Course Specification

(Postgraduate Programs)

Course Title:	**Statistical Mechanics**
Course Code:	**PHYS604**
Program:	Master of Science in Physics
Department:	**Physical Sciences**
College:	**Science**
Institution:	**Jazan University**
Version:	
Last Revision Date:	20/4/2024

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 2/year 1)					
4. Course general Description: **This course covers topics such as Review of classical physics: basic idea of statistics and thermodynamics; Kinetic theory of gas: phase space representation, Liouville's theorem, statistical ensembles, relation with thermodynamics, partition function, application of partition function, equipartition theorem; Quantum statistical mechanics: density matrix, expectation value, statistical ensembles, quantum statistical formulations, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, idea gas (ideal Bose and ideal Fermi), relation with statistics.**					
5. Pre-requirements for this course (if any)**:** Non					
6. Co-requirements for this course (if any)**:** Non					
7. Course Main Objective(s):					

7. Course Main Objective(s)

The main objectives of this course are focused on the following:

- **Apply the basic relation of statistical and thermodynamic concepts in both classical an quantum regimes.**
- **Distinguish between the interpretations in terms of classical and quantum statistical mechanic**
- **Perform relevant parameters using the methods of statistical mechanics.**
- **Describe the theoretical and mathematical background of statistical mechanics.**
- **Apply methods of statistical mechanics to study physical systems.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding: Upon completing the course students will be able to**			
1.1	**Describe** some essential concepts such as idea gas, formulation of statistical physics, statistical postulates in equilibrium statistics,	PLO1.1	Lectures, discussion comparisons	**Direct** : In class interactive questioning, quizzes, written exams **Indirect:** student survey

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	significance of particle and energy exchange.			
1.2	**Discuss** basics ideas such as phase space representation, statistical ensembles, various statistics, relation with thermodynamics	PLO1.2	Lectures, discussion	**Direct** : In class interactive questioning, quizzes, written exams **Indirect:** student survey
...				
2.0	**Skills: Upon completing the course students will be able to**			
2.1	**Obtain** basic laws or equations such as equipartition theorem, partition for various ensembles and cases, various distribution functions	PLO2.1	Lectures, discussion	**Direct** : In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.2	**Apply** laws of statistical physics to find specific distribution functions in classical and quantum regime, relation of statistical and thermodynamic laws, various thermodynamics parameters.	PLO2.1	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.3	**Solve** some basic problem of interest such as calculating the partition function, expectation values, variances, specific heat, pressure, energy	PLO2.1	Lectures, discussion, Tutorial	**Direct** : In class interactive questioning, quizzes, written exams **Indirect:** student survey
3.0	**Values, autonomy, and responsibility: Upon completing the course students will be able to**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	**Apply** practices of life-long learning in various physics topics and scientific disciplines.	PLO3.2	Expository and Discovery, and Interactive Discussions.	Group assignments, discussion
3.2	**Demonstrate** abilities of team work, bear individual responsibilities on assigned tasks	PLO3.3	Expository and Discovery, and Interactive Discussions.	Group assignments, discussion
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	Short review of statistical physics: review of preliminary concepts and description of systems in statistical mechanics, correlations, central limit theorem	3
2.	Kinetic theory of gas: Kinetic theory, phase space, Liouville's theorem, the Boltzmann equation, transport phenomena; Classical statistical mechanics, phase space dynamics and entropy, the micro-canonical ensemble, canonical and grand-canonical ensembles, equi-partition theorem, Maxwell-Boltzmann distribution	21
3	Quantum statistical physics : Quantum statistical Mechanics, quantization effects, Bose-Einstein and Fermi-Dirac statistics, density matrix formulation, quantum gases, Fermi liquids, Bose condensation.	21
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Assignments, and Classroom Activities**	**3,5,7,13**	**20**
2.	**Mid-term exams**	**6,12**	**30**
3.	**Final Exam**	**16**	**50**

Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	1. R. K. Pathria and P. D. Beale, Statistical Mechanics (Butterworth-Heinemann, 2011)
Supportive References	1. Mehran Kardar, Statistical Physics of Particles (Cambridge University, press, 2007). 2. D.A. McQuarrie, Statistical Thermodynamics (University, Science Book 2000). 3. K. Huang, Statistical Mechanics, 2nd edition (John Wiley and Sons, 1987)
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Class room
Technology equipment (Projector, smart board, software)	Data show- smart boar
Other equipment (Depending on the nature of the specialty)	none

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Department Council
REFERENCE NO.	Psci2415
DATE	1/10/2024