

PHYS 1111A University Physics I

Introduction to Mechanics, Fluids and Waves

(2022-23 1st term)

1. Course Description

This introductory **calculus-based** course discusses the basic principles of mechanics, fluids and waves. The course assumes a background of HKDSE Physics or a good preparation in HKDSE Combined Science with a physics component. It is suitable for potential majors in physics, other science subjects and engineering, and for those who intend to minor in physics. Topics include: particle kinematics, force and motion, work and kinetic energy, potential energy, momentum, systems of particles and collisions, rotation, Newton's law of gravitation, fluid statics and the dynamics of ideal fluids, oscillations, and waves. Students are advised to take this course concurrently with an introductory mathematics course that includes vectors and calculus. Not for students taken PHYS1113.

Note: The two courses PHYS1111 and PHYS1113 are similar, and both will satisfy requirements for going on as a physics major. The difference is that PHYS1113 will assume better preparation in mathematics (especially calculus), whereas PHYS1111 will introduce these tools more slowly. The time thus saved in PHYS1113 will be used for more advanced examples and applications.

By default, students admitted into the Enrichment Stream in Theoretical Physics (ESTP) will be assigned to PHYS1113, and other students to PHYS1111. But students, if they wish, may change to the one that is most suitable for them, through the following steps.

Contact the teacher for the course you wish to transfer into (Dr SS Tong sstong@cuhk.edu.hk for PHYS1111 and Dr PK Leung pkleung@cuhk.edu.hk for PHYS1113) and get admitted temporarily as an observer with access to the course webpage, so that you can sample the curriculum and teaching style and pace.

- Discuss with the teacher as early as possible (preferably in week 1). Transfer into PHYS1113 will require the specific approval of the teacher, based on HKDSE grades in physics and mathematics (including M2), and if necessary a short test.
- Once approval is given orally, then go through the formal ADD/DROP procedure with the Registry. Exceptionally, such approval may be given up to Week 4.
- The two courses are scheduled at the same hour, and the progress will be very close. With approval from the instructors, students may swap between the two courses in the ADD/DROP period.

Grading in both courses will be criteria-referenced and not norm-referenced; see Section 10 on Grade Descriptors. In particular, there will be no 'curve' to govern the grade distribution for each individual course. Rather, there will be some overlapping or similar questions to align the absolute grade thresholds. In other words, we try to ensure that with the same ability and performance, the grade should be the same no matter which course you enroll in.

2. Learning Outcomes

- gained an understanding in Newtonian mechanics and waves, within a formalism using vectors and elementary calculus;
- acquired familiarity with some mathematical methods, such as vector algebra and elementary calculus, gained an appreciation of their roles and applications in mechanics and the ability to apply them in other courses;
- acquired the necessary background necessary for upper-level courses in mechanics as well as other physics courses in the curriculum;
- developed an appreciation of the quantitative nature of physics;
- built up skills for solving relevant problems; and
- acquired a sense of the importance of classical physics, especially its fundamental role in different fields in science and engineering.

3. Learning Resources

Course Website

The course website (CUHK Blackboard: <https://blackboard.cuhk.edu.hk/>) has the following information and resources:

- Course materials: lecture notes, homework assignments and solution, and supplementary materials
- Submission for homework assignments and take-home/online examinations
- Links for online lectures, lecture recordings and Micro-modules.
- A notice board for announcements of homework assignments and important events (e.g. examination and project presentation schedule).

Textbook

- **HRW**: D. Halliday, R. Resnick, and J. Walker, *Principles of Physics*, 11th ed., John Wiley & Sons. You should look up the textbook for the assigned readings and some of the homework problems.
- Students can purchase the hardcopy or *electronic* textbook at the University book store. Multiple copies of the 9th edition have been reserved in the University library¹. The difference between the two editions is unimportant.

