Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

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	**Applied Electronics and Information Engineering**
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 digitale audio-video Digital Audio-Video Techniques			
2.2 Course Lecturer				Conf. Dr. Ioan TACHE			
2.3 Instructor for practical activities				Conf. Dr. Ioan TACHE			
2.4 Year of studies	3	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.06.A.226		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	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	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.					5
Tutoring					
Examinations					3
Other activities (if any):					

3.7 Total hours of individual study	8.00
3.8 Total hours per semester	50
3.9 Number of ECTS credit points	2

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion and/or promotion of the following disciplines: · Signals and systems · Digital integrated circuits Fundamental electronic circuits
4.2 Results of learning	Accumulation of the following knowledge: - Television Systems - Television studio equipment - Encoding/Decoding standards and techniques for bit-rate reduction for video and audio signals - Measurements methods in digital television - TV receivers for terrestrial, cable, satellite and Internet broadcasting Video and audio quality monitoring in digital television

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 computer and video projector.
5.2 Seminary/ Laboratory/Project	Mandatory attendance at laboratories (according to the undergraduate studies regulations in UPB)

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 discipline familiarizes students with digital television systems and video signal processing equipment. The elements of human visual perception and the notions of colorimetry are presented. The construction and parameters of image sensors and display devices are studied. Equipment for digital television studios is being studied. IPTV and OTT systems are being studied.

Applications familiarize students with video signals, digital television receivers and digital television studio equipment. The following are studied in particular:
The way of generating image signals, analyzing and measuring the parameters of these signals;Construction of digital receivers for terrestrial, cable and satellite television, receivers parameters measurement;Video and audio quality measurement in digital television systems.

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	The discipline familiarizes students with digital television systems and video signal processing equipment. The elements of human visual perception and the notions of colorimetry are presented. The construction and parameters of image sensors and display devices are studied. Equipment for digital television studios is being studied. IPTV and OTT systems are being studied. Applications familiarize students with video signals, digital television receivers and digital television studio equipment. The following are studied in particular: The way of generating image signals, analyzing and measuring the parameters of these signals;Construction of digital receivers for terrestrial, cable and satellite television, receivers parameters measurement;Video and audio quality measurement in digital television systems.
Transversal (General) Competences	The ability to make decisions in order to solve current or unpredictable problems that arise in the process of operating telecommunications systems. Ability to provide planning and project management in the field of electronics and telecommunications. The ability to constantly inform and document for personal and professional development by reading specialized literature. Flexibility in using new systems and technologies within a team where members achieve a well-defined goal together.

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.* • Understanding the main characteristics of the human visual system and how they are used in television systems. • Understanding the colorimetric systems in which video cameras and display devices operate in various television systems. • Knowing the parameters of television systems. • Knowledge of television studio equipment. • Knowledge of coding/decoding techniques and standards for video and audio signals compression. • Knowledge of parameter measurement methods in digital television systems. • Knowledge of TV receivers for terrestrial, cable, satellite or Internet transmission.

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).* • Analyzes analog and digital video signals. • Understands and interprets test signals and images. • Uses coding/decoding techniques and standards adapted to the parameters of the transmission channel. • Applies and understands how to use video signals in special effects and video editing/editing. • Works in the team of a television center coordinated with specialists in the artistic and economic fields. • Performs link balance analysis calculations on terrestrial, cable and satellite communication channels. • Designs reception systems and equipment for terrestrial, cable, or satellite transmission of digital television signals. • Measures transmission parameters in digital television systems, analyzes and interprets results to ensure business continuity at television service operators. • Ensures the adjustment, testing and troubleshooting of television studio and television center equipment. • Determines the quality of video and audio signals and images through measurements.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Search for suitable bibliographic sources and analyze them. • Correctly cite the bibliographic sources used. • Contributes through new solutions to the development of the specialized field. • Prepares scientific papers to present the results of his research. • Analyzes and exploits new scientific solutions for business opportunities in his field of expertise.

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.)*

Teaching is based on overhead presentation, Power Point presentations (covering communication and demonstration) and video presentations. The oral communication method is the expository method. Each course will begin with the recapitulation of the previous chapter. All course materials are available on the Moodle platform.

Presentations use images and diagrams so that the information presented is easy to understand and assimilate. During the course, students can ask questions for a quick resolution of any ambiguities.

Problems related to situations that arise in practice are used in each chapter, so that students quickly discover the scope of application of the theoretical knowledge taught.

Practical laboratory activities allow the development of skills in the use of equipment in the field of television, as well as the development of collaborative and communication relationships between student team members.

