Form: Course Syllabus		
	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
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	Number of Pages	06

1.	**Course Title**	Statistical Mechanics - 2
2.	**Course Number**	0302956
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	-
5.	**Program Title**	PhD in Physics
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Physics
9.	**Course Level**	PhD
10.	**Year of Study and Semester (s)**	TBA
11.	**Other Department(s) Involved in Teaching the Course**	none
12.	**Main Learning Language**	English
13.	**Learning Types**	x**Face to face learning** ☐Blended ☐Fully online
14.	**Online Platforms(s)**	☐Moodle ☐Microsoft Teams
15.	**Issuing Date**	Dec. 2025
16.	**Revision Date**	

17. Course Coordinator:

Name: Usama Al Kh0awaja	Contact hours: TBA
Office number:	Phone number:
Email:	

18. Other Instructors:

19. Course Description:

Quantum Statistics and the Density Matrix; Quantum Statistics of the Various Ensembles and Examples; The Ideal Bose Gas; Photons and Phonons; Bose-Einstein Condensation; The Ideal Fermi Gas; Magnetic Behavior of An Ideal Fermi Gas; The Electron Gas in Metals; Special Topics from: Phase Transitions; Spin-Spin Correlation; The Ising Model.

20. Program Intended Learning Outcomes: (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

1. **SO1:** to be able to demonstrate an advanced and comprehensive understanding of core physics concepts and specialized knowledge in a chosen field of research, contributing to the frontier of physics.
2. **SO2:** to be able to develop and execute independent, original research projects that address complex scientific problems, advancing theoretical and experimental physics.
3. **SO3:** to be able to apply advanced mathematical and computational techniques to analyze complex physical phenomena and critically evaluate scientific literature and experimental results.
4. **SO4:** to be able to effectively communicate complex physics concepts, research findings, and their significance through academic writing, presentations, and public outreach.
5. **SO5:** to be able to adhere to high ethical standards and professional responsibility in conducting research, including data integrity, ethical treatment of subjects, and the responsible use of resources.
6. **SO6:** to be able to demonstrate leadership and collaborative skills within multidisciplinary teams, contributing to the development of new scientific knowledge and promoting knowledge-sharing across disciplines.
7. **SO7:** to be able to cultivate the ability to adapt to new scientific advancements and continuously engage in professional development to contribute to innovation in the field of physics.
8. **SO8:** to be able to master experimental and computational techniques relevant to the research field, demonstrating competency in operating and developing specialized physics instrumentation and software.

21. Course Intended Learning Outcomes: (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. (Knowledge A1) **Explain the difference between classical and quantum statistics**

2. (Skills B1) **Derive quantum statistics based on quantum Physics principles and ensemble theory.**

3. (Skills B2)	**Apply statistical Physics theory to the classical and quantum ideal gases, weakly interacting gases including the electron gas, magnetic systems.**
4. (Competences C1)	**Formulate the quantum statistical Physics theory for phase transitions, spin systems, and Ising model.**
5. (Competences C2)	**Formulate the second quantization for spin systems and electron gas.**

Course ILOs	**The learning levels to be achieved**					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
1		**x**				
2			**x**			
3			**x**			
4						**x**
5						**x**

٢٢. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Course ILOs / Program ILOs	ILO (1)	ILO (2)	ILO (3)	ILO (4)	ILO (5)
1	x	x	x	x	x
2					
3		x	x	x	x
4					
5					
6					
7					
8					

٢٣. Topic Outline and Schedule:

Week	Lecture	Topic	ILO/s Linked to the Topic	Learning Types	Platform Used	Synchronous / Asynchronous	Evaluation Methods	Learning Resources
1	1.1	Quantum Statistics and the Density Matrix	1					
	1.2	Quantum Statistics and the Density Matrix;	1					
	1.3	Quantum Statistics and the Density Matrix;	1					
2	2.1	Quantum Statistics and the Density Matrix;	1					
	2.2	Quantum Statistics and the Density Matrix;	1					
	2.3	Quantum Statistics and the Density Matrix;	1					
3	3.1	The Ideal Bose Gas;	2,3					
	3.2	The Ideal Bose Gas;	2,3					
	3.3	The Ideal Bose Gas;	2,3					
4	4.1	Magnetic Behavior of An Ideal Fermi Gas	2,3					
	4.2	Magnetic Behavior of An Ideal Fermi Gas	2,3					
	4.3	Magnetic Behavior of An Ideal Fermi Gas	2,3					
5	5.1	Bose-Einstein Condensation	2,3					
	5.2	Bose-Einstein Condensation	2,3					
	5.3	Bose-Einstein Condensation	2,3					
6	6.1	Weakly interacting systems	2,3					
	6.2	Weakly interacting systems	2,3					
	6.3	Weakly interacting systems	2,3					
7	7.1	Weakly interacting systems	2,3					
	7.2	Weakly interacting systems	2,3					
	7.3	Weakly interacting systems	2,3					
8	8.1	Strongly interacting systems	2,3					
	8.2	Strongly interacting systems	2,3					
	8.3	Strongly interacting systems	2,3					
9	9.1	The Electron Gas in Metals	2,3					
	9.2	The Electron Gas in Metals	4,5					
	9.3	The Electron Gas in Metals	4,5					
	10.1	The Electron Gas in Metals	4,5					
	10.2	The Electron Gas in Metals	4,5					

10	10.3	The Electron Gas in Metals	4,5					
11	11.1	Spin-Spin Correlation;	4,5					
	11.2	Spin-Spin Correlation;	4,5					
	11.3	Spin-Spin Correlation;	4,5					
12	12.1	Spin-Spin Correlation;	4,5					
	12.2	Spin-Spin Correlation;	4,5					
	12.3	Spin-Spin Correlation;	4,5					
13	13.1	The Ising Model	4,5					
	13.2	The Ising Model	4,5					
	13.3	The Ising Model	4,5					
14	14.1	Phase Transitions	4,5					
	14.2	Phase Transitions	4,5					
	14.3	Phase Transitions	4,5					
15	15.1	Phase Transitions	4,5					
	15.2	Phase Transitions	4,5					
	15.3	Phase Transitions	4,5					

٢٤. Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	ILO/s Linked to the Evaluation activity	Period (Week)	Platform
Test1	20	TBA	1,2	TBA	Paper exam
Test2	20	TBA	3,4	TBA	Paper exam
Project and presentation	30	TBA	1,2,3,4,5	TBA	presentation
Final exam	30	TBA	1,2,3,4,5	TBA	Paper exam

٢٥. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform…etc.):

2٦. Course Policies:

A- Attendance policies:
B- Absences from exams and submitting assignments on time:
C- Health and safety procedures:
D- Honesty policy regarding cheating, plagiarism, misbehavior:
E- Grading policy:
F- Available university services that support achievement in the course:

2٧. References:

A- Required book(s), assigned reading and audio-visuals:
TBA
B- Recommended books, materials, and media:
TBA

2٨. Additional information:

Name of the Instructor or the Course Coordinator:	Signature:	Date:
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Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
…….	……..……	……..……
Name of the Head of Department	Signature:	Date:
…….	……..……	……..……
Name of the Head of Quality Assurance Committee/ School or Center	Signature:	Date:

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Name of the Dean or the Director	Signature:	Date:
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