Form: Course Syllabus		
	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	23/01/2023
	Number of Pages	06

1.	**Course Title**	Statistical Physics
2.	**Course Number**	0302447
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	Thermal Physics (0332341)
5.	**Program Title**	Physics
6.	**Program Code**	2
7.	**School/ Center**	Science
8.	**Department**	Physics
9.	**Course Level**	Senior (fourth year)
10.	**Year of Study and Semester (s)**	2024/2025, Second Semester
11.	**Other Department(s) Involved in Teaching the Course**	None
12.	**Main Learning Language**	English
13.	**Learning Types**	☒Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	☐Moodle ☒Microsoft Teams
15.	**Issuing Date**	03/2/2025
16.	**Revision Date**	11/6/2025

17. Course Coordinator:

Name: Sami Mahmood Contact hours: 10:30 – 11:30, Sunday Tuesday Thursday

Office number: 17 Phone number: 22023

Office hours: 12:00 – 1:00 Sunday, Tuesday, Thursday, and 11:30 – 12:30 Wednesday

Email: s.mahmood@ju.edu.jo

18. Other Instructors:

Name:
Office number:
Phone number:
Email:
Contact hours:
Name:
Office number:
Phone number:
Email:
Contact hours:

19. Course Description:

Macroscopic and microscopic description of a system; Classical postulate of statistical mechanics; Microcanonical ensemble; Statistics of ideal gases: classical gas, bosons, fermions; Canonical ensemble; Grand canonical ensemble; Partition functions; Thermodynamic functions; Photon gas and Planck's law of black-body radiation; Bose-Einstein Condensation

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)

For purposes of mapping the course ILOs to the physics program ILOs, at the successful completion of the physics program, graduates are expected to be able to:

SO1: Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline.

SO2: Formulate or design a system, process, procedure or program to meet desired needs.

SO3: Develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.

SO4: Communicate effectively with a range of audiences in oral or written forms and exhibit ethical and professional values.

SO5: Reflect the impact of technical and/or scientific solutions in economic, environmental, and societal contexts.

SO6: Function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

21. Course Intended Learning Outcomes

Upon completion of the course, the student will be able to:

CLO1: Define the macrostate of a system at equilibrium and enumerate the corresponding microstates
CLO2: Calculate the entropy of a macroscopic system from the statistical weight of its macrostate and derive the conditions for the equilibrium state.
CLO3: Derive the entropy of the perfect classical gas in the microcanonical ensemble.
CLO4: Derive and apply the Maxwell-Boltzmann (MB) statistics for the ideal classical gas.
CLO5: Derive and apply the Bose-Einstein (BE), and Fermi-Dirac (FD) statistics for quantal gases, and determine the criterion for the classical regime.
CLO6: Determine the canonical and grand canonical distributions, and the corresponding partition functions
CLO7: Derive the thermodynamic parameters and potentials for the ideal gas
CLO8: Apply Bose-Einstein statistics to investigate Black-Body radiation and BE condensation

Course ILOs	The learning levels to be achieved					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
CLO1	✓	✓	✓			✓
CLO2	✓	✓	✓			
CLO3		✓	✓	✓		
CLO4		✓	✓		✓	
CLO5		✓	✓		✓	
CLO6		✓	✓		✓	
CLO7		✓	✓		✓	
CLO8		✓	✓	✓		✓

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

Program ILOs / Course ILOs	SO1	SO2	SO3	SO4	SO5	SO6
CLO1	✓	✓				
CLO2	✓					
CLO3	✓	✓				
CLO4	✓	✓				
CLO5	✓	✓				
CLO6	✓					
CLO7	✓					
CLO8	✓					

23. Topic Outline and Schedule:

Week	Lecture	Topic	ILO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully Online)	Platform Used	Synchronous / Asynchronous Lecturing	Evaluation Methods	Learning Resources
1 23/2	1.1	Introduction						
	1.2	Macroscopic Physics	CLO1					
	1.3	Microstates of a spin ½ system	CLO1					
2 2/3	2.1	Statistical weight of the macrostate	CLO2					
	2.2	Entropy and the directionality of thermodynamic processes	CLO1 CLO2					
	2.3	Statistical Fluctuations	CLO1					
3 9/3	3.1	Postulate of classical statistical mechanics	CLO1 CLO2					
	3.2	Conditions of the equilibrium state	CLO2					

