Identification	Subject	PHSC112, Physics 2, 6 ECTS
	Department	Physics and Electronics
	Program	Undergraduate
	Term	Spring 2026
	Instructor	Ph.D. Shirkhan Humbatov
	E-mail:	shirxanhumbatov@gmail.com
	Phone:	
	Classroom/hours	08:30-15:35
	Office hours	
Prerequisites	PHSC 111-Physics 1	
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	1. University physics with modern physics 14th edition global edition by Hugh D. Young, Roger A. Freedman and Lewis A Ford. 2015 2. Fundamentals of Physics, Extended (10th ed.), Wiley - Halliday, D., Resnick, R., and Walker, J. - 2013 3. Physics for Scientists and Engineers with Modern Physics (10th ed.), Cengage Learning - Serway, R. A., and Jewett, J. W. Jr. - 2018 4. University Physics with Modern Physics (15th ed.), Pearson - Young, H. D., Freedman, R. A. - 2018 5. University Physics Volume 1. OpenStax - Ling, S. J., Sanny, J., and Moebs, W. - 2016	
Course website	https://www.damtp.cam.ac.uk/user/tong/em.html https://ocw.mit.edu/courses/8-02-physics-ii-electricity-and-magnetism-spring-2019/ https://ocw.mit.edu/courses/6-013-electromagnetics-and-applications-spring-2009/d3be4ea78b036a6362230fb41780cf54_MIT6_013S09_notes.pdf https://phet.colorado.edu	
Course description	Physics II provides a continuation of the fundamental concepts introduced in Physics I, with a focus on electromagnetism, optics, and wave phenomena. The course covers electric fields, electric potential, capacitance, and current-carrying circuits, emphasizing analytical problem-solving and practical applications. Students will explore magnetic fields, electromagnetic induction, and the behavior of alternating currents in circuits. Additionally, the course introduces the principles of light, including reflection, refraction, interference, and diffraction, as well as the basic concepts of electromagnetic waves. Through lectures, problem-solving sessions, and laboratory experiments, students develop a deeper understanding of physical principles and acquire the skills to apply them to real-world scenarios in engineering and science.	
Course objectives	✓ This course aims to provide students with a rigorous and systematic understanding of the fundamental laws governing electricity, magnetism, optics, and electromagnetic wave phenomena. ✓ Students will develop the ability to analyze and model electrostatic interactions, current electricity, magnetic fields, and electromagnetic induction using advanced mathematical formulations, including vector calculus and differential equations. ✓ The course emphasizes the application of Maxwell's equations as the unifying theoretical framework, enabling students to integrate diverse	

physical concepts into a coherent understanding of classical electromagnetism.

- ✓ Through problem-solving and experimental analysis, students will gain proficiency in deriving, applying, and interpreting physical principles in real-world contexts, ranging from electrical circuits to wave propagation and optical systems.
- ✓ A strong focus is placed on fostering conceptual clarity, analytical rigor, and critical thinking skills, preparing students for higher-level studies in modern physics, electronics, and applied sciences.
- ✓ By engaging with laboratory simulations, computational tools, and theoretical exercises, students will acquire competencies in quantitative reasoning, experimental interpretation, and scientific communication.
- ✓ Ultimately, the course is designed to cultivate both a deep theoretical foundation and the practical problem-solving abilities required for physics majors, future educators, and engineers working with advanced physical systems.

Learning outcomes	**By the end of this course, students will be able to:** 1. **Explain and mathematically analyze** the fundamental concepts of electric charge, electric fields, Gauss's law, and electric potential, applying these principles to calculate field distributions, flux, and energy storage in dielectric and capacitive systems. 2. **Demonstrate proficiency** in solving circuit problems involving resistive, capacitive, and inductive elements in both direct-current (DC) and alternating-current (AC) regimes, using Kirchhoff's rules, phasor analysis, and resonance conditions. 3. **Evaluate and predict** the behavior of charges and currents in magnetic fields, applying Ampere's law, Biot–Savart law, Faraday's law, and Maxwell's equations to describe magnetic interactions, induction phenomena, and electromagnetic wave propagation. 4. **Apply vector calculus and differential equations** to model electromagnetic fields, energy transfer, and wave dynamics, linking theoretical formalism to real-world applications such as power distribution, superconductivity, and wireless transmission. 5. **Analyze and interpret** optical phenomena—including reflection, refraction, dispersion, polarization, interference, and diffraction—using wave optics and geometric optics models to design and evaluate engineering optical systems (lenses, microscopes, interferometers). 6. **Integrate conceptual knowledge with experimental and computational methods** by solving complex quantitative problems, performing laboratory-based verification of physical laws, and critically reflecting on the role of electromagnetism and optics in modern engineering technology.

