

General information	Title and code of subject, number of credits	ETR468, Electrical drives, 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	Spring 2026	
	Lecturer	M.Sc. Muhammad Alizada	
	E-mail:	malizada@khazar.org	
	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"> 1. Electric Drives: An Integrative Approach by Ned Mohan, Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, Minnesota, USA 2003 2. Electrical Drives: Principles, Planning, Applications, Solutions by Jens Weidauer and Richard Messer, 2nd Edition, 2024. 3. Electric Machinery Fundamentals by Stephen J. Chapman, 5th Edition, 2012. 		
Teaching methods	Case analysis		x
	Group discussion		x
	Lecture		x
	Simulation		x
Evaluation Criteria	Components	Date/ Deadline	Percent (%)
	Practical Assignments	5 lab work 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>This course introduces students to the principles and concepts of electrical drives. It covers fundamental topics related to electric motors, power electronic converters, control techniques, and drive system components used in industrial and modern applications. Throughout the course, students will study the operating principles, characteristics, and performance of various electrical machines and electrical drive systems. Furthermore, students will be introduced to the analysis and simulation of electrical drive systems using appropriate software tools, enabling them to model, analyze, and evaluate motor control and drive performance. The course emphasizes practical applications, hands-on understanding, and problem-solving techniques</p>		

	relevant to electrical drives and industrial automation systems.
Course objectives	<p>The objective of the Electrical Drives course is to provide undergraduate students in Electrical and Electronics Engineering with theoretical knowledge and practical understanding of electrical drive systems and their applications. The course aims to develop students' ability to analyze, model, and control electrical drives using appropriate analytical methods and simulation tools. This course primarily focuses on the principles and applications of electrical drives. It is organized into the following main sections. The first section introduces the fundamental concepts of electrical drives, including power electronic converters and drive system components. The second section covers the operating principles, characteristics, and control methods of DC motors and induction motors. The third section focuses on the analysis and control of synchronous motors and special-purpose motors used in industrial applications. The final section introduces advanced drive control techniques, performance evaluation, and practical considerations in electrical drive systems. Additionally, students will gain hands-on practical experience related to electrical drives in the Electrical Power Systems Laboratory, where they will perform experiments and applications on electric drive systems.</p>
Learning outcomes	<p>Upon completing this course on Electrical Drives, students should be able to achieve the following learning outcomes:</p> <ul style="list-style-type: none"> • Understand the fundamental principles and structure of electric drive systems, including mechanical load requirements and drive components. • Analyze mechanical and electrical system requirements for the selection and design of appropriate electric drives. • Apply knowledge of electric circuits and magnetic circuits in the analysis of electrical drive systems. • Explain the principles of electromechanical energy conversion and their role in electric drive operation. • Understand the operation and applications of switch-mode power electronic converters used in electrical drives • Analyze the operating principles and performance characteristics of DC motors and electronically commutated motor (ECM) drives. • Design and analyze feedback control systems for electric drives. • Understand the principles of AC machines, including space vector concepts and their application in drive systems. • Analyze the steady-state performance of induction machines. • Understand and evaluate adjustable-speed induction motor drive systems. • Use simulation and laboratory tools to analyze, test, and troubleshoot electrical drive systems. • Apply electrical drive principles to practical engineering applications, considering system performance, reliability, and safety.

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 classes 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 students loses 1 mark.</p>
---------------------	---

Tentative Schedule

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1.		<i>Introduction to Electric Drive Systems and Mechanical Requirements: Definition and classification of electric drives, Components of electric drive systems, Load characteristics and torque–speed relationships, Matching motors to mechanical system requirements.</i>	[1], p. 19-61 [2], p. 13–22

		<i>Questions and Exercises</i>	
2.		<i>Review of Electric Circuits:</i> Basic circuit laws and analysis techniques, AC and DC circuit concepts related to drives. <i>Questions and Exercises</i>	[1], p. 65-82 [3], p. 624–650
3.		<i>Switch-Mode Power Electronics:</i> Power semiconductor devices, Basic converter topologies, Role of power electronics in electric drives. <i>Questions and Exercises</i>	[1], p. 85-115 [2], p. 65-114
4.		<i>Magnetic Circuits:</i> Magnetic materials and properties, Magnetic flux, MMF, and reluctance, Magnetic circuits in electrical machines. <i>Questions and Exercises</i>	[1], p. 117-149 [3], p. 1–35
5.		<i>Electro-Mechanical Energy Conversion:</i> Principles of energy conversion, Force and torque production, Energy flow in electromechanical systems. <i>Questions and Exercises</i>	[1], p. 151-169
6.		<i>DC Motor and ECM Drives:</i> DC motor types and characteristics, electronically commutated motors (ECM), Control and applications of DC drives. <i>Questions and Exercises</i>	[1], p. 171-198 [2], p. 151-158
7.		<i>Feedback Controller Design:</i> Open-loop and closed-loop control systems, Speed and torque control, Basic controller design concepts. <i>Questions and Exercises, Quiz 1</i>	[1], p. 203-222
8.		<i>AC Machines and Space Vector Concepts:</i> Introduction to AC machines, Space vector representation, Applications in drive control <i>Questions and Exercises</i>	[1], p. 225-259
9.		<i>Sinusoidal PMAC Drives and Synchronous Machines:</i> Permanent magnet AC machines, Operating principles of synchronous machines, Control of PMAC drives. <i>Questions and Exercises</i>	[1], p. 263-288
10.		Mid term exam	
11.		<i>Induction Machines: Steady-State Analysis:</i> Construction and principle of operation, Equivalent circuit and performance analysis, Torque–speed characteristics <i>Questions and Exercises</i>	[1], p. 291-334 [2], p. 169-204
12.		<i>Adjustable-Speed Induction Motor Drives:</i> Speed control methods, Voltage and frequency control, Applications of adjustable-speed drives. <i>Questions and Exercises</i>	[1], p. 337-359 [2], p. 385-412
13.		<i>Vector Control of Induction Motor Drives:</i> Concept of field-oriented control, Implementation of vector control, Performance advantages <i>Questions and Exercises</i>	[1], p. 365-380 [2], p. 342-358

14.		<i>Reluctance Drives:</i> Types of reluctance motors, Operating principles and control, Industrial applications. <i>Questions and Exercises, Quiz 2</i>	[1], p. 385-398 [2], p. 205-236
15.		<i>Energy Efficiency and Economics of Electrical Drives:</i> Efficiency improvement techniques, Energy-saving considerations, Economic analysis of drive systems <i>Questions and Exercises</i>	[1], p. 401-460 [2], p. 237-248
		<i>Final Exam</i>	

