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)				Inginerie audio Audio Engineering			
2.2 Course Lecturer				Prof. dr. ing. Cristian Negrescu			
2.3 Instructor for practical activities				As. drd. ing. Horia-Sebastian Ioniță			
2.4 Year of studies	3	2.5 Semester	I	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		S	2.9 Course code	04.D.05.A.022		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.					23
Tutoring					8
Examinations					2
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	Physics, Signals and systems, Digital signal processing, Fundamental electronic circuits.

4.2 Results of learning	Basic knwledge regarding: • Oscillations and mechanic systems • The theory of signals and systems • Electronic circuits • Matlab operating and programming

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

5.1 Course	Amphitheater with multimedia equipment (video projector, graphics tablet + accessories, computer) Course participation is mandatory (according to the regulation for undergraduate studies in UNSTPB)
5.2 Seminary/ Laboratory/Project	Room equipped with computers and audio equipment (sound level meter, mixing console, amplifier, loudspeakers, microphones) Minimum required software: operating system, Matlab, Adobe Audition or other similar software. Laboratory classes participation is madatory (according to the regulation for undergraduate studies in UNSTPB)

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)*

Course objectives: This subject is intended to be an introduction to audio engineering. The wide coverage area allows for an overview of an entire audio chain of high (professional) quality. In this course, a careful balance between the concepts of acoustics, electronics and signal processing allows covering the topics of interest such as room acoustics or sound capturing and recording of high resolution multichannel digital audio signals **Applications** objectives: Highlighting specific interdisciplinary issues (acoustic engineering, psychoacoustics, electrical engineering (signal processing, music) in commercial or audio studio chains. Theoretical calculations will be performed, as well as mechanical and electrical measurements, acoustic experiments and software. We use both general and dedicated software/hardware.

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** competences acquired as a result of graduation the Audio Engineering course aim at the partial fulfillment of C1, C2 and C3 and, depending on the study program, C5 or C6, as follows:**C1 (**TST/RST/ELA/MON/INF) The ability to use fundamental knowledge regarding electronic devices, circuits and instrumentation. **C2 (**TST/RST/ELA/MON/INF) The capacity to apply, in specific situations, the basic methods of electric and non-electric signal processing; implementing medium complexity procedures on signal processor. **C3 (**TST/RST/ELA/MON/INF) Understanding and ability to use the fundamental concepts regarding communications and information transmission. **Conception**, implementation and operation of data, voice, video, multimedia services (C6-TST) based on understanding and application of fundamental concepts regartding communications and information transmission (C3) **Development** of multimedia systems and human-machine intrfaces (C6-INF) based on the understanding and application of fundamental concepts regarding communications and information trasnmission (C3) **Multiple** skills as designer of medium-level complexity analogous, digital and mixed signal microsystems (C5-MON), based on understanding and ability to use the fundamental concept regarding communication and information transmission (C3) In addition, the skills acquired in this discipline are as follows: Demonstrate the possession and ability to use basic knowledge in the field of Electronics, Telecommunications and Information Technologies Demonstrate the ability to correlate previously acquired knowledge with that accumulated in the field of audio engineering Demonstrate the ability to apply basic knowledge and tools in signals and systems theory, systems, electronic circuits, acoustics, analog and digital signal processing Demonstrate the ability to correlate and apply in practice the knowledge assimilated at the course Demonstrate the ability to apply standardized methods and tools, specific to the field of signal processing, to carry out the process of evaluating a real situation, and identify solutions to some specific problems Demonstrate the ability to reason and analyze coherently and correctly the context of application of the basic knowledge of the field, using key concepts of the discipline, the tools made available by it, as well as the specific methodology presented both in the course and in the applications (seminar and laboratory). Demonstrate oral and written communication skills in English: demonstrating understanding of ETTI domain-specific scientific vocabulary in the context of audio engineering as well as the ability to communicate effectively orally and in writing