Other References

- H.D. Young and R.A. Freedman, *University Physics with Modern Physics*, 12th ed., Addison-Wesley 2008 (or later edition)
- J.W. Jewett Jr. and R.A. Serway, *Physics for Scientists and Engineers with Modern Physics*, 7th ed., Thomson 2008 (or later edition)
- PM Fishbane, SG Gasiorowicz, ST Thornton, *Physics for Scientists and Engineers with Modern Physics*, 3rd ed. Pearson 2005 (or later edition)

eLearning

A series of eLearning Micro-modules have been developed to support student learning in this course. They enable students to study more at their own pace, for example by going through a particular segment of the material again after the lecture. The Micro-modules consist of supplementary and stand-alone material on a selection of topics (~1200 minutes). They are open to the public, at

<http://www.phy.cuhk.edu.hk/elearning/year1phy/>

The Micro-modules will cater to diversity among students, in several different ways:

- Filling some initial gaps
- Extending some topics (**beyond course requirements**)
- More systematic formalism (**beyond course requirements**)

As a result, some advanced topics are omitted from the lectures. More capable students can learn on their own — including topics that obviously go beyond the requirements of the course. Also, the initial gaps will not need to be discussed (at least not to the same level of detail) in class. Thus, it is hoped that the pace of lectures can be more relaxed, allowing time for discussions and/or demonstrations. Students are advised to first read the Preface to these modules, to understand how these stand in relation to other elements of the course.

The eLearning Micro-modules on mathematical skills developed by the Physics Department are provided on the following page, with direct links to facilitate searching for a particular topic.

<http://www.phy.cuhk.edu.hk/elearning/maths.html>

The Micro-modules on this page include the extensions mentioned, and also another series for pre-university level mathematical skills for filling any initial gaps.

¹ These copies do not 'belong' to the library, and therefore may not be listed on the Library Catalogue. You should go directly to the Reserve Books Section.

4. Course Content (Coverage: Chapter 1-17 of HRW)

	Topics	Contents	Ref.(HRW)
1.	Particle kinematics & dynamics	Vectors and scalars; motion in one, two and three dimensions; Newton's laws, force and motion; circular motion; work, kinetic energy, potential energy, conservation of energy (Elementary calculus will be reviewed/introduced if necessary, at the level of the textbooks)	p. 1-200
2.	Systems of particles	Center of mass, linear momentum, impulse, Newton's second law for a system of particles, collisions	p. 201-240
3.	Rotation	Rotational kinematics, rotational inertia, torque, Newton's second law for rotation, work and rotational kinetic energy, rolling, angular momentum, conservation of angular momentum	p. 241-304
4.	Gravitation	Newton's law of gravitation, gravitational potential energy, Kepler's laws	p. 330-358
5.	Fluids	Pressure, Pascal's principle, Archimedes' principle, ideal fluids in flow and equation of continuity, Bernoulli's equation	p. 359-385
6.	Oscillations	Simple harmonic motion, energy in a simple harmonic motion, damped oscillation, forced oscillations and resonance	p. 386-412
7.	Waves	Transverse and longitudinal waves, wavelength and frequency, energy of a travelling string wave, the principle of superposition, interference of waves, standing waves, sound waves, the speed of sound, intensity and sound level, interference, beats, Doppler's effect	p. 413-475

5. Teachers, Teaching Assistants, and Class Schedule

Teacher	Office	Zoom ID	Email	Off. No.	Consultation
Tong Shiu Sing	SC223	706 319 2414	sstong@cuhk.edu.hk	3943 6400	Face-to-face: after class

TAs	Office	Email	Ex. Class	Consultation hours
Chan Lik Chun	SC313 (25T)	1155110651@link.cuhk.edu.hk	AE04	Mon 10:30 – 12:15
Cheng Ho Lam	SC322 (2T)	1155063446@link.cuhk.edu.hk	AE02	Tue 14:30 – 16:15
Lee Tsz Ming	SC313 (30T)	1155109291@link.cuhk.edu.hk	AE03	Fri 10:30 – 12:15
Leung Man Hei	SC313 (27T)	1155127383@link.cuhk.edu.hk	AE01	Tue 14:30 – 16:15
Zhou Rongzi	SC313 (15E)	1155092080@link.cuhk.edu.hk	Grading	Thu 13:30 – 15:15

