

General information	Title and code of subject, number of credits	ETR356, Generation, transmission and distribution of electricity, 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	Spring 2026	
	Lecturer	M.Sc. Muhammad Alizada	
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	Phone number:		
	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus)	
	Consultations		
Prerequisites			
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	<p>Textbooks:</p> <ol style="list-style-type: none"> Pieter Schavemaker, Lou van der Sluis. Electrical Power System Essentials, Wiley 2017. Leonard L. Grigsby. Electric Power Generation, Transmission, and Distribution. CRC Press 2012. J. Duncan Glover, Thomas J. Overbye, Mulukutla S. Sarma. Power System Analysis and Design, 6th Edition, Cengage Learning, 2017. 		
Teaching methods	Case analysis		x
	Group discussion		x
	Lecture		x
	Simulation		x
Evaluation Criteria	Components	Date/ Deadline	Percent (%)
	Practical Assignments	5 lab works during the semester	15
	Quizzes	2 quizzes during the semester	10
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		100
Course description	<p>The modern world is difficult to imagine without electricity, as it plays a vital role in both obvious and less visible aspects of everyday life. This course offers a comprehensive study of the fundamental principles, technical approaches, and recent developments in the generation, transmission, and distribution of electrical power. It explores conventional and renewable energy sources, including thermal, hydroelectric, nuclear, wind, and solar power, while emphasizing efficiency, economic feasibility, and environmental sustainability. The course examines the theoretical and practical foundations of high-voltage transmission systems, covering topics such as power flow analysis, transmission line modeling, reactive power control, and power system stability. It also addresses the integration of emerging technologies, including smart grids, energy storage systems, and distributed energy</p>		

	resources, and their impact on modern power networks. In the area of power distribution, the course focuses on distribution system structures, load forecasting, voltage regulation, and reliability evaluation. Key issues such as power quality, fault analysis, and protection schemes are discussed to ensure the reliability, resilience, and security of electrical power systems.
Course objectives	<p>This course provides Electrical and Electronic Engineering students with a solid understanding of the principles, technologies, and trends in the generation, transmission, and distribution of electrical energy. Students will study conventional (thermal, hydro, nuclear) and renewable (wind, solar) power generation, transmission system operation, and distribution network management, with attention to efficiency, reliability, and sustainability.</p> <p>By the end of the course, students will be able to:</p> <ul style="list-style-type: none"> Analyze and compare power generation methods in terms of efficiency, cost, and environmental impact. Apply theoretical knowledge to practical problems in power transmission and distribution. Understand modern challenges in power networks, including smart grids and energy storage.
Learning outcomes	<p>Upon completing this course on Electrical Engineering Fundamentals, students should be able to achieve the following learning outcomes:</p> <ul style="list-style-type: none"> • Explain the operational principles of conventional and renewable power generation technologies.. • Evaluate the role of reactive power control, voltage regulation, and grid interconnection in ensuring reliable power transmission. • Describe the structure, components, and operational characteristics of power distribution networks. • Investigate the role of smart grids, distributed generation, and energy storage in modern power networks. • Apply theoretical knowledge to real-world case studies and engineering challenges in power system management. <p>In addition, students will gain practical experience in the Electrical Power Systems Laboratory, applying theoretical concepts through hands-on experiments and exercises.</p>

Class Policy	<p>Lesson organization General information on the subject will be provided for the students during lectures. Student's knowledge on the previous topics will be evaluated and new topic will be explained by mins of visual aids during seminars. Student's knowledge level will be tested orally and in written forms before midterm and final exams. Submission of the individual works by the end of course is obligatory.</p> <p>Attendance Participation of students at all classis is important. Students should inform dean's office about missing lessons for particular reasons (illness, family issues and etc.). Students, missing more than 25% of lessons, are not allowed to take the exam.</p> <p>Quizzes Those students who have informed the teacher and the dean's office about missing the quiz in advance for particular reasons, are allowed to take the quiz next week.</p> <p>Exams All the issues related to the participation and admission to the exam are regulated by the faculty dean. Topics of midterm and final exams are provided for the students before the exams. The questions of midterm exams are not repeated in the final exam.</p> <p>Violation of the rules of the exams Disrupting the quiz and taking copy during midterm and final exams is forbidden. Quiz papers of the student who do not follow these rules are canceled and the students are expelled from the quiz by getting 0 (zero).</p> <p>The rule for completing the course In accordance with the University rules the overall success rate to complete the course should be 60% or above. The students who failed the exam would be to take this subject next semester or next year.</p> <p>Rules of conduct for Students Disruption of the lesson and not following ethical norms during the lesson, as well as conduction of the discussions by the students without permission and using mobile phones is forbidden.</p> <p>Quizzes Quizzes will be held 2 times during the semester The quizzes will be announced in the classroom two weeks before. Quiz is from homework problems. The homework problems will be selected from questions and problems in the end of each chapter. The No. of homework problems will be announced after finishing each chapter.</p> <p>Practical Assignments Will be held 5 times during the semester. Each laboratory activity carries 3 points. Tasks are assigned in accordance with the topics covered in the course.</p> <p>Attendance Students who attend the whole classes will get 5 marks. for two absence student loses 1 mark.</p>
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Tentative Schedule

