Course Information

Course Information

Course Number/Section	**PHYS 4311.001**
Course Title	**Thermodynamics and Statistical Mechanics**
Term	**Spring 2013**
Days & Times	**Tuesday/Thursday, 10:00 AM – 11:15 AM**
Location	**FN 2.104**

Professor Contact Information

Professor	**Mark Lee**
Office Phone	**972-883-2863**
Email Address	**marklee@utdallas.edu**
Office Location	**ECSN 2.904**
Office Hours	**1-3 PM Wednesdays, or by appointment**

Prerequisites / Corequisites:

Prerequisite: PHYS 2326 or 2422 or equivalents, Corequisite: PHYS 3411 or 3311 or equivalents

Course Description:

Study of the elements of thermodynamics, kinetic theory, and statistical mechanics; the concepts of temperature, entropy, phase transitions, transport phenomena, partition functions, statistical ensembles; the Maxwell Boltzmann, Fermi-Dirac, and Bose-Einstein distributions; and the equipartition theorem. Applications of the theories will be considered.

Student Learning Objectives/Outcomes:

The objective of this course is to give students a rigorous introduction to and understanding of the basic foundations of thermodynamics and statistical mechanics.

Objectives	Outcomes/Measures
Understand rigorous scientific definitions of temperature, equilibrium, heat, and work	Summaries and Problem solving in Homework/Exams
Understand and apply zeroth and first laws of thermodynamics	Summaries and Problem solving in Homework/Exams
Understand and apply the concept of entropy and second law of thermodynamics	Summaries and Problem solving in Homework/Exams
Understand the equipartition theorem and the partition function	Summaries and Problem solving in Homework/Exams
Describe the statistical nature of many-particle ensembles in the large N limit	Summaries and Problem solving in Homework/Exams
Understand classical and quantum statistical distributions	Summaries and Problem solving in Homework/Exams
Be able to apply thermodynamic and statistical mechanics concepts to problems in energy transport, engine efficiency, and phase transitions	Summaries and Problem solving in Homework/Exams

Required Textbook:
An Introduction to Thermal Physics, by Daniel V. Schroeder, © 2000, Addison Wesley Longman; ISBN-13: 978-0201380277
(This is the same text used last year)

Suggested Textbooks:
Fundamentals of Statistical and Thermal Physics by Frederick Reif, © 1965, McGraw-Hill; ISBN-13: 978-0070518001
(This is the classic textbook on this subject. Detailed and rather boring, but it is an invaluable reference for any professional who deals with thermodynamics or statistical mechanics.)

Thermal Physics (2nd ed.) by Charles Kittel and Herbert Kroemer, © 1980, W. H. Freeman; ISBN-13: 978-0716710882

Course Mechanics:
There will be one homework assignment each week, handed out and due on Thursdays, except for the week preceding an exam. Assignments will be posted on the e-Learning website for this course. Students may work together on homework assignments, but what you turn in should be an honest reflection of your own understanding.

Grading Policy:
10% Homework Score; 25% Hour Exam 1 Score , 25% Hour Exam 2 Score; 40% Final Exam Score (Total 100%). If the Final Exam Score is better than the Homework or either Hour Exam Scores, then the Final Exam Score will be substituted in place of the lower score in computing the course grade.

General Course Policies:
Make-up exams: None. If you miss an hour exam, your final exam score will stand in for that missing hour exam.
Late Work: Not accepted.
Special Assignments: None
Class Attendance: Highly advised, but not required.

Plan of Study

(considered tentative, subject to change as we go along)

