S Y L L A B U S

General information	**Title and code of subject, number of credits**	ETR 535 Electrical power systems ECTS 8 credits	
	Department	Physics and Electronics	
	Program	Graduate	
	Academic semester	Fall 2025	
	Lecturer	PhD, Associate Prof. Elchin Hasanov	
	E-mail:	elgafgas@yahoo.com	
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	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room Office hours: Wednesday 14:00 – 15:00	
Prerequisites	ETR 234 – The prerequisites for this course are Circuits and Electronics and Electromagnetics and match Applications		
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** **1. Alternative Energy Systems & Applications by B.K.Hodge, Wiley, 2010 ISBN 978-0-470-14250-9** **2. Renewable Energy Technologies, edited by J.C.Sabonnadiere, Wiley, 2009,ISBN 978-1-84821-135-3** **3. Sustainable Energy Systems and Applications, Springer, 2011, 978-0-387-95860-6**		
Teaching methods	**Lecture**		x
	Group discussions at seminars		x
Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Quizzes	During the semester	5
	Active participation	At each lesson	5
	Individual research papers and presentations	At the end of the semester	15
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**
Course description	This course is an introductory subject in the field of electric power systems and electrical to mechanical energy conversion. Electric power has become increasingly important as a way of transmitting and transforming energy in industrial, military and transportation uses. Examples of new uses for electric power include all manners of electric transportation systems (electric trains that run under catenary, diesel-electric railroad locomotion, 'maglev' medium and high speed tracked vehicles, electric transmission systems for ships and diesel-electric locomotives, replacement of hydraulics in high performance actuators, aircraft launch and recovery systems, battery powered factory material transport systems, electric and hybrid electric cars and buses, even the 'more electric' airplane).		
Course objectives	Electric power systems are also at the heart of alternative energy systems, including wind and solar electric, geothermal and small scale hydroelectric generation. The course material includes: fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus modeling of magnetic field devices and description of their behavior using appropriate models simplification of problems using transformation techniques analysis of power electric circuits, magnetic circuits, and elements of linear and rotating electric machinery use of lumped parameter electromechanics to understand power systems models of synchronous, induction, and DC machinery the interconnection of electric power apparatus and operation of power systems The material in this subject will be useful to students who pursue careers or research in electric power systems, power electronic systems, vehicle electrical systems (e.g. electric or hybrid vehicles), development or use of electric motors and generators, robots and "mechatronics".		
Rules (Educational	**Lesson organization** General information on the subject will be provided for the students during lectures.		

policy and behavior)	Student's knowledge on the previous topics will be evaluated and new topic will be explained by means 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. **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. **Lates** Those students who are late for lessons for more than 15 minutes are not allowed to participate at the lesson. Despite this, the student is allowed to take part in the second part of the lesson. **Tests** Those students who have informed the teacher and the dean's office about missing the test in advance for particular reasons, are allowed to take the test next week. **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 exam are not repeated in the final exam. Violation of the rules of the exams Disrupting the test and taking copy during midterm and final exams is forbidden. Test papers of the student who do not follow these rules are canceled and the students are expelled from the test by getting 0 (zero). **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. 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.
Learning outcomes	Advanced Undergraduate Subject in the area of Optics, Electromagnetics and Energy. Each student will complete problem sets and some quizzes. Is a graduate course, and carries H-level graduate credit. It will meet with and will incorporate two additional elements: - Each student taking 6.690 will have additional problems on the problem sets. These problems can be expected to require more initiative, in-depth analysis. - Each student taking thus course will be asked to formulate and carry out an in-depth project in an area related to the subject. Past students have done projects on distributed generation, special purpose power systems and rebuilding the some sountres electric power grid. Upon successful completion of the course, students should be able to understand: Limitations of fossil fuels and Problems related to fossil fuel based power plants The principles and technology of different types of energy sources and architectures of generating electric power. Energy systems based on solar, wind , and fuel cell based systems

