PHY6252: STATISTICAL MECHANICS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Statistical Mechanics

Subject Code
PHY - Physics
Course Number
6252

Academic Unit
Physics (PHY)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Calculus

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
PHY8252 Statistical Mechanics

Part II Course Details

Abstract
In this course, we study macroscopic system from a microscopic or molecular point of view. Topics include ensembles (such as canonical ensemble and grand canonical ensemble), partition functions, Helmholtz and Gibbs free energies, partition

functions applied into ideal monatomic gas and diatomic gas, Boltzmann Statistics, Fermi-Dirac and Bose-Einstein Statistics, chemical equilibrium, and applications to systems such as ideal gases, interfaces, liquid crystals, polymeric materials, crystalline solids, heat capacity of solids, and electrical conductivity.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Recognize important technical terms and definitions in statistical mechanics		x		
2	Use appropriate mathematical notations statistical mechanics to the study of physics problems		x	x	
3	Apply the laws of statistical mechanics to the study of material properties from the basic molecular constituents.		x	x	x
4	Solve real and hypothetical molecular statistical problems.		x	x	x

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Explain key concepts and theory of the topics of the course	1, 2, 3, 4	2 hrs/wk
2	Tutorial	Present solutions of the problem sets	1, 2, 3, 4	1 hr/wk

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Problem sets and midterm	1, 2, 3, 4	20	-	Yes

Continuous Assessment (%)

20

Examination (%)

80

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

5

Additional Information for ATs

For a student to pass the course, at least 5% of the maximum mark for the final examination must be obtained

Assessment Rubrics (AR)

Assessment Task

Problem sets and midterm (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts.

Excellent

(A+, A, A-) Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format

Good

(B+, B, B-) Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format

Fair

(C+, C, C-) Will exhibit a basic level of competence in understanding, explaining, and integrating the knowledge in written format

Marginal

(D) Will exhibit some deficiencies in understanding, explaining, and integrating the knowledge in written format

Failure

(F) Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

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Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts and physics theory.

Excellent

(A+, A, A-) Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format

Good

(B+, B, B-) Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format

Fair

(C+, C, C-) Will exhibit a basic level of competence in understanding, explaining, and integrating the knowledge in written format

Marginal

(D) Will exhibit some deficiencies in understanding about experimental methods and the interpretation of results

Failure

(F) Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

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Assessment Task

Problem sets and midterm (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts.

Excellent

(A+, A, A-) Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format

Good

(B+, B) Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format

Marginal

(B-, C+, C) Will exhibit some deficiencies in understanding, explaining, and integrating the knowledge in written format

Failure

(F) Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

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Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

1. Capacity for using physics knowledge and theory to solve problems 2. Demonstrate correct understanding of key concepts and physics theory.

Excellent

(A+, A, A-) Will exhibit a high level of competence in understanding, explaining, and integrating the knowledge in written format

Good

(B+, B) Will exhibit a good level of competence in understanding, explaining, and integrating the knowledge in written format

Marginal

(B-, C+, C) Will exhibit some deficiencies in understanding about experimental methods and the interpretation of results

Failure

(F) Will exhibit lack of competence in understanding, explaining, and integrating the knowledge in written format

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Part III Other Information

Keyword Syllabus

Ensembles (such as canonical ensemble and grand canonical ensemble), partition functions, Helmholtz and Gibbs free energies, partition functions applied into ideal monatomic gas and diatomic gas, Boltzmann Statistics, Fermi-Dirac and Bose-Einstein Statistics, chemical equilibrium, and applications to systems such as ideal gases, interfaces, liquid crystals, polymeric materials, crystalline solids, heat capacity of solids, and electrical conductivity.

Reading List

Compulsory Readings

	Title
1	Donald A. McQuarrie, “Statistical mechanics”, University Science Books, 2000

Additional Readings

	Title
1	Reif F., “Fundamentals of Statistical and Thermal Physics,” McGraw-Hill, New York, 1965
2	Richard P. Feynman, Statistical Mechanics: A Set of Lectures (CRC Press, 1998)