The Hashemite University
Faculty of Science
Department of Physics

Department: Physics	
Year: 2025/2026	**Semester:** First

Course Information	
Course Title	Statistical Mechanics and Thermodynamics
Course Number	102741
Course Credits	Three credit hours
Prerequisite	None
Course Duration	15-weeks
Instructor	**Prof, Dr. M.Al-Sugheir**
Course Time	11:30-13:00
Office Location	Phys./room 203
Office Phone	EXT. 4540
Office Hours	10-11 and 13-14, Monday and Wednesday
Useful Web Sites	http://phys.educ.ksu.edu; http://library.thinkquest.org http://www.utexas.edu http://www.phys.ksu.edu

Course Description
Statistical distributions: Maxwell-Boltzmann distribution, Bose-Einstein distribution, Fermi-Dirac distribution, canonical ensembles theory, grand canonical ensembles theory, statistical interpretation of thermodynamics functions, formulation of quantum statistics, first and second order phase transition .

Textbook	
Title	Statistical Mechanics
Authors	R. K. Pathria
Publisher	Butterworth-Heinemann
Year	1996
Edition	2^{th} edition

References

1. L. D. Landau and E. M. Lifshitz, *Statistical Physics*, Addison-Wesley (1969).
2. W. Greiner, L. Neise, and H. Stvcker, Thermodynamics and Statistical Mechanics, Springer-Verlag (1995).
3. Kerson Huang, *Thermodynamics and Statistical Physics*, Second Edition, Willey (1987).
4. F. Reif, *Fundamentals of Statistical and Thermal Physics*, McGraw-Hill (1965).
5. F. Mandel, *Statistical Physics*, Second Edition, John Wiley and Sons (1988).
6. Kerson Huang, *Introduction to statistical Physics*, Taylor and Francis (2002).
7. C. Kittel and H. Kroemer, *Thermal Physics*, Second Edition, W. H. Freeman (1980).

Evaluation Policy

Assessment Type	Expected Date	Weight
Homework		30%
Midterm Exam		30%
Final Exam		40%

Course Objectives

This course will give you a general background in advanced statistical mechanics, which is the basic tool of physics linking microscopic features of particles (e.g. position and momentum of atoms or molecules) to macroscopic properties of materials (e.g. pressure and temperature). The behaviour of single molecules, atoms etc. is governed by the laws quantum mechanics. These laws also apply to an assembly of many electrons, atoms or molecules, but their complexity of their solutions goes far beyond the capability of the brightest mind, such that their exact solution is generally impossible. The laws of thermodynamics can be derived from the microscopic quantum mechanical equations by the application of statistical methods.

The main aims of this course are:

Demonstrate how thermodynamic laws and results, applicable to collections of large numbers of particles, may be obtained from knowledge of the microscopic behaviour of the constituent particles in a macroscopic system using statistical mechanics.

Promote familiarity with statistical mechanics and thermodynamic principles and their application to a wide variety of systems (in condensed matter, solid state physics, nuclear physics, astrophysics etc.).

Introduce tools needed to describe collective behaviour that is at odds with classical statistical mechanics (e.g. Black-body radiation, the heat capacity of metals, Bose-Einstein condensation, neutron stars etc.).

Teaching and Learning Methods

1. Lecturing and special sessions for problems solving
2. Simulations: Some simulation programs on PC that cover some of the topics in this course will be demonstrated throughout the course period.

Course Contents			
Week #	**Topics**	**Sections**	**Chapter in Text**
1 & 2	The Statistical Basis of Thermodynamics	1-6	1
3 & 4	Elements of Ensemble Theory	1-5	2
5 & 6	The Canonical Ensemble	1-10	3
7 & 8	The Grand Canonical Ensemble	1-5	4
9 & 10	Formulation of Quantum Statistics	1-5	5
11	The Theory of Simple Gases	1-5	6
12	Ideal Bose Systems	1-5	7
13	Ideal Fermi Systems	1-6	8
14 & 15	Statistical Mechanics of Interacting Systems	1-9	9