The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus

[Course Title] **Honors General Physics II**

[Course Code] UFUG 1504

[No. of Credits] 3

[Any pre-/co-requisites] UFUG 1503

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Course Description

The UFUG 1504 is a more challenging version of UFUG 1502. It intends to provide a solid foundation to students who wish to take more advanced physics related study and research in the future. The course consists of three modules, which are **Module 1**: Electrostatics and Circuit, including Coulomb's law, Electric Fields, Gauss's Law, Electric potential, Capacitance, Current and Resistance, and Circuits; **Module 2**: Magnetism and Electromagnetics, including Magnetic Fields, Magnetic Field due to Currents, Induction and Inductance, Electromagnetic Oscillations, and Maxwell's Equations, Electromagnetic Waves; **Module 3**: Optics and Modern Physics, including Images, Interference, Diffraction, Photons and Matters Waves, and Atoms. In addition to the lecture, students are required to take 3 of 5 experimental sections, which are Coulomb constant, Michaelson interfered, Electromagnetic induction and maglev, Hall effect, Polarization Of light experiment.

Intended Learning Outcomes (ILOs)

	Course ILOs	**Nature of the learning outcomes** *(A - Knowledge/Content Related; B - Academic Skills/Competencies;* *C - Others)*
1	Classify the nature of electric and magnetic fields and describe visible light as part of the electromagnetic wave spectrum.	A, B

2	Derive expressions for the electric field components around a dipole and other simple charge distributions and derive the capacitance and the associated stored energy of simple structures both in a vacuum and in the presence of a dielectric medium	A, B
3	Perform simple calculations by applying the basic concepts of electromagnetism and optics. Derive Gauss' Law in differential form from the integral form	A, B
4	Use Stoke's theorem to find differential form of Ampere's Law and Faraday's Law.	A, B
5	Quote Maxwell's equations in both integral and differential form and be able to identify all terms.	A, B
6	Recast Maxwell's equations in 1D and use 1D Maxwell's equations to derive (1D) wave equation, to find dispersion relation of 1D wave equation from a trail solution.	A, B
7	Equate **j.E** to rate of charge of energy density in electromagnetic fields and to drive Poynting's theorem and show that energy is conserved when Poynting Vector is included.	A, B
8	Derive Poisson's equation from definition of V, to write B and E in terms of V and A and to rewrite Maxwell's equations in terms of potentials.	B

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Understand and apply the principles of Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, current, and resistance in electrostatics and circuits.	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Electrostatics and Circuit's concepts (ILO 1), evaluate their application (ILO 2), critically analyze their role in physic (ILO 3), and evaluate consequences of their applications (ILO 4).
Analyze and calculate magnetic fields, magnetic fields due to currents, induction, inductance, electromagnetic oscillations, and Maxwell's equations in magnetism and electromagnetics.	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Magnetism and Electromagnetics' concepts (ILO 1), evaluate their application (ILO 2), critically analyze their role in physic (ILO 3), and evaluate consequences of their applications (ILO 4).

Analyze and interpret optical phenomena such as images, interference, and diffraction.	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Optics Physics' concepts (ILO 1), evaluate their application (ILO 2), critically analyze their role in physic (ILO 3), and evaluate consequences of their applications (ILO 4).
Understand the dual nature of light and matter, including the concepts of photons and matter waves.	ILO1, ILO2	This task assesses students' ability to explain and apply Modern Physics' concepts (ILO 1) and evaluate their application (ILO 2).
Describe the structure of atoms and how they interact with electromagnetic radiation.	ILO1, ILO2, ILO3	This task assesses students' ability to explain and apply Modern Physics and Electromagnetics' concepts (ILO 1), evaluate their application (ILO 2), critically analyze their role in physic (ILO 3).
Apply knowledge of these topics to solve complex problems in physics and engineering.	ILO3	This task assesses students' ability to critically analyze and Electromagnetics' role in physics and engineering (ILO 3).
Demonstrate proficiency in laboratory experiments related to electrostatics, magnetism, optics, and modern physics.	ILO1, ILO2, ILO3, ILO4, ILO5	This task assesses students' ability to explain and apply Electrostatics and Circuit, Magnetism and Electromagnetics, and Optics and Modern Physics concepts (ILO 1), evaluate their application (ILO 2), critically analyze their role in physic (ILO 3), evaluate consequences of their applications (ILO 4), and make and communicate decisions critically using experimental data.