	3.3	Time average vs. ensemble average	CLO2					
4 16/3	4.1	Ensemble average of the entropy of a macroscopic system	CLO2					
	4.2	Volume of phase space and the entropy of the ideal classical gas	CLO3					
	4.3	The entropy of mixing and Gibbs Paradox	CLO1 CLO2					
5 23/3	5.1	Thermodynamics of the ideal classical gas	CLO3					
	5.2	Distribution over energies and the weight of the configuration of an ideal classical gas	CLO2					
	5.3	The most probable distribution	CLO4					
6 30/3	Eid Al-Fitr							
	6.3	Applications of Maxwell-Boltzmann statistics	CLO4					
7 6/4	7.1	Statistics of a quantum gas in the microcanonical ensemble	CL5					
	7.2	Bose-Einstein statistics	CLO5					
	7.3	Validity criterion of the classical regime	CLO5					
8 13/4	8.1	Fermi-Dirac Statistics	CLO5					
	Sunday, 15/4/2025, 8:30 – 9:20, First Exam							
	8.3	Fermi Energy	CLO5					
9 20/4	9.1	Equilibrium of a closed system in a heat bath at constant temperature	CLO6					
	9.2	Boltzmann distribution and the partition function	CLO6					
	9.3	The canonical ensemble	CLO6					
10 27/4	10.1	Energy fluctuations	CLO6					
	10.2	Statistics and thermodynamics	CLO6					
	Labor Day							
11 4/5	11.1	Partition function of the ideal classical gas	CLO6					
	11.2	The basic statistical quantity in the canonical ensemble, and the thermodynamics of the ideal classical gas	CLO7					
	11.3	Equilibrium of an open system in contact with a heat and particle reservoir at a fixed temperature	CLO6					

12 11/5	12.1	The grand canonical distribution	CLO6					
	12.2	The grand partition function and the grand potential	CLO6					
	Thursday, 15/5/2025, 8:30 – 9:20, Second Exam							
13 18/5	13.1	Statistics and thermodynamics	CLO7					
	13.2	Ideal classical and quantal gases in the grand canonical ensemble	CLO4 CLO7					
	13.3	Bose-Einstein condensation	CLO8					
14 25/5	Independence Day							
	14.2	Bose-Einstein condensation	CLO8					
	14.3	Bose-Einstein condensation	CLO8					
15 1/6	15.1	Black-body radiation	CLO8					
	15.2	Black-body radiation	CLO8					
		Wednesday, 4/6/2025 is the last day of teaching. 11/6/2025 – 24/6/2025 is the period of final exams						

24. 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
First Exam	20	Macrostate and microstates, entropy, and	CLO1 – CLO3	Week 8 (15/04/2025)	
Second Exam	30	Statistics of ideal gases, and the canonical ensemble	CLO4 – CLO6	Week 12 (15/05/2025)	
Final Exam	50	All course content	CLO1 – CLO8		

25. Course Requirements:

Each student should have access to a computer & internet connection

26. Course Policies:

A- Attendance policies:

Attendance is mandatory. Students who record absences more than the legally acceptable limit **may lose their chance to sit for the final exam of the course**.

B- Absences from exams and submitting assignments on time:

False medical reports and other devious ways to avoid taking exams on time are not acceptable. The students are encouraged to handle their responsibilities and develop **positive learning attitudes**.

C- Health and safety procedures:

Follow the instructions regarding health and safety procedures in the university.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

The course is designed to provide students with learning opportunities. Group work and discussions accompanied with individual input and hard work are encouraged to fulfill the objectives of the course, whereas **cheating and misbehavior are completely unacceptable**.

E- Grading policy:

The grading policy aims at evaluating the learning outcomes of the students, and their capacity to apply their knowledge in solving-real life problems.

F- Available university services that support achievement in the course:

- ✓ E-learning resources
- ✓ Microsoft Teams
- ✓ Smart Class rooms

Computer facilities

27. References:

A- Required book(s), assigned reading and audio-visuals:

*Textbook: F. Mandl; Statistical Physics, (John Wiley & Sons, New York, 1971)
Power point presentations and illustrations designed to explain the contents of the course.

B- Recommended books, materials, and media:

[1] A.J Pointon, An Introduction to Statistical Physics for Students, (Longman, London, 1967)
[2] C. Kittel and H. Kroemer, Thermal Physics, 2nd Ed., (W. H. Freeman & Co., San Francisco, 1980)
[3] R. K. Pathria, Statistical Mechanics, (Pergamon Press, New York, 1972)

28. Additional information:

Name of the Instructor or the Course Coordinator: Sami H. Mahmood	Signature: 	Date: 3/2/2025
Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
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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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