

Identification	Subject	PHSC112 Physics -2, 6 ECTS credits
	Department	Physics and Electronics
	Program (Undergraduate, Graduate)	Undergraduate
	Term	Fall 2026
	Instructor	Ph.D. Shirkhan Humbatov
	Email:	shirkhan.humbatov@khazar.org shirxanhumbatov@gmail.com
	Classroom/hours	408 Elshan Mehdiyev str. (Bakikhanov campus), Thursday - Saturday 08:30–15:35
Prerequisites	PHSC 111 (Physics I)	
Language	English	
Compulsory/Elective	Compulsory	
Textbooks and course materials	Required textbook: [1] Young, H. D., Freedman, R. A., & Ford, A. L. University Physics with Modern Physics, 14th ed., Pearson, 2016. Course materials: [2] Instructor lecture notes, handouts, worked examples, and assigned problem sets. Supplementary learning resources: MIT OpenCourseWare – Physics II: Electricity and Magnetism; OpenStax University Physics, Volume 2; PhET Interactive Simulations.	
Course description	Physics II provides a mathematically grounded introduction to classical electromagnetism and optics. The course develops electrostatics through electric charge, Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, and dielectric media. Steady-current phenomena are studied through current, resistance, electromotive force, electrical power, and direct-current circuits using Kirchhoff's rules. Magnetism is introduced through magnetic forces, magnetic flux, the motion of charged particles, and magnetic fields generated by currents. Time-dependent electromagnetic phenomena include Faraday's law, Lenz's law, inductance, transient circuits, alternating current, and Maxwell's equations. The course then examines electromagnetic-wave generation and propagation, followed by geometrical and wave optics, including reflection, refraction, polarization, interference, and diffraction. Throughout the course, conceptual reasoning is integrated with quantitative problem solving, vector analysis, graphical interpretation, and physically meaningful applications.	
Course objectives	The main objective of this course is to establish a rigorous conceptual and quantitative foundation in electromagnetism and optics. The course aims to: • Develop a clear understanding of electric charge, electric fields, electric flux, electric potential, capacitance, and dielectric behavior. • Enable students to apply Coulomb's law, Gauss's law, the Biot–Savart law, Ampère's law, Faraday's law, and Lenz's law to physical systems. • Develop proficiency in analyzing direct-current and alternating-current circuits, including resistance, capacitance, inductance, impedance, resonance, and power. • Establish Maxwell's equations as the unified framework of classical electromagnetism and relate them to electromagnetic-wave propagation.	

	• Develop a scientifically grounded understanding of reflection, refraction, total internal reflection, polarization, image formation, interference, and diffraction. • Strengthen mathematical modeling, vector reasoning, dimensional analysis, and systematic problem-solving skills. • Connect theoretical models with experimental observations and applications in electronics, optics, photonics, and engineering. • Provide the theoretical foundation required for more advanced study in physics and engineering.		
Learning Outcomes	By the end of the course, students will be able to: • Analyze electrostatic interactions using Coulomb's law, superposition, electric-field concepts, electric flux, and Gauss's law. • Determine electric potential and electrostatic energy and relate potential to electric field, equipotential surfaces, capacitance, and dielectric polarization. • Analyze DC circuits by applying Ohm's law, equivalent-resistance relations, Kirchhoff's rules, electrical power, and R–C transient equations. • Evaluate the motion of charged particles and forces on current-carrying conductors in magnetic fields using appropriate vector relationships. • Calculate magnetic fields produced by moving charges and currents using the Biot–Savart law and Ampère's law. • Analyze electromagnetic induction, motional emf, self- and mutual inductance, and R–L, L–C, and R–L–C circuit behavior. • Solve alternating-current circuit problems using reactance, impedance, phase relationships, resonance, and average power. • Interpret Maxwell's equations and apply electromagnetic-wave concepts to propagation, energy transport, momentum transfer, and polarization. • Analyze geometrical-optics systems using reflection, refraction, thin-lens, and spherical-surface relations. • Quantitatively interpret interference and diffraction phenomena, including two-source interference, thin films, interferometry, single-slit diffraction, and diffraction gratings.		
Teaching methods	Lecture		☒
	Seminar / problem solving		☒
	Group discussion		x
	Simulation		x
Evaluation Criteria	Methods	Date/deadlines	Percentage (%)
	Midterm Exam	TBC	30
	Quizzes	Four quizzes during the semester	20
	Practical Assignments	-	0
	Activity	During the semester	10
	Attendance	At each lesson	5
	Final Exam	TBC	35
	Total		100
Class Policy	Preparation for class Physics II requires consistent independent study and regular quantitative problem-solving practice. Students are expected to review assigned textbook sections and lecture materials before class. After each session, students should consolidate their notes, revisit important derivations, and solve assigned		

