

Identification	<b>Subject (code, title, credits)</b>	ETR 635, Electroacoustic and acoustic electronic devices- 6 ECTS	
	<b>Department</b>	Physics and Electronics	
	<b>Program (undergraduate, graduate)</b>	Graduate	
	<b>Term</b>	Fall, 2023	
	<b>Instructor</b>	Ph.D. Shir Khan Humbatov	
	<b>E-mail:</b>	<a href="mailto:shirxanhumbatov@gmail.com">shirxanhumbatov@gmail.com</a>	
	<b>Phone:</b>	+99477-631 32 83	
	<b>Classroom/hours</b>	11 Mehseti str. (Neftchilar campus)	
	<b>Office hours</b>	Monday: 11:50-15:10/ Thursday: 11:50-15:10	
<b>Prerequisites</b>	PHSC 111		
<b>Language</b>	English		
<b>Compulsory/Elective</b>	Compulsory		
<b>Required textbooks and course materials</b>	1. Electroacoustics by Mendel Kleiner, CRC Press Taylor & Francis Group, 2013		
<b>Course outline</b>	<p>In this course discusses the key scientific and engineering principles that are necessary to understand how these important transducers, as well as ultrasonic transducers, are designed. The compromises that are necessary in the design of practical transducers are also introduced. The course is based on the theory necessary for understanding how these transducers work, such as mechanical and acoustical analogies, conversion between analogies, transducers, radiation, and impedance. The material presented is suitable for an advanced undergraduate or graduate course on electroacoustics, technical acoustics, engineering acoustics, or communications acoustics being an outgrowth of the course on Electroacoustics.</p>		
<b>Course objectives</b>	<p>To understand the concepts of Electroacoustic and acoustic electronic devices, students should have a basic knowledge of mechanics, molecular physics and acoustic. By consolidating their knowledge of the wave mechanics and acoustics students will gain a more comfortable understanding of the subject. Thus main objective of the course is to teach engineering principles, students will find the material useful in the broad range of applications they may come across in their graduate research projects as well as later in their careers.</p>		
<b>Learning outcomes</b>	<p>Understanding topics related to microsystems and nanoelectronics. Apply the conceptual themes of nanotechnology. Understand methods for solving Electroacoustic and acoustic electronic devices problems in related fields of Engineering. As the course also includes material on the measurement and evaluation of electroacoustic transducers, it will build students' skills as a buyer, quality control engineer, and evaluator of electroacoustic transducers.</p>		
<b>Teaching methods</b>	<b>Lecture</b>		<input checked="" type="checkbox"/>
	<b>Group discussion</b>		<input checked="" type="checkbox"/>
	<b>Experiential exercise</b>		<input checked="" type="checkbox"/>
	<b>Case analysis</b>		<input checked="" type="checkbox"/>
	<b>Quiz, Classroom Exams</b>		<input checked="" type="checkbox"/>
<b>Evaluation</b>	<b>Methods</b>	<b>Date/deadlines</b>	<b>Percentage (%)</b>
	<b>Midterm Exam</b>		30
	<b>Class Participation</b>	At each lesson	5
	<b>Quizzes</b>	During the semester, 4 time	20
	<b>Activity</b>	During the semester	10
	<b>Final Exam</b>		35
	<b>Total</b>		100

<b>Policy</b>	<ul style="list-style-type: none"> <li>▪ <b>Preparation for class</b> The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions.</li> <li>▪ <b>Withdrawal (pass/fail)</b> This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.</li> <li>▪ <b>Cheating/plagiarism</b> Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.</li> <li>▪ <b>Professional behavior guidelines</b> The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.</li> <li>▪ <b>Attendance</b> Students who attend the whole classes will get 5 marks. for three absence student loses 1 mark.</li> <li>▪ <b>Activity</b> Students who will be active during discussion of past lessons and who will be solve homework problems in a seminar will be awarded with one activity mark.</li> </ul>
<b>Quizzes</b>	<ul style="list-style-type: none"> <li>▪ There will be 2 quizzes examination during the semester. The quizzes will be announced in the classroom two weeks before. Quiz is based on homework problems. The homework problems will be selected from questions and problems in the end of each chapter. The number of homework problems will be announced after finishing each chapter.</li> <li>▪ The students who able to pass midterm and first quiz with max points automatically get max 10 point for the second quiz.</li> </ul>

**Tentative Schedule**

Week	Date/Day (tentative)	Topics	Textbook
1	09.2023 09.2023	<b>Introduction to Electroacoustic Systems</b> - Recording - Reproduction - Linearity	1. Electroacoustics by Mendel Kleiner 2. Handnotes given by teacher
2	09.2023 09.2023	<b>Sound and Its Properties</b> - Sound Waves - Plane Wave Solutions to the Wave Equation - Frequency and Time Domains - Sound Intensity and Sound Power - Propagation Losses - Elementary Sound Sources - Reflection and Transmission at Boundaries - Huygens' Principle - Scattering Diffraction - Acoustic Reciprocity	1. Electroacoustics by Mendel Kleiner 3. Handnotes given by teacher
3.	10.2023 10.2023	<b>Waves in Membranes and Plates</b> - Wave Types in Infinite Media	1. Electroacoustics by Mendel Kleiner 4.

