NIU Course Syllabus for Physics 463/563
Thermodynamics, Kinematic Theory, and Statistical Mechanics

Spring 2017, Tuesdays and Thursdays, 3:30-4:45 pm

Course Description:
Review of such topics as the laws of thermodynamics, the entropy concept, and thermodynamic potentials. Probability, distribution functions and transport phenomena. Introductory treatment of classical and quantum-mechanical statistical mechanics. Emphasis on applications to areas of modern physics.
Prerequisites : PHYS 320 or consent of department.
Credits: 3. **Contact hours**: 3.0. **Lecture hours**: 3.0. **Method of delivery**: Traditional

Course Goals:
1. Develop logical, objective, and critical thinking with scientific method using classical thermodynamics, kinematic theory and classical and quantum-mechanical statistical mechanics.
2. Develop the relationship between classical thermodynamics, kinematic theory, and statistical mechanics based on the classical and quantum mechanics.
3. Develop advanced quantitative analytical skills and methods with statistics, advanced calculus and partial differential equations.

Student Learning Outcomes: Upon successful completion of the course, with statistics, advanced calculus, and partial differential equations, students will be able to explain, analyze and/or apply:
- The Kinematic theory of gases. This is a bridge to statistical mechanics.
- Concepts of distinguishable and indistinguishable particles.
- Relationship between thermodynamic probability and Entropy.
- Concepts of quantum states, energy levels, and density of states.
- Classical and quantum statistics such as Boltzman, Fermi-Dirac, Bose-Einstein, and Maxwell-Boltzman statistics.
- Relationship between classical and statistical thermodynamics such as
    - paradox in classical thermodynamics,
    - fundamental understanding of thermodynamics of ideal gas,
    - the heat capacity of gases and solids,
    - magnetism,
    - Bose-Einstein gases, and
    - Fermi-Dirac Gases
- Information Theory (if time allows).

Class room: FR 238
Instructor: Yasuo Ito, Ph.D. La Tourette 218
Tel: 815-753-6477
e-mail: yito@niu.edu
Office Hours: Tuesdays and Thursdays, 2:00 pm – 3:00 pm ; Other hours by an appointment.

Text book: Classical and Statistical Thermodynamics, A. H. Carter (required). Other references such as "*Concepts in Thermal Physics*" by S.J. Blundell and K.M. Blundell. Please read your textbook before coming to the class!!

The view graphs, homework assignments and their solutions will be posted on the Blackboard web course. Therefore, it is essential for you to familiarize with the Blackboard web course.

Grading (tentative)**:**
> **5%** Attendance. Attendance is ***MANDATORY***. A student will receive attendance points if the student attends more than or equal to 85% of the course (25 out of 30 classes), according to the attendance rate. *Perfect attendance will receive extra credit points.* Students will not receive attendance points if he/she misses 6 - 9 classes. Students will receive ***Negative*** attendance points if he/she misses class more than 9 classes, **(-1/class)**.
> **40%** Homework ***ESSENTIAL*** The deadline is usually 1 week after the last lecture of each chapter.
> **25%** Midterm Exam Thursday **February 23rd and March 30th** in class.
> **30%** Final Exam (comprehensive) Tuesday **May 9th, 4 – 5:50 pm**.
> To pass this course, you must score at least **50%** on the homework **AND** at least **50%** overall.
> **Attendance is required.**

Extra credits:
Extra credit assignments may also be given such as essays, problem solving etc.. *These Extra credit points are directly added to the raw scores of the final grading points described above.*

Grading scale:
> **PHYS 463**:
> A (90 ≤ x), A- (85 ≤ x <90), B+ (80 ≤ x <85), B (75 ≤ x <80), B- (70 ≤ x <75), C+ (65 ≤ x <70), C (55 ≤ x <65), D (50 ≤ x <55), F (x <50).
> **PHYS 563**:
> A (90 ≤ x), A- (85 ≤ x <90), B+ (80 ≤ x <85), B (75 ≤ x <80), B- (70 ≤ x <75), C+ (65 ≤ x <70), C (60 ≤ x <65), C- (55 ≤ x <60), D (50 ≤ x <55), F (x <50).