Course Outline:

Week	Topic	Briefly outline what this topic will cover	Indicate which course ILOs this topic is related to
1	Introduction, Coulomb's law	Coulomb's law describes the electrostatic force between two charged particles, which is fundamental in understanding the behavior of electric charges and the principles of electromagnetism.	ILO1, ILO2, ILO3, ILO4
2	Electric field, Gauss's Law,	Electric fields are the regions around charged particles where other charges experience a force. Gauss's Law, a fundamental law of electromagnetism, relates the electric flux through a closed	ILO1, ILO2, ILO3, ILO4

		surface to the charge enclosed by that surface.	
3	Electric potential, Capacitance,	Electric potential is a scalar quantity that describes the work done per unit charge in moving a test charge from one point to another in an electric field. Capacitance is a measure of a system's ability to store electric charge and energy in an electric field.	ILO1, ILO2, ILO3, ILO4
4	Current and Resistance, Circuits	Current is the flow of electric charge through a conductor, and it is measured in amperes. Resistance is the opposition to the flow of current in a material, and it is measured in ohms. Circuits, which are systems of interconnected electrical components such as resistors, capacitors, and inductors.	ILO1, ILO2, ILO3, ILO4
5	Module 1 exam, Lab session 1	**Lab session 1: Hall effect TBD**	ILO1, ILO2, ILO3, ILO4
6	Magnetic Fields, Magnetic Field due to Currents	Magnetic fields are regions of space where a magnetic force is experienced by magnetic materials or moving electric charges. The magnetic field due to currents, known as Ampere's Law, describes the magnetic field around a current-carrying conductor.	ILO1, ILO2, ILO3, ILO4
7	Magnetism and Electromagnetics, Induction and Inductance	Electromagnetics is the study of the interaction between electric and magnetic field. Inductance is a measure of an electrical component's ability to store energy in a magnetic field when current flows through it.	ILO1, ILO2, ILO3, ILO4
8	Electromagnetic Oscillations, Maxwell's Equations I	Electromagnetic oscillations refer to the periodic variations in the electric and magnetic fields that propagate through space as electromagnetic waves. Maxwell's Equations provide a unified framework for understanding electromagnetism and predicting the behavior of electromagnetic waves	ILO1, ILO2, ILO3, ILO4
9	Maxwell's Equations II, Electromagnetic Waves, Lab session 2	Maxwell's Equations provide a unified framework for understanding electromagnetism and predicting the behavior of	ILO1, ILO2, ILO3, ILO4

		electromagnetic waves. Electromagnetic waves are a form of energy that is characterized by the oscillating electric and magnetic fields. **Lab session 2: Electromagnetic induction and maglev**	
10	Module 2 exam	**TBD**	ILO1, ILO2, ILO3, ILO4
11	Images, Interference,	It will discuss how images are formed by light rays, the different types of images (real, virtual, upright, inverted, magnified, reduced), and the principles of reflection and refraction that govern the formation of images.	ILO1, ILO2, ILO3
12	Diffraction, Photons and Matters Waves, Lab session 3	Diffraction is the bending of waves around obstacles and the spreading of waves as they pass through small openings. Photons are the fundamental particles of light and electromagnetic radiation. Matter waves refer to the wave-like behavior exhibited by particles, as described by the wave-particle duality principle in quantum mechanics. **Lab session 3: Polarization of light experiment.**	ILO1, ILO2, ILO3
13	Atoms, Conduction of Electricity in Solids	Atoms are the basic building blocks of matter and consist of a nucleus containing protons and neutrons, surrounded by electrons orbiting in energy levels or shells. The conduction of electricity in solids is the movement of electric charge through a material. In solids, electrical conduction can occur through two main mechanisms: metallic conduction and semiconductor conduction.	ILO1, ILO2, ILO3
14&15	Module 3 exam	Module 3 exam time will be arranged by ARS.	ILO1, ILO2, ILO3, ILO4

