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| **General Information** | **Subject name, code and number of credits** | ARCH 320, Physics of Architecture, 2 KU/ 4 ECTS |
| | **Department** | Architecture and design department |
| | **Program (bachelor's degree, master's degree)** | Bachelor |
| | **Academic semester** | Spring 2026 |
| | **Instructor(s)** | Elbay Aliyev, *PhD(c) in Architecture* |
| | **E-mail:** | elbay.aliyev@khazar.org |
| | **Lecture Room/Schedule** | Neftchiler campus |
| | **Office hours** | At times agreed upon with students |
| **Prerequisites** | - | |
| **Language of instruction** | English | |
| **Type of subject (compulsory, elective)** | Compulsory | |
| **Textbooks and additional literature** | 1. **Grondzik, Walter T., & Alison G. Kwok (2019).** *Mechanical and Electrical Equipment for Buildings* **(13th ed.).** John Wiley & Sons<br>2. **Long, Marshall (2014).** *Architectural Acoustics* **(2nd ed.).** Academic Press (Elsevier)<br>3. **Ermann, Michael (2015).** *Architectural Acoustics Illustrated***.** John Wiley & Sons<br>4. **Egan, M. David (reprinted 2007).** *Architectural Acoustics***.** J. Ross Publishing<br>5. **Steffy, Gary (2008).** *Architectural Lighting Design* **(3rd ed.).** John Wiley & Sons<br>6. **Karlen, Mark, Christina Spangler, & James R. Benya (2017).** *Lighting Design Basics* **(3rd ed.).** John Wiley & Sons<br>7. **Gordon, Gary (2015).** *Interior Lighting for Designers* **(5th ed.).** John Wiley & Sons<br>8. **Livingston, Jason (2021).** *Designing with Light: The Art, Science, and Practice of Architectural Lighting Design* **(2nd ed.).** John Wiley & Sons. –<br>9. **Tregenza, Peter, & Michael Wilson (2011).** *Daylighting: Architecture and Lighting Design***.** Routledge<br>10. **National Institute of Building Sciences (2017–2025).** *Whole Building Design Guide* **(WBDG) – Acoustics and Lighting Resource Pages.** (Online at WBDG.org<br>11. **Əbdülrəhimov, R. (2015)** — *Memarlıq Fizikası*, *Pedaqoji nəşriyyat* (Azerbaijan) |
| **Course outline** | This course introduces the fundamental principles of architectural acoustics and lighting and examines their role as design-forming factors in architecture. The course focuses on sound and light as physical and perceptual elements that | |

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| | influence spatial quality, user comfort, and functional performance in buildings. Through lectures, practical exercises, calculations, and project-based work, students learn to analyze acoustic and lighting conditions, apply basic technical methods, and integrate these principles into architectural design. Particular attention is given to public spaces such as conference halls and theatre halls, where students develop and present acoustic and lighting solutions from initial analysis to final design. |
| **Course objectives** | The objectives of the discipline **Physics of Architecture** are:<br>1. to provide students with fundamental knowledge of the **physical principles of sound and light** in architectural environments;<br>2. to develop an understanding of the relationship between **acoustic and lighting conditions**, human perception, and architectural space;<br>3. to introduce basic methods of **acoustic and lighting analysis and calculation** applicable to architectural design;<br>4. to form skills in evaluating the **acoustic comfort and lighting quality** of interior and urban spaces;<br>5. to train students to apply acoustic and lighting principles in the **design of architectural spaces** of various functions;<br>6. to develop the ability to translate physical parameters into **architectural form, spatial organization, and material selection**;<br>7. to foster an integrated approach to architecture, where **technical performance and artistic expression** are considered as interconnected components of design;<br>8. to prepare students for further professional and academic work involving **environmental performance, architectural physics, and sustainable design**. |
| **Results of teaching (learning)** | As a result of mastering the discipline Physics of Architecture students are expected to achieve the following learning outcomes:<br>**Knowledge**<br>• understand the physical principles of sound and light as applied to architectural space;<br>• know the basic concepts, terminology, and parameters of architectural acoustics and architectural lighting;<br>• understand the relationship between physical performance, human perception, and architectural form;<br>• be familiar with internationally accepted approaches to acoustic and lighting design in architecture.<br>**Skills**<br>• analyze architectural spaces in terms of acoustic comfort and lighting quality;<br>• perform basic acoustic and lighting calculations relevant to architectural practice;<br>• evaluate the influence of form, materials, and spatial configuration on sound and light behavior;<br>• develop diagrammatic and graphic representations of acoustic and lighting solutions;<br>• apply theoretical knowledge to practical and project-based design tasks.<br>**Competences** |