Teaching methods		
Teaching methods	**Case analysis**	x
	Group discussion	x
	Lecture	x
	Simulation	x

Evaluation Criteria	Methods	Date/deadlines	Percentage (%)
	Midterm Exam		30
	Attendance	At each lesson	5
	Quizzes	During the semester, total 4 quizzes, for each 5 points	20
	Activity	At each lesson	10
	Final Exam		35
	Total		100
Class Policy	• **Preparation for class** The pedagogical structure of this course necessitates diligent individual study and external preparation. Course sessions are designed to emphasize the primary theoretical frameworks introduced in the text. Pre-class engagement with assigned chapters is essential to facilitate a comprehensive understanding of the material. Subsequent to each session, students should synthesize their notes and resolve pertinent problems, case studies, and sample examination questions located at the conclusion of each chapter. • **Withdrawal (pass/fail)** This course strictly adheres to the grading ordinances of the School of Science and Engineering. Consequently, students are required to achieve a minimum threshold of 60% to secure a passing grade. In the event of an unsatisfactory result, the student will be mandated to repeat the course in the following academic term or year. • **Cheating/plagiarism** Any instance of academic dishonesty or plagiarism during Quizzes, Midterms, or Final Examinations will result in the immediate nullification of the assessment. In such cases, the student will automatically be assigned a score of zero (0) without further consideration. • **Professional behavior guidelines** Students are expected to conduct themselves in a manner that fosters a constructive academic and professional environment during instructional hours. Unauthorized discourse 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 lesson will be awarded with one activity mark. • **Quizzes** There will be 4 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. The students who able to pass midterm and first quiz with max points automatically get max 5 point for the second quiz.

Tentative Schedule			
Week	Date/Day (Tentative)	Topics	Textbook/Assignments
1	16.02.26-21.02.26	**ELECTRIC CHARGE AND ELECTRIC FIELD** **Short description:** ✓ Electric Charge ✓ Conductors, Insulators, and Induced Charges ✓ Coulomb's Law ✓ Electric Field and Electric Forces ✓ Electric-Field Calculations ✓ Electric Field Lines ✓ Electric Dipoles	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 21. 2. Handnotes given by teacher
2	23.02.26-28.02.26	**GAUSS'S LAW** **Short description:** ✓ Charge and Electric Flux ✓ Calculating Electric Flux ✓ Gauss's Law ✓ Applications of Gauss's	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 22. 2. Handnotes given by teacher
3	02.03.26-07.03.26	**ELECTRIC POTENTIAL, CAPACITANCE AND DIELECTRICS** **Short description:** ✓ Electric Potential Energy ✓ Electric Potential ✓ Calculating Electric Potential ✓ Equipotential Surfaces ✓ Potential Gradient ✓ Capacitors and Capacitance ✓ Capacitors in Series and Parallel ✓ Energy Storage in Capacitors and ✓ Electric-Field Energy ✓ Dielectrics ✓ Molecular Model of Induced Charge ✓ Gauss's Law in Dielectrics	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 23-24. 2. Handnotes given by teacher
4	09.03.26-14.03.26	**CURRENT, RESISTANCE AND ELECTROMOTIVE FORCE** **Short description:** ✓ Current	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 25.