*The lab session will be arranged by UGTL, any questions about lab session please ask Zehao Pan (Zehaopan@hkust-gz.edu.cn)

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
In-class test	10%	30/05/2026 *
Written assignment	20%	30/05/2026 *
Module-based exam	50%	30/05/2026 *
Lab report	20%	30/05/2026 *

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Grading Rubrics

Assessment Task	Rubrics for excellent in the task
In-class test	Correctly answer questions (usually in choices) in quiz, and actively lead and participate in the flipped classroom, the group discussions, or other interactive activities and effectively collaborate with team members.
Written assignment	Correctly answer questions (usually in Q&A with derivations in steps and calculations), if the final answers are not correct, we will check the key steps to give marks.
Module-based exam	Correctly answer questions (usually in choices and Q&A with derivations in steps and calculations), if the final answers are not correct, we will check the key steps to give marks.
Lab report	Proper records and analysis of data, clear organization of the report, proper conclusion and perspectives for projects.

Final Grade Descriptors:

The course consists of three modules, which are **Module 1**: Electrostatics and Circuit; **Module 2**: Magnetism and Electromagnetics; **Module 3**: Optics and Modern Physics. The Final Grade will be calculated based on equation: **Final Grade**= 35% (**Module 1 Grade)**+ 35% (**Module 2 Grade)**+ 30% (**Module 3 Grade)**, while **Module Grade**= 10% (**In-class test**)+ 20% (**Written assignment**)+ 50% (**Module-based exam**)+ 20% (**Lab report**).

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	A+: final grade≥96; A: 96> final grade≥92; A-: 92>final grade≥88;
B	Good Performance	B+: 88> final grade≥84; B: 84>final grade≥80; B-: 80>final grade≥76;
C	Satisfactory Performance	C+: 76> final grade≥72; C: 72>final grade≥68;

		C-: 68>final grade⩾64;
D	Marginal Pass	D: 64> final grade⩾52;
F	Fail	F: 52≥ final grade;

Course AI Policy

In this course, students are permitted to use AI tools for their coursework and assignments. However, it is essential that whenever students utilize AI tools, they clearly indicate and acknowledge this in their work. This transparency is crucial to ensure academic integrity and proper credit for the use of such tools. Students should clearly mention in their submissions when AI tools have been employed and provide relevant details on the purpose and outcomes of using these tools. This practice will help in maintaining honesty and clarity in the academic work produced by students.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include [specific details, e.g., strengths, areas for improvement]. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

Students are allowed to resubmit assignments or assessments under certain conditions as specified by the instructor. If the submission is after deadline, 10% points will be deducted. If the submission is after tutorial or answer is released, 60% points will be deducted. Any reason, such as network issues, submitting the wrong assignment, or missing the deadline, will be deemed a late submission, and all submissions shall be subject to the time displayed on Canvas.

Make-up Exam Policy

Force majeure circumstances (e.g., illness, participation in national/international competitions) that result in failure to sit for the exam require you to **notify the course instructor 15 minutes prior to the exam**. You must also submit the corresponding supporting documents, such as a hospital-stamped medical certificate and official competition proof materials. The score obtained in the make-up exam will be **capped at 70%**.

In addition, late arrival, transportation problems, forgetting the exam time, sudden personal urgent matters and other such reasons will **not be eligible for a make-up exam arrangement**.

Required Texts and Materials

David Halliday, Robert Resnick, Jearl Walker - Fundamentals of Physics_ Extended-Wiley (2018)

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.