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<tr><td></td><td colspan="3"><ul><li>integrate acoustic and lighting considerations into the architectural design process;</li><li>make informed design decisions based on physical and perceptual criteria;</li><li>communicate acoustic and lighting concepts clearly through drawings, diagrams, and presentations;</li><li>critically assess existing buildings and urban spaces from the perspective of acoustic and lighting performance;</li><li>work independently and collaboratively on analytical and design-oriented tasks.</li></ul></td></tr>
<tr><td rowspan="3">Teaching methods</td><td>Lecture</td><td colspan="2">x</td></tr>
<tr><td>Group discussions</td><td colspan="2">x</td></tr>
<tr><td>Analysis of practical issues</td><td colspan="2">x</td></tr>
<tr><td rowspan="8">Evaluation</td><td>Components</td><td>Date/Deadline</td><td>Percentage (%)</td></tr>
<tr><td>Presentation</td><td></td><td>10</td></tr>
<tr><td>Assignment</td><td></td><td>15</td></tr>
<tr><td>Activity</td><td></td><td>10</td></tr>
<tr><td>Attendance</td><td></td><td>5</td></tr>
<tr><td>Midterm exam</td><td></td><td>25</td></tr>
<tr><td>Final exam</td><td></td><td>35</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Rules<br>(Education policy and conduct)</td><td colspan="3">Student performance in this course is evaluated on a 100-point scale. Assessment is based on transparency and consistency, and for each assignment and examination the formation of points is defined in advance. Grades are awarded strictly according to the criteria outlined below.<br>Attendance (5 points) - Attendance reflects the student’s regular participation in the learning process and is evaluated with a maximum of 5 points. A student who attends all classes during the semester receives the full score. One point is deducted for every three missed classes. Attendance points are based solely on physical presence and cannot be compensated by additional assignments or activities.<br>Activity (10 points)<br>Assignment – Acoustic Design of a Conference Hall (15 points)<br>The semester assignment focuses on the acoustic design of a conference hall using acoustic materials and is evaluated with a maximum of 15 points.<br>The score is formed according to the following criteria:<br>–functional and acoustic zoning of the hall and spatial logic – 4 points,<br>–correctness and justification of selected acoustic materials – 5 points,<br>–clarity of acoustic solutions in plans and sections – 4 points,<br>–graphic quality and readability of the presentation – 2 points.<br>The assignment must be completed individually and submitted by the specified deadline.</td></tr>
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**Presentation – Acoustic Materials and Lighting (10 points)**
The presentation is evaluated with a maximum of **10 points** and assesses the student's understanding and ability to explain topics related to **acoustic materials and architectural lighting**.
Assessment is based on:
–clarity and logical structure of the presentation – **4 points**,
–correct use of terminology and concepts – **3 points**,
–ability to establish a relationship between acoustics and lighting – **3 points**.
**Mid-term Examination – Acoustic Calculation of a Theatre Hall (25 points)**
The mid-term examination consists of the **presentation of the preliminary stage of a theatre hall acoustic design**, including basic calculations, and is evaluated with a maximum of **25 points**.
Points are awarded according to the following criteria:
*– correct functional and acoustic analysis of the theatre hall – **6 points**,*
*– preliminary calculation of reverberation time and key acoustic parameters – **8 points**,*
*– integration of calculations with architectural design solutions – **6 points**,*
*– clarity of presentation and explanation – **5 points**.*
The mid-term examination evaluates the student's understanding of acoustic principles at both conceptual and technical levels.
**Final Examination – Acoustic and Lighting Design of a Theatre Hall (30 points)**
The final examination is the principal assessment stage of the course and is evaluated with a maximum of **30 points**. Students present the **final acoustic and lighting design solution** for a theatre hall.
Assessment is based on the following criteria:
*– technical accuracy and justification of acoustic solutions – **10 points**,*
*– appropriateness of the lighting concept to the spatial design – **7 points**,*
*– level of integration between acoustics and lighting – **6 points**,*
*– conceptual coherence and overall design consistency – **4 points**,*
*– quality of graphic and visual presentation – **3 points**.*

Each grade is calculated strictly as the **sum of the points assigned to the relevant criteria**. No deviations from the established point distribution are permitted, and no additional or unannounced criteria are applied during evaluation. This system is designed to ensure transparency and to prevent disputes related to grading.