		✓ Resistivity ✓ Resistance ✓ Electromotive Force and Circuits ✓ Energy and Power in Electric Circuits ✓ Theory of Metallic Conduction	2. Handnotes given by teacher
5	16.03.26-21.03.26	**DIRECT-CURRENT CIRCUITS** **Short description:** ✓ Resistors in Series and Parallel ✓ Kirchhoff's Rules ✓ Electrical Measuring Instruments ✓ R-C Circuits ✓ Power Distribution Systems	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 26. 2. Handnotes given by teacher
6	23.03.26-28.03.26	**MAGNETIC FIELD AND MAGNETIC FORCES** **Short description:** ✓ Magnetism ✓ Magnetic Field ✓ Magnetic Field Lines and Magnetic Flux ✓ Motion of Charged	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 27. 2. Handnotes given by teacher
7	30.03.26-04.04.26	**SOURCES OF MAGNETIC FIELD** **Short description:** ✓ Magnetic Field of a Moving Charge ✓ Magnetic Field of a Current Element ✓ Magnetic Field of a Straight ✓ Current-Carrying Conductor ✓ Force Between Parallel Conductors ✓ Magnetic Field of a Circular ✓ Current Loop ✓ Ampere's Law ✓ Applications of Ampere's Law	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 28. 2. Handnotes given by teacher
8	06.04.26-11.04.26	Midterm Exam Problem solving	
9	13.04.26-18.04.26	**ELECTROMAGNETIC INDUCTION** **Short description:** ✓ Induction Experiments ✓ Faraday's Law ✓ Lenz's Law ✓ Motional Electromotive Force	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 29-30. 2. Handnotes given by teacher

		✓ Induced Electric Fields ✓ Eddy Currents ✓ Displacement Current and Maxwell's ✓ Equations ✓ Superconductivity ✓ Mutual Inductance ✓ Self-Inductance and Inductors ✓ Magnetic-Field Energy ✓ The R-L Circuit ✓ The L-C Circuit ✓ The L-R-C Series Circuit	
10	20.04.26-25.04.26	**ALTERNATING CURRENT** **Short description:** ✓ Phasors and Alternating Currents ✓ Resistance and Reactance ✓ The L-R-C Series Circuit ✓ Power in Alternating-Current Circuits	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 31. 2. Handnotes given by teacher
11	27.04.26-02.05.26	**ELECTROMAGNETIC WAVES** **Short description:** ✓ Maxwell's Equations and ✓ Electromagnetic Waves	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 32. 2. Handnotes given by teacher
12	04.05.26-09.05.26	**PROPAGATION of ELECTROMAGNETIC WAVES** **Short description:** ✓ Plane Electromagnetic Waves and the Speed of Light ✓ Sinusoidal Electromagnetic Waves ✓ Energy and Momentum in Electromagnetic Waves ✓ Standing Electromagnetic Waves	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 32. 2. Handnotes given by teacher
13	11.05.26-16.05.26	**THE NATURE AND PROPAGATION OF LIGHT** **Short description:** ✓ The Nature of Light ✓ Reflection and Refraction ✓ Total Internal Reflection ✓ Dispersion ✓ Polarization ✓ Scattering of Light	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 33. 2. Handnotes given by teacher

		✓ Huygens's Principle ✓ Summary ✓ Questions/Exercises/Problems	
14	**18.05.26-23.05.26**	**GEOMETRIC OPTICS** **Short description:** ✓ Reflection and Refraction at a Plane Surface ✓ Reflection at a Spherical Surface ✓ Refraction at a Spherical Surface ✓ Thin Lenses ✓ Cameras ✓ The Eye ✓ The Magnifier ✓ Microscopes and Telescopes	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 34. 2. Handnotes given by teacher
15	**25.05.26-30.05.26**	**INTERFERENCE AND DIFFRACTION** **Short description:** ✓ Interference and Coherent Sources ✓ Two-Source Interference of Light ✓ Intensity in Interference Patterns ✓ Interference in Thin Films ✓ The Michelson Interferometer ✓ Fresnel and Fraunhofer Diffraction ✓ Diffraction from a Single Slit ✓ Intensity in the Single-Slit Pattern ✓ Multiple Slits ✓ The Diffraction Grating	1. **University physics with modern physics by Hugh D. Young, Roger A. Freedman and Lewis A Ford.,** Chapter 35-36. 2. Handnotes given by teacher
		Final Exam	