problems. Particular attention should be given to identifying the relevant physical law, constructing appropriate diagrams, applying vector and mathematical methods correctly, using SI units consistently, and interpreting the physical meaning of the result.

Passing requirement (pass/fail)

The course follows the grading regulations of the School of Science and Engineering. Undergraduate students must achieve an overall course result of at least 60% to pass. A failing result is handled in accordance with applicable University regulations governing course repetition or reassessment.

Cheating/plagiarism

Academic dishonesty, including cheating, plagiarism, unauthorized collaboration, copying another student's work, or using unauthorized materials or devices during an assessment, is prohibited. A confirmed violation in a quiz, midterm examination, final examination, or other assessed work will be handled according to University academic-integrity rules and may result in a score of zero (0) for the affected assessment.

Generative AI Policy

Generative AI tools may be used as learning aids for concept clarification, study organization, practice-question generation, and formative feedback. They may not be used to generate or complete answers for quizzes, examinations, or other assessed work unless explicitly authorized by the instructor. Students are responsible for checking the scientific accuracy, equations, calculations, units, assumptions, and references produced by AI tools. Permitted AI use in assessed work must be appropriately acknowledged.

Professional behavior guidelines

Students are expected to maintain a respectful, constructive, and academically focused environment. They should arrive on time, be prepared for class, participate appropriately, and follow the instructor's directions. Unauthorized conversations, disruptive conduct, unethical behavior, and inappropriate use of electronic devices are not permitted during instructional activities.

Attendance

Students who maintain full attendance throughout the semester will receive 5 attendance marks. For every three recorded absences, 1 attendance mark will be deducted, subject to University attendance regulations. Students remain responsible for material, announcements, and assignments missed during an absence.

Quizzes

Four quizzes will be administered during the semester. Quiz dates will normally be announced in class approximately two weeks in advance. Quizzes will assess both conceptual understanding and quantitative problem-solving skills and will be based primarily on lecture content, assigned readings, and homework problems selected from the relevant textbook chapters.

Activity

Up to 10 activity marks may be earned through meaningful academic participation during the semester. Credit may be awarded for explaining physical concepts, contributing to review discussions, solving seminar problems, presenting logically structured solutions, interpreting graphs or diagrams, and demonstrating the reasoning behind an answer rather than merely stating a numerical result.