Transversal (General) Competences	Methodically analyze the problems encountered in the activity, proving the ability to identify the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks Demonstrate autonomy and critical thinking by demonstrating the ability to think in scientific terms, search and analyze data independently, identify solutions, and draw and present conclusions Demonstrate minimal teamwork skills to solve problems of medium complexity Demonstrate the capacity for analysis and synthesis: having the ability to present synthetically the knowledge acquired as a result of a systematic analysis process. Respect the principles of academic ethics in all his conduct Practices elements of emotional intelligence in appropriate social-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or 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.* **A minimal** package regarding both the phenomena and concepts involved and the basic functionalities and particularities of the elements found in a professional audio chain **A basic** language with specific terms in the field of audio engineering **Technical** elements involved in the production of audio content.
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).* **Understand**, define, describe, use the package mentioned before **Use** the aforementioned languge correctly **Is** familiar with the technical elements mentioned before **Able** to correctly evaluate and configure a low/medium complexity audio chain for recording/playback **Able** to select and group relevant information in a given context. **Able** to use specific principles with reason **Able** to perform teamwork **Able** to elaborate a scientific text in the field of audio engineering **Able** to verify/expermient/test the identified solutions, to solve practical applications, to formulate conclusions to the realized experiments **Able** to argue the identified solutions/ways of solving.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* **Select** Select appropriate bibliographic sources and analyze them. **Respect** the principles of academic ethics, correctly citing the bibliographic sources used. **Is** responsive to new learning contexts. **Collaboorate** with other colleagues and teaching staff in carrying out teaching activities **Apply** principles of professional ethics/deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment.

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 performed using an overhead projector and classical methods that covers the communication and demonstration activities.
Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery-centered learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.
In the teaching activity, lectures will be used, based on Power Point presentations or different videos that will be made available to the students. Each course will start with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course.
The course materials are: notes, Powerpoint presentations and, for the most of the chapters, written material with detailed explanations. Students have the bibliographic material at their disposal.
For reasons related to the gradual introduction of concepts, the presentation is slightly different from that of the bibliographic material and depends on how the students answer the questions and participate in the course (student engagement)
Given the fluency of the presentation and the progressive construction of the course, continuous attandance at hte classes becomes mandatory

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Overview Course objectives. General presentation of the chapters Connection between chapters Sound Introductive notions. Definitions. Sound. Sound Field Sound field parameters Sound level	3
2	2. The sound as noise. Noise measurements. Sound level meter. 2.1. The Sound level meter. Principles. Architecture 2.2. Frequency weighting. The sound level meter as a sound analyzer 2.3. Measurement of sound intensity level. The intensity probe. Two channel sound level meter. 2.4. The measuring condenser microphone. Construction. Principle of operation 2.5. The preamplifier	5

3	3. Psychoacoustic notions 3.1. Notions of anatomy and physiology of the human auditory organ 3.2. Objective and subjective in sound perception 3.3 Sound intensity and loudness. Loudness level. The phon. Equal loudness contours 3.4. Loudness level measurement for sinusoidal signals. The Sone. The Phon-Sone conversion 3.5. Critical bands. Perceptual scales. 1/3 octave bands distributions	6
4	4. The structure of the musical material 4.1. Fundamental frequency. Pitch 4.2. The representation of musical material through notes 4.3. Harmony. Consonance and dissonance of sounds. Musical intervals 4.4. Musical instruments. Classification 4.5. String instruments (Guitar, Violin). Wind instruments (flute, trumpet) 4.6. Time/frequency structure of signals generated by musical instruments	6
5	5. Sound systems 5.1. Sound systems and public address systems 5.2. Functional architecture of sound systems. 5.3. Design and configuration of sound systems 5.4. Mixing console. 5.5. Dynamic processors 5.6 Microphones for speech and instruments. The microphone selection and placement techniques 5.7. Audio equalizers 5.8. Sound effects processors 5.9. Power amplifiers 5.10. Acoustic enclosures. Features. Acoustic enclosure placement	8
	Total:	28

