

UFUG1503 (L01) - Honors General Physics I

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[Course Title] Honors General Physics I


[Course Code] UFUG 1503

[No. of Credits] 3

[Any pre-/co-requisites] None

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Course Description

The UFUG 1503 Honors General Physics I is a calculus-based general physics course covering topics in mechanics and thermodynamics, providing solid foundations for students to pursuit deep understandings and methods. This course will be divided into three modules: **Module 1** covers fundamentals of mechanics including motion, Newton's laws, momentum conservation, rotation; **Module 2** covers work and energy, energy conservation, oscillations, and waves; **Module 3** covers laws of thermodynamics, kinetic theory. Understanding calculus is a preliminary to enroll in this course. This is the in-depth version of course UFUG 1501 General Physics I.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Apply Newton's laws of motion to predict and describe the simple dynamics motions.
2. Use the principles of energy and linear momentum conservations to solve problems involving kinetic and potential energy as well as collisions between objects.
3. Analyze the rotational motion in terms of angular displacements, velocity and acceleration.
4. Explain oscillatory motion and the phenomena related to waves, including superposition, interference, diffraction, Doppler effect.
5. Use gas laws and kinetic theory of gases to explain the physical phenomena of gases.
6. Apply the first and second laws of thermodynamics to solve the real-life problems.
7. Perform quantitative analysis of problems in mechanics and thermodynamics, with the calculus and other math tools.

8. Assess real physics problems in mechanics and thermodynamics, and propose potential solutions, with calculus-based approach.

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
In-class test	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6, ILO7	Assesses foundational concepts across course topics (e.g., motion/vectors via Newton's laws, force/momentum conservation, rotational kinematics, oscillatory/wave basics). Uses multiple-choice questions and interactive activities (flipping classroom) to evaluate application.
Written assignment	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6, ILO7	Requires step-by-step derivations and calculations for mechanics problems (e.g., predicting motion with Newton's laws, solving energy/momentum conservation problems, analyzing rotational motion). Mandates use of calculus and other math tools (aligning with ILO7) to demonstrate quantitative problem-solving for these ILOs.
Module-based exam	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6, ILO7, ILO8	Covers all course modules (mechanics + thermodynamics). Evaluates: <ul style="list-style-type: none"> - Application of Newton's laws, energy/momentum conservation, rotational analysis, and wave phenomena (ILO1–4). - Use of gas laws/kinetic theory and thermodynamics laws to explain/solve problems (ILO5–6). - Quantitative analysis with calculus (ILO7) and assessment of real physics problems + proposing calculus-based solutions (ILO8).

Assessed Task	Mapped ILOs	Explanation
Lab report	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6, ILO7	<p>Links to experiments (e.g., motion/force measurements, oscillatory motion analysis, gas property investigations). Requires:</p> <ul style="list-style-type: none"> - Applying Newton's laws, energy principles, rotational concepts, or wave theories to experimental data (ILO1–4). - Using gas laws/thermodynamics to interpret thermal phenomena (ILO5–6). - Quantitative data analysis (e.g., curve fitting, integration) with math tools (ILO7).

Course Outline:

Week	Topic	Briefly outline what this topic will cover	Indicate which course ILOs this topic is related to
1	Introduction, measurement, motion and vectors, basic cross product	Measurement, Motion Along a Straight Line, Vectors. Motion in Two and Three Dimensions. Basic calculus and cross product.	ILO1, ILO2, ILO3, ILO4
2	Force and motion, Center of mass	Newton's first and second laws, some particular forces, friction, the drag force and terminal speed, uniform circular motion, center of mass	ILO1, ILO2, ILO3, ILO4
3	Kinetic energy and work, Linear momentum	Kinetic energy, work and the gravitational force, work	ILO1, ILO2, ILO3, ILO4

done by a general variable force, linear momentum, collision and impulse, conservation of linear momentum

Rotational variables, rotation with constant angular acceleration, kinetic energy of rotation, calculating the rotational inertia, torque, rolling as translation and rotation combined, forces and kinetic energy of rolling, angular momentum of a rigid body, conservation of angular momentum