Tentative Schedule			
Week	Date/Day (tentative)	Topics	Textbook/Assignments
1.	19.09.26	ELECTRIC CHARGE AND ELECTRIC FIELD Electric charge; conductors, insulators, and induced charges; Coulomb's law; electric field and electric forces; electric-field calculations; electric field lines; electric dipoles. Problem solving	[1] Ch. 21, pp. 683–712 [2] Instructor handnotes
2.	26.09.26	GAUSS'S LAW Charge and electric flux; calculating electric flux; Gauss's law; applications of Gauss's law; charges on conductors. Problem solving	[1] Ch. 22, pp. 722–744 [2] Instructor handnotes
3.	03.10.26	ELECTRIC POTENTIAL; CAPACITANCE AND DIELECTRICS Electric potential energy; electric potential; calculating electric potential; equipotential surfaces; potential gradient; capacitors and capacitance; series and parallel capacitors; energy storage; dielectrics; induced charge; Gauss's law in dielectrics. Problem solving	[1] Ch. 23, pp. 752–776; Ch. 24, pp. 785–808 [2] Instructor handnotes
4.	10.10.26	CURRENT, RESISTANCE, AND ELECTROMOTIVE FORCE Current; resistivity; resistance; electromotive force and circuits; energy and power in electric circuits; theory of metallic conduction. Problem solving	[1] Ch. 25, pp. 816–840 [2] Instructor handnotes
5.	17.10.26	DIRECT-CURRENT CIRCUITS Resistors in series and parallel; Kirchhoff's rules; electrical measuring instruments; R–C circuits; power distribution systems. Problem solving	[1] Ch. 26, pp. 848–872 [2] Instructor handnotes
6.	24.10.26	MAGNETIC FIELD AND MAGNETIC FORCES Magnetism; magnetic field; magnetic field lines and magnetic flux; motion of charged particles in a magnetic field; magnetic force on a current-carrying conductor; force and torque on a current loop; Hall effect. Problem solving	[1] Ch. 27, pp. 881–911 [2] Instructor handnotes
7.	31.10.26	SOURCES OF MAGNETIC FIELD Magnetic field of a moving charge and a current element; straight current-carrying conductor; force between parallel conductors; circular current loop; Ampère's law and applications; magnetic materials. Problem solving	[1] Ch. 28, pp. 921–947 [2] Instructor handnotes
	TBC	MIDTERM EXAM Midterm examination and review/problem-solving activities as announced by the instructor.	

8.	07.11.26	ELECTROMAGNETIC INDUCTION Induction experiments; Faraday's law; Lenz's law; motional emf; induced electric fields; eddy currents; displacement current and Maxwell's equations; Problem solving	[1] Ch. 29, pp. 955–980; [2] Instructor handnotes
9.	14.11.26	INDUCTANCE Mutual and self-inductance; magnetic-field energy; R–L, L–C, and L–R–C circuits. Problem solving	[1] Ch. 30, pp. 990–1012 [2] Instructor handnotes
10.	21.11.26	ALTERNATING CURRENT Phasors and alternating currents; resistance and reactance; L–R–C series circuit; power in AC circuits; resonance; transformers. Problem solving	[1] Ch. 31, pp. 1020–1043 [2] Instructor handnotes
11.	28.11.26	ELECTROMAGNETIC WAVES Maxwell's equations and electromagnetic waves; plane electromagnetic waves and the speed of light. Problem solving	[1] Ch. 32, §§32.1–32.2, pp. 1050–1058 [2] Instructor handnotes
12.	05.12.26	PROPAGATION OF ELECTROMAGNETIC WAVES Sinusoidal electromagnetic waves; energy and momentum in electromagnetic waves; standing electromagnetic waves. Problem solving	[1] Ch. 32, §§32.3–32.5, pp. 1059–1072 [2] Instructor handnotes
13.	12.12.26	THE NATURE AND PROPAGATION OF LIGHT The nature of light; reflection and refraction; total internal reflection; dispersion; polarization; scattering of light; Huygens's principle. Problem solving	[1] Ch. 33, pp. 1078–1104 [2] Instructor handnotes
14.	19.12.26	GEOMETRIC OPTICS Reflection and refraction at plane and spherical surfaces; thin lenses; cameras; the eye; magnifier; microscopes and telescopes. Problem solving	[1] Ch. 34, pp. 1111–1151 [2] Instructor handnotes
15.	26.12.26	INTERFERENCE AND DIFFRACTION Interference and coherent sources; two-source interference; interference intensity; thin-film interference; Michelson interferometer; Fresnel and Fraunhofer diffraction; single-slit diffraction; multiple slits; diffraction grating; X-ray diffraction. Problem solving	[1] Ch. 35, pp. 1160–1179; Ch. 36, pp. 1186–1209 [2] Instructor hand notes
	TBC	Final exam	

