COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	2606005	**SEMESTER**	6
COURSE TITLE	Sound Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures	2	4
Laboratory	2	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialisation Course
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (in English)
COURSE WEBSITE (URL)	http://audio.teipir.gr/sound_systems/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The objective of this course module is to provide students with an introductory coverage of a wide scientific field including all subjects an Audio/Acoustics Engineer can deal with. The module ensures that the students will have the basic knowledge/skills to develop a professional expertise in the subject of Audio/Acoustics Engineer.
During this module, the students become familiarized with issues related to the sciences of Acoustical Physics, Applied Acoustics, Electro-acoustics, and Architectural Acoustics.

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Sound Systems that enable them to:

1. Know, understand and explain by drawing curves the notions of sound and sound waves,
2. Understand the phenomena governing the acoustics of open and closed areas and design key parameters of the acoustic behaviour of the second ones,

3. Conduct measurements of sound and noise,
4. Know and understand the principles of operation of electroacoustic devices and systems and apply them in problem solving,
5. Conduct electro-acoustic systems measurements,
6. Understand, assess and evaluate the effects of noise on humans and demonstrate correct use of noise-related Legislation.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Production of free, creative and inductive thinking

(3) COURSE CONTENT

Lectures:

1. Introduction, Subject of this Course Module, “Sound”
2. Sound as an elastic wave
3. Measurement of Sound 1: Acoustic pressure, frequency, measurable energy-related quantities.
4. Measurement of Sound 2: Levels, Decibel, Leq, Relation between pressure-intensity-power, “adding” dB, sound spectra, A,B,C, filters, types of sounds and noises.
5. Acoustics of Open Spaces 1: Sound reflection – propagation – absorption – refraction / wave vs. geometrical approach. Equiphase surfaces, directions (rays) of propagation, Huygens principle, diffraction of sound, interaction, interference and polarization of sound waves.
6. Acoustics of Open Spaces 2: Absorption of sound by materials, absorption coefficients, porous sound absorbing materials, membrane-type absorbents, Helmholtz resonator, perforated surfaces, sound diffusers.
7. Acoustics of Open Spaces 3: Sound attenuation due to absorption by the transmission medium, because of weather conditions, Doppler-Fizzeau phenomenon, emission from sources of different geometry, ground effect on transmission, sound attenuation by sound, sound barriers
8. Room Acoustics 1: Large vs. small rooms (enclosures). Small room acoustics: parallel

walls, orthogonal rooms, standing waves modes of oscillation. Large room acoustics: "good room acoustics" criteria, echo, Haas phenomenon, flutter echo, coloration, sound concentration.

9. Room Acoustics 2: Approximate statistical formulas of room acoustics, average absorption coefficient noise reduction coefficient, diffused sound intensity, mean free path, reverberation, diffuse sound field, reverberation time, calculation of reverberation in large rooms, Sabine and Norris - Eyring models.
10. Room Acoustics 3: Very large rooms, communicating rooms, non-uniform absorption, the effect of reverberation on speech, speech intelligibility measures, music, recommended reverberation times.
11. Room Acoustics 4: Propagation in large rooms, propagation over reflective surfaces - method of images, critical distance, room constant, acoustic gain of rooms, near field, far field, reverberant field, architectural acoustic design principles for large rooms.
12. Noise and Humans, Noise-Related Legislation 1: Impact of noise on hearing and other pathological effects, permissible noise limits, History of noise legislation, noise in the house, noise at work, noise dose.
13. Noise and Humans, Noise-Related Legislation 2: Noise exposure, indicators of noise and noise exposure, noise pollution, measurement units of noise and noise pollution, Greek legislation European legislation, EU Directive 2003/10/EU.

Laboratory Experiments:

Lab Project 1: Electronic Systems' Impulse Responses
Lab Project 2: Electroacoustic Systems' Impulse Responses
Lab Project 3: Measurements of Phase Characteristics and Acoustic Center of Loudspeakers
Lab Project 4: Electric Equivalents and Analogs of Loudspeakers and Loudspeaker Drivers
Lab Project 5: Distortion and Noise Measurements of Electroacoustic Systems
Lab Project 6: Room Impulse Response
Lab Project 7: Reverberation and Room Acoustic Parameters
Lab Project 8: Measurement and Analysis of Noise using Calibrated Microphone
Lab Project 9: Design and Characterization of a 2-Way Active Crossover 2 using FPAA
Lab Project 10: Audiometry, Measurement of Sounds Level Perception, Measurements based on Loudness Threshold
Lab Project 11η: Masking Effect, Measurement of Binaural Masking Level Difference
Lab Project 12: Objective Psychoacoustic Metrics.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of electronic presentation with multimedia content in class, • Student support through the course webpage and the departmental e-learning platform (moodle), • Electronic communication of instructors and students,

<table>
<tr><td></td><td>through the course webpage and by e-mail.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>Lectures, Laboratory experiments, assignments or projects and study.

<table><tr><th>Activity</th><th>Semester workload (hours)</th></tr><tr><td>Lectures</td><td>26</td></tr><tr><td>Study for lectures</td><td>26</td></tr><tr><td>Laboratory experiments</td><td>26</td></tr><tr><td>Assignments or Projects - report</td><td>26</td></tr><tr><td>Study and preparation for exams</td><td>16</td></tr><tr><td>Course Total</td><td>120</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Student evaluation is performed in the language of instruction.

Final course grade =
Lectures part grade x 60% + Laboratory part grade x 40%,

Lectures part grade results from:
Final written exam on all taught material (80%),
Projects or assignments (20%).

The exam includes:
• Multiple choice questions,
• Development questions,
• Problem solving involving sensors and measurements.

Laboratory part grade results from:
• Written test on two groups of lab experiments.
• Reports on lab experiments.
• Oral grade from lab participation.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Essential reading

1. SKARLATOS D., Applied Acoustics, Gotsis Publications ISBN-13: 978-9608771017 (in Greek).
2. BERANEK L. L., MELLOW T., Acoustics: Sound Fields and Transducers, Academic Press, 2012, ISBN-13: 978-0123914217.
3. KLEINER M., Electroacoustics, CRC Press, 2013, ISBN-13: 978-1439836187.
4. ALTON EVEREST F., POHLMANN K. C., Master Handbook of Acoustics, McGraw-Hill/TAB Electronics, 2009, ISBN-13: 978-0071603324
5. ROSSING T. D., DUNN F. (ed.): Springer Handbook of Acoustics, Springer; 2nd Edition 2014, ISBN-13: 978-1493907540.
6. Lecture Notes.
7. Laboratory Handbook (in Greek)

Recommended Books

1. OLSON H. F., MASSA F., Applied Acoustics, Literary Licensing, LLC, 2013, ISBN-13: 978-1258824280.
2. BERANEK L. L., Acoustics, Amer Inst of Physics; Rev Sub edition, 1986, ISBN-13: 978-0883184943.
3. BALLOU G., Electroacoustic Devices: Microphones and Loudspeakers, Focal Press, 2009, ISBN-13: 978-0240812670.
4. ALTEN S. R., Recording and Producing Audio for Media, Cengage Learning PTR, 2011, ISBN-13: 978-1435460652
5. FAHY F. J., Foundations of Engineering Acoustics, Academic Press, 2000, ISBN-13: 978-0122476655.
6. DAVID EGAN M., Architectural Acoustics, J. Ross Publishing Classics, 2007, ISBN-13: 978-1932159783.