Policy	▪ **Preparation for class** The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major pointsintroduced in the text. Reading the assigned chapters and having some familiaritywith them before class will greatly assist your understanding of the lecture. Afterthe lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions. ▪ **Withdrawal (pass/fail)** 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 least60% to pass. In case of failure, he/she will be required to repeat the course thefollowing term or year. ▪ **Cheating/plagiarism** 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. ▪ **Professional behavior guidelines** The students shall behave in the way to create favorable academic and professionalenvironment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. **Attendance** Students who attend the whole classes will get 5 marks. for three absence student loses 1 mark. ▪ **Activity** 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. ▪ **Quizzes** There will be 3 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.

This program reflects the comprehensive information about the subject and information about any changes will be provided in advance.

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1	***20.09.25***	Basics: Alternating Current Theory, Inductance in AC circuits, Capacitance in AC Circuits, Resonance, Transformers, Polyphase AC	[1] p. 7-27 [2]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.2-2
2	***27.09.25***	Fundamentals: Phasors, instantaneous power, real and reactive power, apparent power, and complex power in single-phase and three-phase circuits; symmetrical components, sequence networks; load characteristics, voltage, and load dependency.	[1] p.27-69 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysi s the lecture material in details. Solving problems.	[1] p.
3	***04.10.25***	Modeling of Power System Components: the three-phase synchronous generator – terminal voltage, power and torque relationships, real and reactive power control, modeling; the power transformer – equivalent circuits, per unit system, three-phase transformer connections and phase shift, per unit sequence models of three-phase and two-winding transformers, autotransformers, and transformers as a control device; the power transmission line – line resistance and conductance, line inductance, line capacitance, medium and short line	[1] p.69-95 [3]

		approximations, equivalent π circuit, maximum power flow, reactive compensation techniques.	
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
4	***11.10.25***	Power Flow Analysis and Control: The power flow problem, power flow solution by GaussSeidel and Newton-Raphson methods; computational aspects of large-scale systems, sparsity techniques,	[1] p. 151-205 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[3]
5	***18.10.25***	Fault Analysis: Symmetrical faults, three-phase short circuits, circuit breakers, and fuse selection. Unsymmetrical faults, single line-to-ground, line-to-line, double line-to-ground faults, sequence bus impedance matrices	[1] p.231-266 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
6	***25.10.25***	Power System Controls: Generator-voltage control, turbine-governor control, load-frequency control; economic dispatch	[1] p.283-320 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems. Rectangular-to-Polar Graphical solution.N-element linear array:Uniform spacing.Nonuniform amplitude .Superconductivity. Planar array.Design considerations.Circular array.	[1] p.322-365
7	***01.11.25***	Power System Stability: Transient stability, the swing equation, equal-area criterion, numerical integration of the swing equation; multimachine stability.	[1] p.385-419 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
8	***08.11.25***	Introduction to microgrids: Classification, architecture, and control; intelligent microgrids and integration of renewable energy systems.	[1] p.433-478 [2]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
9	***15.11.25***	***Mid term exam***	
10	***23.11.25***	Protection, load flow Forces in electromagnetic systems: energy flow **I**nduction motor control: volts/Hz and field oriented control	[1] p.497-556 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
11	***30.11.25***	Faraday's law again: DC and PM machines Switching power electronic circuits	[1] p.611-641 [3]

		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
12	***07.12.25***	Multiply excited systems, synchronous machines PowerWorld simulator; control of power flow.	[1] p.653-701
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	
13	***14.12.25***	Two axis theory: generators Windings, wound rotor machines	[1] p.739-799
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
14	***21.12.25***	Single phase power Three phase power Transformers.	[1] p.811-865
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
15	***28.12.25***	Single Phase Induction Motors Synchronous Machines Alternator Synchronization DC Machines/Special Machines	[1] p.883-958
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
		Final Exam