**Note:** Late submissions will not be accepted unless officially excused. Important: All tasks must be scanned and submitted via the Teams assignment section one day before the exam date.
**Completion of the course:** The student's knowledge is evaluated with a maximum of 100 points. An overall success rate of 60% and above is considered to complete the course. A failed student can take this subject again in the next semester or the next year.
**Rules of conduct of the student:** A student is not allowed to violate the University's internal disciplinary rules and use a mobile phone.

**Schedule (subject to change)**

| Week | Date | Topics of the subject | Textbook/Resource |
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| 1 | | **Introduction to Architectural Acoustics.** *Sound as a physical phenomenon. Human hearing and perception. Fundamentals of architectural acoustics and noise protection.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.39–79<br>3. Michael Ermann (2015), *Architectural Acoustics Illustrated*, pp.4–17<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.15–30 |
| 2 | | **Sound Propagation in Architectural Space.** *Reflection, absorption, diffusion, and transmission of sound in enclosed spaces.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.259–312<br>3. Michael Ermann (2015), *Architectural Acoustics Illustrated*, pp.26–33<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.45–60 |
| 3 | | **Acoustic Parameters and Evaluation Criteria.** *Sound pressure level, frequency spectrum, reverberation time, intelligibility, and acoustic comfort.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.313–344<br>3. Michael Ermann (2015), *Architectural Acoustics Illustrated*, pp.58–67<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.70–90 |
| 4 | | **Acoustics of Halls of Various Purposes, Sizes, and Shapes.** *Functional acoustic requirements for speech, music, and multifunctional spaces.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.345–415<br>3. Michael Ermann (2015), *Architectural Acoustics Illustrated*, pp.132–147<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.102–118 |
| 5 | | **Architectural Form, Materials, and Acoustic Shaping.** *Influence of room geometry, surfaces, and materials on sound behavior.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.417–455, 495–559<br>3. Michael Ermann (2015), *Architectural Acoustics Illustrated*, pp.220–237<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.120–135 |
| 6 | | **Sound Insulation of Interior Environments in Buildings.** *Airborne and impact sound. Soundproofing of walls, floors, and partitions.* | 10. WBDG – Acoustic Comfort (2017), "Sound Masking" section<br>4. M. David Egan (2020), *Architectural Acoustics*, Chapter 6 (pp.285–318 in 2020 ed.)<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.140–155 |
| 7 | | **Noise Protection in the City.** *Urban noise sources, propagation, and architectural–planning protection measures.* | 2. Marshall Long (2014), *Architectural Acoustics*, pp.723–827<br>10. WBDG – Auditorium Space Type (2017), "Special Acoustical Design" section<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.160–176 |

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| 8 | | **Midterm exam** | |
| 9 | | **Introduction to Architectural Lighting.** *Light and vision. Light in architecture as a form-generating factor and "building material" of architectural images.* | 6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.9–14<br>8. Jason Livingston (2021), *Designing with Light*, Chapters 4–5 (pp.47–74) |
| 10 | | **Basic Photometric Concepts and Visual Comfort.** *Luminous flux, illuminance, luminance, glare, color temperature, and perception.* | Tregenza, Peter & Michael Wilson (2011), *Daylighting: Architecture and Lighting Design*, Chapters 1–4 (pp.3–76)<br>6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.27–34 |
| 11 | | **Skylight in Architecture. Natural Indoor Lighting.** *Daylight from the sky, window geometry, and spatial distribution of natural light.* | 6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.15–25, 35–57<br>8. Jason Livingston (2021), *Designing with Light*, Chapters 8–10 (pp.125–174)<br>11. Əbdülrəhimov, *Memarlıq Fizikası*, pp.210–226 |
| 12 | | **Sunlight in Architecture. Insolation and Sun Protection.** *Solar geometry, insolation of buildings and territories, shading systems.* | 6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.59–78<br>8. Jason Livingston (2021), *Designing with Light*, Chapter 11 (pp.175–208) |
| 13 | | **Artificial Light in Architecture.** *Artificial lighting systems and functional lighting in interior spaces.* | 6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.89–102, 111–120<br>8. Jason Livingston (2021), *Designing with Light*, Chapter 15 (pp.231–254) |
| 14 | | **Urban Lighting and Architectural Lighting Design.** *Lighting of urban spaces, façades, and public areas.* | 7. Gary Gordon (2015), *Interior Lighting for Designers*, pp.16–36<br>6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.103–109 |
| 15 | | **Color in Architecture. Architectural Color Science.** *Interaction of color and light. Psychological and spatial effects of color.* | 6. Karlen, Mark et al. (2017), *Lighting Design Basics*, pp.79–87<br>8. Jason Livingston (2021), *Designing with Light*, Chapter 14 (pp.209–229) |
| **Final Exam** | | | |