		<ul style="list-style-type: none"> <li>- Wave Types in Media of Limited Extension</li> <li>- Transverse Waves in Thin Bars and Plates</li> <li>- Audibility of Resonance Characteristics</li> <li>- Sandwich Sheets</li> <li>- Vibration in Lossy Plates</li> </ul>	2. Handnotes given by teacher
4.	10.2023 10.2023	<p style="text-align: center;"><b>Electroacoustical Analogies</b></p> <ul style="list-style-type: none"> <li>- Acoustical Circuit Elements</li> <li>- Waves in Tubes</li> <li>- Acoustic Impedance</li> <li>- Acoustic Capacitance</li> <li>- Acoustic Mass</li> <li>- Length-End Corrections</li> <li>- Acoustic Transformers</li> <li>- Acoustic Generators</li> <li>- Power Relationships</li> <li>- Filters</li> </ul>	1. Electroacoustics by Mendel Kleiner 7. 2. Handnotes given by teacher
5.	10.2023 10.2023	<p style="text-align: center;"><b>Conversion between Analogies</b></p> <ul style="list-style-type: none"> <li>- Impedance and Admittance Analogies</li> <li>- Conversion between Analogies</li> <li>- “Dot” Method</li> <li>- Transformation between Mechanical and Acoustical Circuits</li> </ul>	1. Electroacoustics by Mendel Kleiner 8. 2. Handnotes given by teacher
6.	10.2023 10.2023	<p><b>MiddermExam</b> Problem solving</p>	
7.	11.2023 11.2023	<p style="text-align: center;"><b>Transducer Operating Principles</b></p> <ul style="list-style-type: none"> <li>- Transducer Operating Blocks</li> <li>- Conversion</li> <li>- Electrodynamical Transducers</li> <li>- Electromagnetic Transducer</li> <li>- Electroresistive Transducers</li> <li>- Capacitive Transducers</li> <li>- Loudspeaker Operation</li> <li>- Piezoelectric Transducers</li> </ul>	1. Electroacoustics by Mendel Kleiner 9. 2. Handnotes given by teacher
8.	11.2023 11.2023	<p style="text-align: center;"><b>Radiation and Impedance</b></p> <ul style="list-style-type: none"> <li>- Radiation of Sound and Power Loss</li> <li>- Sound Radiation Characterization</li> <li>- Radiation Ratio</li> <li>- Radiation Impedance</li> <li>- Vibrating Plane and Sound Field Intensity</li> <li>- Power Radiated into an Infinitely Long Tube</li> <li>- Impedance Matching</li> <li>- Fundamental Sources</li> </ul>	1. Electroacoustics by Mendel Kleiner 10. 2. Handnotes given by teacher
9.	11.2023 11.2023	<p style="text-align: center;"><b>Sound Source and Acoustic Environment</b></p> <ul style="list-style-type: none"> <li>- Reflecting Surfaces and Radiation Impedance</li> <li>- Single Rigid Plane Surface</li> <li>- Multiple Surfaces</li> <li>- Power Output of Dipoles near Reflecting Surfaces</li> <li>- Room Modes</li> <li>- Mutual Impedance</li> </ul>	1. Electroacoustics by Mendel Kleiner 11. 2. Handnotes given by teacher
10.	11.2023 11.2023	<p><b>Quiz</b> Problem solving</p>	
11	12.2023 12.2023	<p style="text-align: center;"><b>Microphones and Sound Fields</b></p> <ul style="list-style-type: none"> <li>- Influence of the Microphone on the Sound Field</li> <li>- Pressure Sensing</li> <li>- Pressure-Gradient Sensing</li> <li>- Two Ways to Achieve Directivity</li> <li>- Common Microphone Directivity Patterns</li> </ul>	1. Electroacoustics by Mendel Kleiner 13. 2. Handnotes given by teacher

12.	12.2023 12.2023	<p style="text-align: center;"><b>Electrodynamic Loudspeaker Drivers</b></p> <ul style="list-style-type: none"> <li>- Moving-Coil Drivers</li> <li>- Magnet Air Gap and Voice Coil</li> <li>- Diaphragms</li> </ul>	<p>1. Electroacoustics by Mendel Kleiner 15. 2. Handnotes given by teacher</p>
13	12.2023 12.2023	<p style="text-align: center;"><b>Baffle and Box</b></p> <ul style="list-style-type: none"> <li>- Aerodynamic Short Circuit</li> <li>- Infinite Baffles</li> <li>- Finite Baffles Closed-Box Enclosures</li> <li>- Power and Efficiency</li> </ul>	<p>1. Electroacoustics by Mendel Kleiner 16. 2. Handnotes given by teacher</p>
14	12.2023 12.2023	<p style="text-align: center;"><b>Horns</b></p> <ul style="list-style-type: none"> <li>- Horn Equations</li> <li>- Exponential Horn</li> <li>- Conical Horns</li> <li>- Hyperbolic Horns</li> <li>- Comparison of Horn Characteristics</li> <li>- Tractrix Horns</li> <li>- Finite Horns</li> <li>- Horn Directivity</li> </ul>	<p>1. Electroacoustics by Mendel Kleiner 19. 2. Handnotes given by teacher</p>
15	12.2023 12.2023	<p style="text-align: center;"><b>Headphones and Earphones</b></p> <ul style="list-style-type: none"> <li>- Design Considerations</li> <li>- Acoustic Environment</li> <li>- Electrodynamic Headphones</li> <li>- Electromagnetic Headphones</li> <li>- Piezoelectric Headphones</li> <li>- Electrostatic Headphones</li> </ul>	<p>1. Electroacoustics by Mendel Kleiner 24. 2. Handnotes given by teacher</p>
		Final Exam	

*This syllabus is a guide for the course and any modifications to it will be announced in advance.*

