City University of Hong Kong
Course Syllabus

offered by Department of Physics
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Statistical Mechanics
Course Code:	PHY6252
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	PHY8252 Statistical Mechanics

Part II Course Details

1. Abstract

This course aims to equip graduate students with knowledges of statistical mechanics that are necessary to conduct research and understand literature particularly relevant to condensed matter physics. The course shall start with the fundamental concepts of Statistical Mechanics. Then the course discusses weakly interacting systems and strongly interacting Systems. In the end, the fluctuation-dissipation theorem and other relevant knowledges of dissipative systems will be introduced.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Recognize and use appropriately important technical terms and definitions		✔		
2.	Use appropriate mathematical notations and apply in concise form the laws of quantum mechanics to the study of modern physics problems		✔	✔	
3.	Apply the laws of statistical mechanics to the study of modern physics problems		✔	✔	✔
4.	Solve real and hypothetical problems in statistical physics by identifying the underlying physics and analyzing the problem		✔	✔	✔
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Explain key concepts and theory of topics of the course	✔	✔	✔				2 hrs/wk
Tutorial	Explain how some problems are solved and the techniques used explain some concepts	✔	✔	✔	✔			1 hr/wk

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 70%								
Homework, Quizzes etc.	✔	✔	✔	✔			70%	
Examination: 30% (duration: 2 hours)	✔	✔	✔	✔			30%	
							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts.	Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a basic level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit some deficiencies in understanding, explaining, and integrating the knowledge in written format	Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format
2. Examination	1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts and physics theory.	Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a basic level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit some deficiencies in understanding about experimental methods and the interpretation of results	Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

Applicable to students admitted in Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Assignment	1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts.	Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit some deficiencies in understanding, explaining, and integrating the knowledge in written format	Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format
2. Examination	1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts and physics theory.	Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format	Will exhibit some deficiencies in understanding about experimental methods and the interpretation of results	Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Method of Statistical Mechanics: grand canonical ensemble, Bose and Fermi distributions, phases and partition functions.
Weakly Interacting Systems: non-ideal gas and the Virial expansion, van der Waals gas, mean field theory for magnetic systems.
Strongly Interacting Systems: phase transitions, critical phenomena, Ising model, Landau theory, ferroelectrics.
Dissipative Systems: Fluctuation-dissipation theorem, Langevin equation, correlations.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

None.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Brian Cowan, Topics in Statistical Mechanics (Imperial College Press, 2005)
2.	R. K. Pathria and Paul D. Beale, Statistical Mechanics 3rd ed (Academic Press, 2011)
3.	Richard P. Feynman, Statistical Mechanics: A Set of Lectures (CRC Press, 1998)
4.	Kerson Huang, Statistical Mechanics (Wiley, 2008)