	Lectures & Tutorials		Exercise Classes (See your group in CUSIS, 1 st class on Sept. 14/15, 2022)			
			AE01	AE02	AE03	AE04
Time	Mon 16:30-18:15	Wed 9:30-11:15	Wed 13:30-14:15	Wed 17:30-18:15	Thu 13:30-14:15	Thu 16:30-17:15
Venue	Yasumoto Int'l Acad. Park LT7	Yasumoto Int'l Acad. Park LT5	Wu Ho Man Yuen Bldg. 504	Wu Ho Man Yuen Bldg. 504	Wu Ho Man Yuen Bldg. 404	Wu Ho Man Yuen Bldg. 404

6. Assessment Scheme

At the end of the course, your performance will be assessed according to the scheme below:

	Homework	Mid-term exam	Final exam	Project Presentation
Weight	15 %	30 %	45 %	10 %
Date & Time	Weekly unless otherwise stated	October 26, 2022	To be arranged centrally	November 30 / December 1, 2022
Venue	---	Yasumoto Int'l Acad. Park LT5	Arranged centrally	Exercise Classes

The midterm examination will be held on **October 26, 2022** during the lecture hours. The final examination will be centrally arranged by the University. The homework assignments will be graded by the TAs and the graded assignments will be returned to you two weeks after submission. If you have enquiries concerning the grading, please feel free to contact the teachers or the TA who is responsible for grading the assignment. The Project Presentation is provisionally scheduled for **November 30 / December 1, 2022** and the exact schedule will be confirmed later.

Important notice: You will fail the course if you are unable to get at least 20% of the marks of all written examinations (midterm and final). In addition to this requirement, your total marks (calculated according to above scheme) have to be above the passing mark in order to pass the course. The passing mark and the mark of each grade will be decided by the Panel of Examiners of the Physics Department according to the Grade Descriptors listed in Section 10 of this course outline.

7. Learning Activities

Lecture	Tutorial		Exercise Class and Assignment		Laboratory		Project / Report		Presentation		Case study		Web teaching		Other 1 (specify) Demos		Other 2 (specify)	
(hr / week) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr / week) in class out class	(hr / week) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class	(hr in total) in class out class
2.25 3	0.75 1		3.5				6	0.75							3			
M M	M M	NA M	NA NA	NA M	NA NA	NA M	M NA	NA NA	NA NA	NA NA	NA NA	NA NA	O NA	NA NA	NA NA	NA NA	NA NA	NA NA

M: Mandatory activity in the course O: Optional activity NA: Not applicable

Notes: (1) One class period is 45 minutes. (2) The three class periods for Lectures and the one class period for Tutorial will be used together, so that interactive activities will be intermingled with lectures.

Lecture and Tutorial

The essential concepts of the course will be taught in the lectures. Students are required to study the course materials after class and encouraged to raise questions and interact with the teachers and TAs. The tutorials will also involve teaching supplementary materials and doing class exercises.

Homework

Homework assignments will be uploaded in the Blackboard course website. Students should to **submit their homework to Blackboard by the due time. NO late submission will be accepted.** The graded homework will be available for review on Blackboard two weeks after the due time. The due time and the TA responsible for a homework will be written at the top of the homework. If you have enquiries concerning the grading, please contact the TA responsible directly. Each assignment consists of four parts:

- **Part A** is an assigned reading of selected parts in the textbook (HRW).

- **Part B** consists of simple problems that are **NOT** required to be handed in. The solution will be made available on the course webpage together with questions. However, please attempt the problems first, and read the solution only afterwards. You will not learn much just by reading the solution. **The problems in this part consist of the basic skills that students have to acquire in order to pass this course.**
- **Part C** should be handed in and will be graded. They are the main problems which constitute 80% of the total marks in each set of assignment.
- **Part D** consists of challenging problems and constitutes 20% of the total marks. In order to encourage students to attempt these problems, 10% of the marks will be awarded for a serious attempt on the problems (even without completing) that is reasonably well documented, and the other 10% for a good solution.

Students should submit their homework in a *single* PDF document to Blackboard; submissions in other formats (e.g. separated images, separated PDF files) or by the wrong channels (e.g. email) will NOT be accepted without prior permission.