4 Rotation, Rolling, torque and angular momentum ILO1, ILO2, ILO3, ILO4

Lab session 1: Guided rail on air cushion. **Module 1 exam time will be Mar. 14 from 9am to 11am.**

5 Module 1 exam, Lab session 1* ILO1, ILO2, ILO3, ILO4

Potential energy, conservation of mechanical energy, work done on a system by an external force, conservation of energy

6 Potential energy, Conservation of energy ILO1, ILO2, ILO3, ILO4

Equilibrium, some examples of static equilibrium, elasticity, Newton's law of gravitation, gravitation and the principle of superposition, gravitational potential energy, satellites: orbits and energy

7 Equilibrium and elasticity, gravitation ILO1, ILO2, ILO3, ILO4

Simple harmonic motion, energy in simple harmonic motion, an angular simple

8 Oscillations, Waves I ILO1, ILO2, ILO3, ILO4

		harmonic oscillator, pendulums, circular motion, transverse waves, wave speed on a stretched string, the wave equation	
9	Waves II, Fluids	Speed of sound, traveling sound waves, interference, the Doppler effect, fluids, density, and pressure, Pascal's principle, Bernoulli's equation	ILO1, ILO2, ILO3, ILO4
10	Module 2 exam, Lab session 2*	Lab session 2: Pendulum vibration. Module 2 exam time will be Apr. 18 from 9am to 11am.	ILO1, ILO2, ILO3, ILO4
11	Temperature, heat and the first law of thermodynamics	Temperature, thermal expansion, absorption of heat, the first law of thermodynamics	ILO1, ILO2, ILO3
12	The kinetic theory of gases	Avogadro's number, ideal gases, pressure, temperature, and RMS speed translational kinetic energy, the molar specific heats of an ideal gas, degrees of freedom and molar specific heats	ILO1, ILO2, ILO3
13	Entropy and the second, third law of thermodynamics	the adiabatic expansion of an ideal gas, entropy, entropy in the real world: engines refrigerators and real engines	ILO1, ILO2, ILO3
14&15	Module 3 exam, Lab session 3*	Lab session 3: Specific heat of air. 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 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. Moreover, utilization of the AI platform for autonomous practice of English-version physics questions, achieve high accuracy in platform-based practice exercises
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**: Mechanic Basics; **Module 2**: Energy and oscillations; **Module 3**: Thermodynamics. 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 \geq 96; A: 96> final grade \geq 92; A-: 92>final grade \geq 88;
B	Good Performance	B+: 88> final grade \geq 84; B: 84>final grade \geq 80; B-: 80>final grade \geq 76;
C	Satisfactory Performance	C+: 76> final grade \geq 72; C: 72>final grade \geq 68; C-: 68>final grade \geq 64;
D	Marginal Pass	D: 64> final grade \geq 52;
F	Fail	F: 52 \geq 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. 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 after tutorial or answer is released, 100% 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.

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.

Course Summary:

Date	Details	Due
Thu Feb 26, 2026	 Homework 1 (https://hkust-gz.instructure.com/courses/2889/assignments/21311)	due by 11:59am
	 First Online Platform Assignment (https://hkust-gz.instructure.com/courses/2889/assignments/21055)	due by 12pm
Fri Mar 20, 2026	 Air-track velocity and momentum (https://hkust-gz.instructure.com/courses/2889/assignments/21813)	due by 11:59pm
Thu Apr 2, 2026	 Homework 3 (https://hkust-gz.instructure.com/courses/2889/assignments/22516)	due by 11:59am
Sat Apr 4, 2026	 Lab 2 Compound Pendulum (https://hkust-gz.instructure.com/courses/2889/assignments/22197)	due by 11:59pm
Thu Apr 16, 2026	 Homework 4 (https://hkust-gz.instructure.com/courses/2889/assignments/22840)	due by 11:59am
Sat May 9, 2026	 Lab 3 The ratio of specific heats (https://hkust-gz.instructure.com/courses/2889/assignments/23123)	due by 11:59pm
	 Homework 2 (https://hkust-gz.instructure.com/courses/2889/assignments/21801)	
	 M1 Exam (https://hkust-gz.instructure.com/courses/2889/assignments/22316)	
	 M2 exam (https://hkust-gz.instructure.com/courses/2889/assignments/23216)	