



Lahore University of Management Sciences

PHY 313: Statistical Mechanics

(For BS, Credit Hours: 4)

PHY 510: Advanced Statistical Mechanics

(For MS/PhD, Credit Hours: 3)

Fall 2023

Instructor	Muhammad Faryad
Room No.	9-119A
Office Hours	TBA in Class
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Course URL (if any)	

Course Basics				
Credit Hours	4			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	1:50 hours
Lab/Tutorial per week	Nbr of Session(s) Per Week		Duration	

Course Distribution	
Core	
Elective	Elective

COURSE DESCRIPTION
This course will have three parts. The first part will deal with phenomenological thermodynamics. We will study laws of thermodynamics, various potentials, and phase transitions. The second part will deal with statistical methods for physics. We will study various probability distributions and their properties, fundamental concepts of estimation and likelihood of a model representing a given data, and the role of uncertainty and error in it. The third part will deal with the equilibrium and non-equilibrium statistical mechanics to understand properties of materials.

COURSE PREREQUISITE(S)
For Undergrad Students: PHY 101: Mechanics, PHY 104: Modern Physics For Graduate Students: None

Class Learning Outcomes
Students will learn how to <ol style="list-style-type: none">1- Determine properties of various probability distributions and2- Derive models based on given data from by hypothesizing a probability distribution3- Apply statistical methods for understanding thermal physics and material properties4- Use random variables and Monte Carlo methods to estimate material properties

Grading Breakup and Policy
Assignment(s): 30% Midterm I: 10% Midterm II: 20% (Cumulative) Final Exam: 40% (Cumulative)



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COURSE OVERVIEW

Modules	Topics	Recommended Readings	Objectives/ Application
1	Laws of Thermodynamics, Thermodynamic Potentials, Stability of Equilibrium State		
2	Thermodynamic Phase Transitions, Pure PVT Systems, Helium Liquids, Landau Theory, Critical Exponents, Binary Mixes		
3	Probability Distributions, Central Limit Theorem, Random Walks, Lattice Random Walks, Continuous Distributions		
4	Stochastic Dynamics, Master Equations, Brownian Motion, Markov Chains, Fokker—Plank Equations		
5	Equilibrium Statistical Mechanics, Microcanonical, Canonical, and Grand canonical Ensembles, Fluctuation Theory, Systems of Identical Particles, Ideal Quantum Gases		
7	Non-equilibrium Statistical Mechanics, Elementary Transport Theory, Boltzmann Equation, Diffusion Equation		
8	Ising Model of Ferromagnets, Exact Solution, Mean field approximation, Monte Carlo Simulation		

Textbook(s)/Supplementary Readings

Reichl, A Modern Course in Statistical Physics, Second Edition, 1998
Schroeder, Introduction to Thermal Physics, 2000

Academic Policies

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (<http://surl.li/gpvwb>), and 2) Understanding and Avoiding Plagiarism (<http://surl.li/gpvwo>).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (<https://rb.gy/8sj1h>)



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Harassment Policy

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (<http://surl.li/gpvwt>)*

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (<https://advising.lums.edu.pk/advising-resources>), etc. To view all support services, their specific role as well as contact information click here (<https://advising.lums.edu.pk/#supportservices>).

Rights and Code of Conduct for Online Teaching

A misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.