Plagiarism of homework is prohibited with zero tolerance and subject to disciplinary actions by the University (See the policy of academic honesty below).

Exercise Class

The exercise classes will be conducted in small-groups, each led by a TA. Guided by the TAs, you will be asked to do additional problems. These problems will **NOT** be given to you beforehand and the solution will **NOT** be posted, so that you are required to go through the entire thinking process of approaching and solving a problem during class. Students are encouraged to attend the exercise classes because they provide a valuable opportunity for you to train your problem solving skills and learn through interacting with the TAs and peers. Some of the exercise class problems, upon modifications, may appear in the examinations.

Important notice: The first exercise class will be held on **September 14/15, 2022**. Students must attend the *last* exercise class on **November 30 / December 1, 2022** for the project presentation, which constitutes 10% towards the final grade.

Project and Presentation

You are required to form a **team of two, investigate a mechanics problem which involves numerical work, and present your findings to your TA and peers in the exercise class**. The particular project assignment (different for each team) will be announced one month ahead of time. The project guidelines will be available in the course website. The presentation will be graded according to your (a) understanding of the problem, (b) accuracy of analytical and numerical work, (c) ability to present the work in a clear and concise manner.

Consultation Hours and Interactions Outside Class

Each TA has his/her own consultation hours. Students are strongly encouraged to use these sessions to interact with the TAs and ask questions related to their learning. Students are also strongly encouraged to **interact with the teacher after class, through emails or telephone, or request an appointment via Zoom or in person**.

8. University Policy on Academic Honesty

Plagiarism is prohibited with zero tolerance and is subject to disciplinary actions by the University. Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Every student should read and understand the University policy on academic honesty available at:

<http://www.cuhk.edu.hk/policy/academichonesty/>

In the first lecture, you are required to sign a **Declaration of Academic Honesty Statement**. Please sign and return it to the teacher after you have read the disciplinary guidelines and procedures on academic honesty stipulated in the above website. Your written work in this course will **NOT** be graded until you have submitted the signed statement.

9. Feedback for Evaluation

Your feedback is very useful for improving the course. There are several channels for you to provide comments and feedback. You can

- send an email to us, give us a phone call, or come to discuss with us online; especially for issues that require immediate action;
- express your views in course evaluation; and/or (e.g. ask a student representative to help you convey the messages) in the staff-student consultation meeting held every year.

10. Grade Descriptors

Your grade in this course will be assessed based on the following grade descriptors.

Grade	Descriptions
A	Demonstrate thorough mastery of principles and subject matter in the course required for attaining all the course learning outcomes. Demonstrate the ability to apply the principles or subject matter to familiar and unfamiliar situations, in a manner that would surpass the normal expectation at this level and standards that may be required at higher levels of study or research. Has the ability to express the knowledge or synthesis of ideas in a clear and cogent manner.
A-	Demonstrate substantial command of principles and subject matter in the course required for attaining almost all the course learning outcomes. Demonstrate the ability to state and apply the principles or subject matter to familiar and some unfamiliar situations, in a manner that is logical and comprehensive. Has the ability to express the knowledge or application with clarity and accuracy.
B	Demonstrate general and sufficient command of principles and subject matter in the course required for attaining most of the course learning outcomes. Demonstrate the ability to state and apply the principles or subject matter accurately to most (but not necessarily all) familiar and standard situations, in a manner that is logical and persuasive. Has the ability to express the knowledge or application in a satisfactory and unambiguous way.
C	Demonstrate general command of principles and subject matter in the course required for attaining some of the course learning outcomes. Demonstrate the ability to state and apply the principles or subject matter to most (but not necessarily all) familiar and standard situations, but with occasional errors and/or in a manner that is fragmented. Has the ability to express the separate pieces of knowledge in an unambiguous way.
D	Demonstrate partial command of principles and subject matter in the course required for attaining some of the course learning outcomes. Demonstrate the ability to state and apply the principles or subject matter to some simple situations only. Has the ability to state the knowledge or application in simple terms.
F	Demonstrate little or no evidence of command of principles and subject matter in the course required for attaining the course learning outcomes, OR failure to meet specified assessment requirements.