Date (2012)	Text Chapters	Topic
1/15	--	Overview, Historical Context, Temperature, Energy, & Heat
1/17	1.1 to 1.3	Equilibrium, Equipartition, & Ideal Gas Model
1/22	1.4 to 1.5	Heat and Work, Equation of State, First Law
1/24	1.6 to 1.7	Heat and Energy Storage & Transport, Enthalpy, Diffusion
1/29	2.1 to 2.2	Systems of Many Particles: Enumerating States
1/31	2.3 to 2.4	Thermal Interactions & the Large N Limit
2/5	2.5 to 2.6	Entropy and the Second Law
2/7	3.1 to 3.2	The Second Law: Temperature, Heat, & Entropy
2/12	3.3 to 3.4	Spin systems and Mechanical Equilibrium
2/14	4.1 to 4.2	Engines & Refrigerators: Theoretical
2/19	4.3 to 4.4	Engines & Refrigerators: Real
2/21	5.1 to 5.2	Free Energy
2/26	**1 to 4**	**Hour Exam 1 (covering Chs. 1 to 4)**
2/28	5.3	Phase Transformations, Phase Diagrams, Free Energy
3/5	5.3	Clausius-Clapeyron Relation, Latent Heat
3/7	5.4	Phase Transformations of Mixtures
3/12	**--**	**Spring Break**
3/14	**--**	**Spring Break**
3/19	5.5 to 5.6	Dilute Solutions & Chemical Equilibrium
3/21	6.1	Statistical Mechanics, Underpinnings of Thermodynamics
3/26	6.2	Boltzmann Factor, Partition Function, Averages
3/28	6.2 to 6.3	Ensemble Averages, Equipartition Theorem
4/2	6.4 to 6.5	Maxwell-Boltzmann Distribution, Statistical Temperature
4/4	6.5 to 6.6	Partition Function Examples, Free Energy
4/9	6.7	Statistical Mechanics of the Ideal Gas
4/11	**5 & 6**	**Hour Exam 2 (covering Chs. 5 & 6)**
4/16	7.1	Statistical Mechanics of Quantum Mechanical Systems
4/18	7.2 to 7.3	Systems of Identical Fermions, Fermi-Dirac Distribution
4/23	7.3	Electrons in Metals and Semiconductors
4/25	7.2	Systems of Identical Bosons, Bose-Einstein Distribution
4/30	7.4	Blackbody Radiation, Bose-Einstein Condensation
5/2	--	Negative Kelvin Temperatures, Population Inversion
5/9	--	**Final Exam, 8:00 to 10:45 AM, FO 2.604**

General Course Policies

Exams

1. **Calculators will be necessary** for all exams. **Any calculators that have internet access will not be allowed in the exams**. A scientific calculator that has trig functions should be all that is used on the exams.
2. **You must show all work for exam problems (excluding multiple choice questions) to receive partial credits.**
3. **Exams will cover both in-class examples and homework**.
4. **You will be allowed to bring one 8.5" x 11" piece of paper with whatever you wish written on both sides to each Hour Exam. You will be allowed to bring two such papers to the Final Exam.** These papers are the only information you may bring to the exams.
5. **No phones of any kind or any devices with internet access are allowed to be used during exams.**
6. You may not leave the exam room with the exam or your answers.
7. You are responsible for all the reading assignments even if we do not discuss them in class. This includes the lecture notes available on eLearning.
8. The final exam will be **cumulative** and will be based on the exams, homework, and any new material.
9. There will be no make-up exams for any reason.

Homework / Extra Credit

1. There will be one homework assignment each week, except in weeks preceding an Hour Exam, assigned each Thursday and due the following Thursday.
2. Homeworks are due on the date specified. No late homework will be accepted.
3. You are welcome to work together on homework but everyone must do his or her own problems and what you turn in should represent an honest reflection of your understanding.

Class Notes / Attendance

1. You can go to the course under eLearning and download lecture notes that form part (but NOT ALL) of the lectures. Be careful: these lectures may not be a complete record of what is covered in class and will not be enough to pass the class.
2. The reading assignment includes the relevant sections from the chapters given above and the lecture notes available on eLearning. Therefore you must **read the chapter sections before the lecture**.
3. Attendance at lectures is up to you. Please be aware that it is highly unlikely that you do well in the class without regular attendance at lectures.

Classroom Citizenship

1. Cell phones must be turned off during all class time.
2. Do not disrupt the class by getting up and leaving in the middle of class.

Student Conduct & Discipline

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

Email Use

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Withdrawal from Class

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

Student Grievance Procedures

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

Incomplete Grade Policy

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

Disability Services

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.

The contact information for the Office of Disability Services is:

The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will

be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

Off-Campus Instruction and Course Activities

Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address given below. Additional information is available from the office of the school dean. (http://www.utdallas.edu/Business Affairs/Travel_Risk_Activities.htm)

These descriptions and timelines are subject to change at the discretion of the Professor.