هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	Statistical Thermodynamics
Course Code:	PHY3505
Program:	Physics
Department:	Physics
College:	Applied sciences
Institution:	Umm AL-Qura University

Table of Contents

A. Course Identification

1. Credit hours:4
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 7^{th} /3^{rd} **year**
4. Pre-requisites for this course (if any): Heat and Thermodynamics
5. Co-requisites for this course (if any):

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	40	100%
2	**Blended**	-	-
3	**E-learning**	-	-
4	**Distance learning**	-	-
5	**Other**	-	-

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	40
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	40

B. Course Objectives and Learning Outcomes

1. Course Description

The course will give the new mathematical treatment based on the concept of the probability and statistical mechanics to measure microscopic properties of the system to calculate the dependence of the macroscopic properties of a system on thermodynamic variables.

2. Course Main Objective

In this course student will be able to

1. realize the difference between macroscopic and microscopic thermodynamic- energy levels and energy states - distinguishable and indistinguishable particles.
2. define the concept of the thermodynamic probability and how to deal with some physical applications through this concept.
3. differentiate between Bose- Einstein, Fermi-Dirac and Maxwell Boltzmann statistics
4. compare between Bose- Einstein, Fermi-Dirac and Maxwell Boltzmann distribution functions and their uses
5. define the concept of the partition function and redefine the thermodynamic quantities in terms of the partition function.
6. apply the statistics on gases and the quantum statistics on some physical systems.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Define basic principles in statistical thermodynamics.	K1
1.2	Describe the mathematical form for Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann distributions and the conditions of applying each one.	K2
2	**Skills :**	
2.1	Solve problems using suitable statistical methods to calculate some thermo-dynamical properties in terms of partition function.	S1
2.2	Explain the difference of statistical distributions (Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein) and apply them appropriately.	S2
3	**Values:**	
3.1	Collaborate and contribute responsibly and effectively in teamwork by introducing presentation in some subjects of course.	V2

C. Course Content

No	List of Topics	Contact Hours
1	**Statistical thermodynamics** 1.1 Introduction 1.2 Energy States and energy levels 1.3 Macro states and microstates 1.4 Thermodynamic probability 1.5 The Bose-Einstein statistics 1.6 The Fermi-Dirac statistics 1.7 The Maxwell Boltzmann statistics 1.8 The statistical interpretation of entropy 1.9 The Bose-Einstein distribution function 1.10 The Fermi-Dirac distribution functions 1.11 The classical distribution function 1.12 comparison of distribution functions for indistinguishable particles 1.13 The Maxwell-Boltzmann distribution function 1.14 The partition function 1.15 Thermodynamic properties of a system	13
2	**Applications of statistics to gases** 2.1 The monatomic ideal gas, 2.2 The distribution of molecular velocities 2.3 Experimental verification of the Maxwell-Boltzmann speed distribution-Molecular beams 2.4 Ideal gas in a gravitational field 2.5 The principle of equipartition of energy 2.6 The quantized linear oscillator 2.7 specific heat capacity of a diatomic gas.	13
3	**Applications of quantum statistics to other systems :** 3.1 The Einstein theory of the specific heat capacity of a solid 3.2 The Debye theory of the specific heat capacity of a solid 3.3 Black body radiation, 3.4 Para-magnetism 3.5 Negative temperatures 3.6 The electron gas.	14
Total		40

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	Knowledge and Understanding		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.1	Define basic principles in statistical thermodynamics.	1. Demonstrating the basic information and principles through lectures. 2. Lecturing method: Board- Power point. 3. Discussions 4. Brain storming. 5. Start each chapter by general idea.	1. Solving examples in lectures. 2. Discussion during lecture. 3. Quizzes. 4. Mid-term. 5. Final exam. 6. Homework.
1.2	Describe the mathematical form for (Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann) statistics and distributions function and the conditions of applying each one.	1. Demonstrating the basic information and principles through lectures. 2. Lecturing method: Board, Power point. 3. Discussions 4. Brain storming.	1. Quizzes. 2. Mid-terms. 3. Final exams. 4. Homework.
2.0	**Skills**		
2.1	Solve problems using suitable statistics to calculate some thermo-dynamical properties in terms of partition function.	1. Following some proofs. 2. Define duties for each chapter. 3. Homework 4. Encourage the student to look for the information in different references.	1. Quizzes. 2. Mid-term. 3. Final exam. 4. Homework.
2.2	Explain the difference of statistical distributions (Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein) and apply them appropriately.	1.Encourage the student to look for the information in different references 2.Group discussions	1. Quizzes. 2. Mid-term. 3. Final exams. 4. Homework.
3.0	**Values**		
3.1	Collaborate and contribute responsibly and effectively in teamwork by introducing presentation in some subjects of course.	1.Team work projects 2. Solving problems	Presentations

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm	7th week	30 %
2	Home works, quizzes, activities	During the semester	20 %
3	Final Exam	End of the semester	50%
4			
5			
6			
7			
8			

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :
4 office hours per week for support and advice students

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	**Thermodynamics, Kinetic theory, and statistical thermodynamics,** F.W. Sears and G.L. Salinger (1975).
Essential References Materials	**Introduction to statistical physics**, k. Huang (2001).
Electronic Materials	
Other Learning Materials	**Fundamentals of Statistical and Thermal Physics**, R. Reif (2008)

2. Facilities Required

Item	Resources
Accommodation (Classrooms)	• good ventilation and lighting room suitable for number of students • board
Technology Resources (AV, data show, Smart Board, software, etc.)	• data show • laptop
Other Resources	

Item	Resources
(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Teaching Strategies	Students	Questionnaire
Student assessment	Instructor	Exams
Course learning outcomes	Instructor	Course report
Quality of learning resources	Instructor	Course report

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Physics department**
Reference No.	
Date	**17/3/2022**