliography

1. David R. Smith, "Digital Transmission Systems", Springer Science & Business Media, 6 dec. 2012 - 808 pages
2. D. Ciurea, M. Răducanu, R.Tapu – „Tehnici şi sisteme de transmisiuni multiplex" – Lucrări de seminar şi îndrumar de laborator, Constanţa, Editura Nautică, ISBN 978-606-6810-27-2, 2014.

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

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.

10. Evaluation

Typeof activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- knowledge of fundamental theoretical concepts; - knowledge of how to apply the theory to specific problems; - differential analysis of the techniques and theoretical methods.	- Three written verification tests of approximately equal weights given during the semester at specific dates fixed on the beginning of course. - Topics cover the entire field, providing a synthesis between the theoretical materials and the exercises and problems.	70%
10.5 Practical applications	- knowledge on how to use the specific equipment used in a telecommunication system; - knowledge of how the data is coded on a transmission line; - knowledge on how to compare the theoretical and experimental results.	- The final laboratory colloquium is divided in two parts: one theoretical and the other one experimental. - The theoretical part is verified based on a multiple choice test. -The practical componentis verified by evaluating the solution (implementation, testing, operation) proposed by the student to a real life	30%

		problem.	

10.6 Minimal performance standard
- Solving a real problem of simple calculation that determines the levels of voltage, current and power through a transmission line. - Demonstrate knowledge regarding the plesiochronous digital hierarchy and synchronous digital systems.

Date	Lecturer	Instructor for practical activities
11.09.2017	Assoc. Prof. PhD. Eng. Ruxandra Țapu	Assoc. Prof. PhD. Eng. Ruxandra Țapu
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Date of department approval
25.09.2017

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Director of Department,
Assoc. Prof. PhD. Eng. Eduard POPOVICI

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