Bibliography:

Cristian Negrescu, Inginerie audio, electronic course support (see Moodle, the current classroom)
Cristian Negrescu, Amelia Ciobanu, Victor Popa, “Inginerie audio – Îndrumar de laborator”, Editura Politehnica Press, Bucureşti, 2013
Dumitru Stanomir, L. Tincu “Acustică aplicată Vol I – Structuri şi sisteme mecano-acustice” Casa de editură Tincu şi Stanomir, Bucureşti, 1999
Lucian Stanciu “Echipamente audio Hi-FI” Matrix ROM, Bucureşti, 1998
Cristian Negrescu “Codecuri perceptuale audio multicanal”, Editura Printech, Bucureşti, 2004

LABORATORY

Crt. no.	Content	No. hours
1	Sound measurements. Sound level meter	2
2	Audio connectors. The mixing console	2
3	Psychoacoustics	4
4	Audio editing. Multichannel audio recording	4
5	The structure of the musical material	2
	Total:	14

Bibliography:
Cristian Negrescu, Inginerie audio, electronic course support (see Moodle, the current classroom)
Cristian Negrescu, Amelia Ciobanu, Victor Popa, “Inginerie audio – Îndrumar de laborator”, Editura Politehnica Press, Bucureşti, 2013
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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 Knowing how to apply theory to specific problems Differential analysis of theoretical techniques and methods	One written test, with multiple choice answers, held during the semester	40

11.5 Seminary/laboratory/project	Laboratory Knowledge on operating the sound-level meter for measuring noise level and reverberation time (ability to choose the correct measure-ment parameters, depending on the context). Knowledge on operating a mixing console in order to configure an audio chain for recording and play-back. Knowledge of audio editing using Adobe Audition	The score given laboratory work is obtained based on assessments in each lab, regarding: The involvment of the student in tasks proposed in the lab The proven skills for sound level measurements of reverberation time The proven skills for using the mixing console presented in the laboratory, and also a mixing console at first sight The proven skills to set up an audio recording / playback chain	40
	Homework/Project Volume and quality of involvement within the assisted component Quality of implementation, quality of explanatory theoretical documentation The quality of the user documentation Presentation quality Meeting deadlines for each stage Answering direct homework/project questions	Students are assessed individually both during and at the end of the homework/project	40
11.6 Passing conditions			
The maximum score that can be obtained is 120. The maximum grade(mark) is 10 and is awarded when obtaining a score with at least 95 points, regardless of the activity from which are obtained (course/laboratory/homework-project) According to the “Regulation of bachelor's university studies” and the “Regulation on the professional activity of students”, the minimal performance standard involves the completion of all laboratory works and to obtain at least 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 curriculum course provides students an introduction to audio engineering. The wide coverage area allows for an overview of an entire audio chain of high (professional) quality. In this course, a careful balance between the concepts of acoustics, electronics and signal processing allows covering the topics of interest such as room acoustics or sound capturing and recording of high resolution multichannel digital audio signals. This provides graduates with the appropriate skills for the current qualification needs and with modern scientific and technical competitive training, enabling them quick employment after graduation, which is perfectly framed with the Polytechnic University of Bucharest policy, both in terms of content and structure and in terms of skills and international openness offered to students. The prospective employers aim both at the academic (teaching and research profile) environment and the research and development industrial environments such as organizations/companies of any sizes, from small ones created by students (e.g. start-up and spin-off) up to multinational companies

Date	Course lecturer	Instructor(s) for practical activities
	Prof. dr. ing. Cristian Negrescu	As. drd. ing. Horia-Sebastian Ioniță

Date of department approval	Head of department
	Conf. dr. ing. Șerban Obreja

Date of approval in the Faculty Council	Dean
	Prof. dr. ing. Mihnea Udrea