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1.		<i>Introduction to Power System:</i> Power System Analysis, general characteristics of power systems, Three-Phase Systems, Structure of Power System. <i>Questions and Exercises</i>	[1], p. 25-72

2.		<i>Electric Power Generation: Nonconventional Methods:</i> Wind Power, Advanced Energy Technologies, Photovoltaics. <i>Questions and Exercises</i>	[2], p. 10-40
3.		<i>Electric Power Generation: Conventional Methods:</i> Hydroelectric Power Generation, Synchronous Machinery, Thermal Generating Plants, Distributed Utilities. <i>Questions and Exercises</i>	[2], p. 43-80
4.		<i>Transmission System:</i> Concept of Energy Transmission and Distribution, Transmission Line Structures, Insulated Power Cables Used in Underground Applications, Transmission Line Construction and Maintenance. <i>Questions and Exercises</i>	[2], p. 83-133
5.		<i>Transmission System:</i> Transmission Line Parameters, Sag and Tension of Conductor, Geomagnetic Disturbances and Impacts upon Power System Operation, Lightning Protection, Reactive Power Compensation, Environmental Impact of Transmission Lines. <i>Questions and Exercises</i>	[2], p. 146-290
6.		<i>Distribution Systems:</i> Power System Loads, Distribution System Modeling and Analysis, Power System Operation and Control, Hard to Find Information (on Distribution System Characteristics and Protection), Real-Time Control of Distributed Generation <i>Questions and Exercises</i>	[2], p. 294-409
7.		<i>Electric Power Utilization:</i> Metering of Electric Power and Energy, Basic Electric Power Utilization - Loads, Load Characterization and Load Modeling, Electric Power Utilization: Motors. <i>Questions and Exercises, Quiz 1</i>	[2], p. 414-437
8.		<i>Power Quality:</i> Wiring and Grounding for Power Quality, Harmonics in Power Systems, Voltage Sags, Voltage Fluctuations and Lamp Flicker in Power Systems, Power Quality Monitoring. <i>Questions and Exercises</i>	[2], p. 442-502
9.		<i>Symmetrical Short Circuit Analysis in Power Systems:</i> Analysis of three-phase faults, per-unit system, bus impedance matrix. <i>Questions and Exercises</i>	[3], p. 355-391
10.		Mid term exam	
11.		<i>Symmetrical Components and Unsymmetrical Short Circuits:</i> Symmetrical components theory, sequence networks, single line-to-ground, and double line-to-ground faults. <i>Questions and Exercises</i>	[3], p. 393-479
12.		<i>Reactive Power Compensation:</i> Voltage regulation, impact of reactive power on transmission lines, compensation methods (shunt capacitors). <i>Questions and Exercises</i>	[3], p. 289-305
13.		<i>Power System Stability:</i> Concepts of stability, the swing equation, and the equal area criterion. <i>Questions and Exercises, Quiz 2</i>	[3], p. 547-600
14.		<i>Power System Protection:</i> Types of relays (overcurrent, distance, differential), protective zones, circuit breakers. <i>Questions and Exercises</i>	[3], p. 482-540

15.		<i>SCADA and Energy Management Systems: Supervisory Control and Data Acquisition (SCADA) systems, automatic generation control (AGC), and voltage regulation.</i> <i>Questions and Exercises</i>	[3], p. 376-390
		<i>Final Exam</i>	

