PHYS 303
Thermal and Statistical Physics
Fall 2018

Instructor: Can Ataca
E-mail: ataca@umbc.edu (expect a response in 48 hours, excluding breaks and weekends)
Office: PHYS 315
Office phone: 410-455-2821
Office hours: TBD, or by appointment

Prerequisite: PHY324 (Modern Physics), MATH251 (Multivariable Calculus)

Lecture Hours: Monday, Wednesday, Friday 11:00-11:50 AM

Classroom: Physics 201

Textbook: Daniel V. Schroeder, *An Introduction to Thermal Physics,* ISBN: 0-201-38027-7
(Recommended) Stephan J. Blundell and Katherine M. Blundell, *Concepts in Thermal Physics*, ISBN: 978-0-19-956210-7
(Recommended) Kerson Huang, *Introduction to Statistical Physics*, ISBN: 978-1-4200-7902-9

Course Objectives: In a single sentence, this course is a bridge linking large scale properties to quantum sizes. Thermal physics deals with materials at large scales (anything you see, touch, …) Instead of following every detail (such as movements of electrons, phonons, …) we use the laws of probability to predict how the bulk material behave. However, to understand matter in more details at quantum scale, we must make a connection between how a single and mole of atoms behave using the laws of statistics. Combining thermodynamics with quantum mechanical principles (naming it as "statistical mechanics"), we then not only predict the principles of thermodynamics, but also explain why thermodynamic principles are what they are.

At the end of this course, you should be able to:

1. Derive thermodynamic properties of a model system (work done, internal energy, heat capacities, enthalpy, …)
2. Understand how thermodynamic properties differ in interacting systems.
3. Apply thermodynamic rules to and calculate thermodynamic parameters of engines and refrigerators.

4. Understand and predict changes in thermodynamic variables during phase transformations.
5. Apply the Fermi distribution and Bose-Einstein distributions to model real life problems/examples.

Weekly Schedule:

Week of	Subject
Aug 29th - 1	Thermal Equilibrium, Ideal Gas
Sept. 3rd - 2	Equipartition Theorem, Heat and Work,
Sept. 10th – 2+1	Heat Capacities, Rates of Process, **Quiz-1**, Two-State Systems
Sept. 17th – 3	Einstein Model of Solid, Interacting Systems, Ideal Gas, Entropy
Sept. 24th – 1+2	**Midterm-1**, Temperature, Entropy and Heat
Oct. 1st – 2 +1	Paramagnetism, Equilibrium and Pressure, Diffusion, Chemical Potential, **Quiz-2**, Heat Engines
Oct. 8th – 2 + 1	Real Engines and Refrigerators
Oct. 15th- - 1 + 2	**Midterm-2**, Energy as Available Work and Force
Oct. 22th – 3	Phase Transformations
Oct. 29th – 3	Dilute Solutions, Chemical Equilibrium, **Quiz-3**
Nov. 5th – 3	Boltzmann Factor, Equipartition Theorem, Maxwell Distribution
Nov. 12th – 2+1	Partition Function, Ideal Gas, **Midterm-3**
Nov. 19th – 3	Gibbs Factor, Bosons and Fermions
Nov. 26th – 3	Degenerate Fermi Gas, Black Body Radiation, Debye Theory of Solids
Dec. 3rd – 2 + 1	Bose-Einstein Condensation, **Quiz-4**, Weakly Interacting Particles
Dec. 10th - 1	The Ising Model of Ferromagnet

Grading:

Your final grade will be determined by:

Final Exam:	25%
3 Mid-Term Exams:	10% + 2 x 15%
Quizzes:	4 x 5%
Homework:	10%
Attendance:	5%

Your letter grade will depend on the total score. If your total grade is:

≥ 85 , your letter grade will be		"A"
$85 > X \geq 70$, then		"B"
$70 > X \geq 60$, then		"C"
$60 > X \geq 50$, then		"D"
$50 > X$,	then	"F"

Midterms and Final Exam: Three mid-term exams will take place during the semester, during the scheduled class time. The dates of the mid-term exams are September 24th (Mon.), October 15th (Mon.) and Nov. 16th (Fri.) 2018. These dates may subject to change. The date of final exam will be determined by the university and it is on Dec. 14th, 2018 (Fri.). Exams will include all the course material covered up to the day of the exam, if not informed otherwise. All of the exams are closed book. At least one question of each exam will be similar to the ones given in homework/quizzes. You may bring one page of **YOUR** hand-written notes into exams. (no photocopies, print-outs are allowed.)

Quizzes: There will be four quizzes. Quizzes will be closed book exams, might take place in any time of the class. It will not be longer than half of the class period. They will be related with the topics covered on that chapter of the book.

Attendance: Attendance (more than %50) is required in order not to fail the course.

Homework: Homework assignments will be available on the Blackboard page on every Wednesday, and are due at the beginning of class next Wednesday, unless you are told otherwise. No late assignments will be accepted. I planned to assign weekly (~total of 14) homework. The top 10 highest graded homework will be counted towards your grading. This is meant to allow for things that come up unexpectedly.

Make-up policy: If you miss a quiz/midterm, you should provide document from legal authorities. If not, your score will be zero and you will not be given an opportunity to retake the make-up exam.

Academic Integrity: By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.

**** Check Blackboard page of the course regularly to get updated information of the course, grades, homework and class notes.**