The teaching staff makes a brief presentation of the concepts that will be used in the respective paper, then guides the students in making the practical application. Students independently test and evaluate the same problems using equipment specific to each lab work. Teaching materials are available in the laboratory and on the Moodle platform

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Characteristics of visual perception. Colorimetry. Colorimetric systems.	2
2	Color television systems. Image decomposition and video signal formation. TV signal spectrum.	2
3	Digital television systems. Bit rate reduction techniques for digital video and audio signals. Systems and standards for digital video signal transmission.	4
4	Digital HDTV systems (HDTV and UHDTV). Three-dimensional television systems (3DTV).	4
5	Image sensors and image display devices. CCD and CMOS image sensors. Image display devices.	2
6	Digital television broadcasting. Terrestrial television broadcasting (DVB-T2 standard). Cable broadcasting (DVB-C/C2 standards). Satellite broadcasting (DVB-S/S2 standards).	4
7	Digital television receiver. Terrestrial and Cable TV receiver. Satellite television receiver equipment.	4
8	IPTV and OTT systems.	2
9	Television studio equipment.	2
10	Video and audio quality measurement in digital television systems	2
	Total:	28

Bibliography:

1. Tache Ioan, Televiziune, suport de curs electronic pe platforma Moodle, https://curs.upb.ro/2021/mod/folder/view.php?id=165887
2. S. Naicu, I. Tache - Receptoare moderne pentru TV în culori - Editura All Educational 1998, ISBN 973-9392-58-x
3. C. Miroiu, N. Drăgulănescu, I. Tache - Recepţia emisiunilor TV transmise prin satelit, Editura Tehnică, Bucureşti 1993, ISBN 973-31-0428-0
4. Ghid de practică TV Sigma – Practicanții de azi, profesioniștii de mâine ai televiziunilor, Universitatea Politehnica București, 2013
5. Gerard O'Driscoll - Next generation IPTV services and technologies, John Wiley & Sons, Inc. 2008, ISBN 978-0-470-16372-6
6. I. Voicu – Transmisia fluxului de date video – Editura Medro, Bucureşti, 2007, ISBN 978-973-8487-24-2
7. Handbook on digital terrestrial television broadcasting networks and systems implementation, International Telecommunication Union – Radiocommunication Sector (ITU-R) 2021 edition, https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-HDB-63-2021&media=electronic
8. ETSI EN 302 755 (2015-07), Digital Video Broadcasting DVB; Frame Structure Channel coding and modulation for a second generation digital terestrial television broadcasting system (DVB-T2), https://www.etsi.org/deliver/etsi_en/302700_302799/302755/01.04.01_60/en_302755v010401p.pdf
9. ETSI EN 302 307-1 (2014-11), Digital Video Broadcasting DVB; Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2, https://dvb.org/?standard=second-generation-framing-structure-channel-coding-and-modulation-systems-for-broadcasting-interactive-services-news-gathering-and-other-broadband-satellite-applications-part-1-dvb-s2
10. Rec. BT.500-14 (10/2019), Methodologies for subjective assesment of the quality of television images, International Telecommunication Union – Radiocommunication Sector, 2019, https://www.itu.int/rec/R-REC-BT.500-14-201910-I/en
11. Rec. BT 709-6 (06/2015), Parameter values for the HDTV standards for production and international programme exchange, International Telecommunication Union – Radiocommunication Sector, 2015, https://www.itu.int/rec/R-REC-BT.709-6-201506-I/en
12. Rec. BT.1790-0 901/2007), Requirements for monitoring of broadcasting chains during operation, International Telecommunication Union – Radiocommunication Sector, 2007, https://www.itu.int/rec/R-REC-BT.1790-0-200701-I/en
13. DVB Bluebook A176r2, DVB-MABR (Multicast Adaptive Bit Rate), 2022, https://dvb.org/?standard=adaptive-media-streaming-over-ip-multicast

LABORATORY

Crt. no.	Content	No. hours
1	Video signals in digital color systems	2
2	Digital Terrestrial Television with DVB-T2	2
3	Television studio	2
4	Video camera	2
5	Satellite digital television receiving equipment	2
6	Video and audio quality measurement in digital television systems	2
7	Final Laboratory assessment	2
	Total:	14

Bibliography:

1. Tache Ioan, Televiziune, suport de curs electronic pe platforma Moodle, https://curs.upb.ro/2021/mod/folder/view.php?id=165887
2. S. Naicu, I. Tache - Receptoare moderne pentru TV în culori - Editura All Educational 1998, ISBN 973-9392-58-x
3. C. Miroiu, N. Drăgulănescu, I. Tache - Recepţia emisiunilor TV transmise prin satelit, Editura Tehnică, Bucureşti 1993, ISBN 973-31-0428-0
4. Ghid de practică TV Sigma – Practicanții de azi, profesioniștii de mâine ai televiziunilor, Universitatea Politehnica București, 2013
5. Handbook on digital terrestrial television broadcasting networks and systems implementation, International Telecommunication Union – Radiocommunication Sector (ITU-R) 2021 edition, https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-HDB-63-2021&media=electronic
6. ETSI EN 302 755 (2015-07), Digital Video Broadcasting DVB; Frame Structure Channel coding and modulation for a second generation digital terestrial television broadcasting system (DVB-T2), https://www.etsi.org/deliver/etsi_en/302700_302799/302755/01.04.01_60/en_302755v010401p.pdf
7. ETSI EN 302 307-1 (2014-11), Digital Video Broadcasting DVB; Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2, https://dvb.org/?standard=second-generation-framing-structure-channel-coding-and-modulation-systems-for-broadcasting-interactive-services-news-gathering-and-other-broadband-satellite-applications-part-1-dvb-s2
8. Rec. BT.500-14 (10/2019), Methodologies for subjective assesment of the quality of television images, International Telecommunication Union – Radiocommunication Sector, 2019, https://www.itu.int/rec/R-REC-BT.500-14-201910-I/en
9. Rec. BT 709-6 (06/2015), Parameter values for the HDTV standards for production and international programme exchange, International Telecommunication Union – Radiocommunication Sector, 2015, https://www.itu.int/rec/R-REC-BT.709-6-201506-I/en
10. Rec. BT.1790-0 901/2007), Requirements for monitoring of broadcasting chains during operation, International Telecommunication Union – Radiocommunication Sector, 2007, https://www.itu.int/rec/R-REC-BT.1790-0-200701-I/en
11. DVB Bluebook A176r2, DVB-MABR (Multicast Adaptive Bit Rate), 2022, https://dvb.org/?standard=adaptive-media-streaming-over-ip-multicast https://www.itu.int/rec/R-REC-BT.709-6-201506-I/en

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; Specifying the video signal corresponding to some test images (and vice versa), knowing how to apply the theory to specific problems.	Written test with problems held during the semester with data scheduled at the beginning of the semester	40%
	Knowledge of the application of the theory to specific problems	Written final test Topics are problems that cover the entire content and realize a synthesis between theoretical presentation and practical problems	20%
11.5 Seminary/laboratory/project	- Knowledge of video signal generation for different television systems - Knowledge of digital television receiver parameters measurement methods Knowledge of the construction and operation of the main television equipment	The final Final Laboratory assessment consists of a practical examination. The practical component is verified by a written test with practical problems of laboratory work and by verification of solving of a practical problem (measurement of parameters of video signals or television equipment)	40%
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)

Television is an area of extremely rapid development in recent years. Widespread introduction of digital terrestrial television, digital cable and satellite television, IPTV systems, the development of high definition television HDTV, 3DTV three-dimensional television systems and systems for ultra high definition television UHDTV, led to rapid developments with regard to television receivers and studio equipment. ICs industry, the image sensors and image display devices industry, the equipment industry for television, the television studios, the terrestrial television broadcasters, the cable and satellite television broadcasters, the video surveillance industry, have an increasing demand for qualified engineers specializing in systems and digital television receivers and studio equipment.

The course syllabus specifically meet these requirements of current development of television in European and global framework in Electronics and Telecommunications Engineering. The concerned domains cover a wide spectrum: integrated circuit industry, image sensors and display devices industry, the digital television studio equipment industry, the industry of digital television receivers and digital television transmission equipment, TV studios, the digital terrestrial television broadcasters, the cable and satellite operators, the IPTV service providers, the video surveillance industry and other areas that use transmission, storing and processing of image signals.

In this way it provides graduates with the appropriate skills and current training needs and with modern technology scientific skills, quality and competitive, that will allow rapid employment after graduation, the course being perfectly framed in Bucharest Polytechnic University policy, both in terms of content and structure, and in terms of skills and international openness for students.

In the development of the content of the discipline, knowledge described by specialized literature as well as own published / presented research was taken into account.

The course has a similar content to the courses held by the university:

• Birmingham City University, United Kingdom, - Audio and Video Processing, Broadcast Technology

• University of Surrey, United Kingdom, - Video Fundamentals, Broadcast Engineering

• Universidad de Malaga, Spain, - Fundamentals of Video. Video equipment

• Polytechnic University of Valencia, Spain, - TV and video systems

Date	Course lecturer	Instructor(s) for practical activities
23.09.2024	Conf. Dr. Ioan TACHE	Conf. Dr. Ioan TACHE

Date of department approval	Head of department Conf. dr. ing. Bogdan Cristian Florea
Date of approval in the Faculty Council	Dean Prof. dr. ing. Radu Mihnea UDREA

Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și

Tehnologia Informației