Grade points (assigned by University):
> PHYS 463: A (4.00), A- (3.67), B+ (3.33), B (3.00), B- (2.67), C+ (2.33), C (2.00), D (1.00), F (0.00).
> PHYS 563: A (4.00), A- (3.67), B+ (3.33), B (3.00), B- (2.67), C+ (2.33), C (2.00), C- (1.67), D (1.00), F (0.00).

Accessibility Statement

If you need an accommodation for this class, please contact the Disability Resource Center as soon as possible. The DRC coordinates accommodations for students with disabilities. It is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu.
Also, please contact me privately as soon as possible so we can discuss your accommodations. The sooner you let us know your needs, the sooner we can assist you in achieving your learning goals in this course.

(Tentative schedule)

0: Review of Thermodynamics (Ch. 1- 10) January 17, 2017

1: **Introduction to the course & Review of Thermodynamics** (Ch. 1- 10) *HW. Summarize*

Thermodynamics definitions, laws and their applications. 10 – 15 pages.

2: **The Kinetic Theory of Gases** (Ch. 11)

3: **Statistical Thermodynamics** (Ch. 12)

4: **Classical and Quantum Statistics (**(Ch. 13)

Mid-Term I: February 23th, Thursday

5: The Classical Statistical Treatment of an Ideal Gas (Ch. 14)

6: The Heat Capacity of a Diatomic Gas (Ch. 15)

7: The Heat Capacity of Solid (Ch. 16)

Mid-Term II: March 30th, Thursday

8: **The Thermodynamics of Magnetism** (Ch. 17)

9: Bose-Einstein Gases (Ch. 18)

10: Fermi-Dirac Gases (Ch. 19)

(**11: Information Theory** (Ch. 20))

Final Exam (Tuesday. May 9, 2016, 4:00 – 5:50 pm)

From the University

Academic Integrity:

Good academic work must be based on honesty. The attempt of any student to present as his or her own work that which he or she has not produced is regarded by the faculty and administration as a serious offense. Students are considered to have cheated if they copy the work of another during an examination or turn in a paper or an assignment written, in whole or in part, by someone else. Students are responsible for plagiarism, intentional or not, if they copy material from books, magazines, or other sources without identifying and acknowledging those sources or if they paraphrase ideas from such sources without acknowledging them. Students responsible for, or assisting others in, either cheating or plagiarism on an assignment, quiz, or examination may receive a grade of F for the course involved and may be suspended or dismissed from the university.

A faculty member has original jurisdiction over any instances of academic misconduct that occur in a course which the faculty member is teaching. The student shall be given the opportunity to resolve the matter in meetings with the faculty member and the department chair. If the facts of the incident are not disputed by the student, the faculty member may elect to resolve the matter at that level by levying a sanction no greater than an F for that course. The faculty member shall notify the student in writing whenever such action is taken, and the Office of Community Standards and Student Conduct shall receive a copy of the Academic Misconduct Incident Report indicating final disposition of the case, which will be placed in the student's judicial file. In all matters where the charge of academic misconduct is disputed by the student or if the faculty member feels a sanction greater than an F in the course is appropriate (such as repeated offenses or flagrant violations), the faculty member shall refer the matter to the Office of Community Standards and Student Conduct making use of the Academic Misconduct Incident Report. Additional sanctions greater than an F in a course can be levied only through the University Judicial System. With regards to finding the student either responsible or not responsible for his or her action, the ruling of the Judicial Hearing Board shall be binding. In cases where there is either a finding of responsibility or an admission of responsibility by the student, any recommendations by the hearing board regarding the course grade are non-binding on the instructor, who remains solely responsible for assigning a course grade, consistent with the policies set forth in the course syllabus.

Attendance:

The university does not use a "cut" system. Each instructor decides whether to excuse class absences and determines how to permit make-up work.

If a student will be absent from classes for a week or more because of an accident, illness, or other emergency, instructors will be notified of the absence only if students or their parents request it through the Division of Student Affairs. Health Services will not release information about students unless they provide a written request.

Leaves of absence will be granted for volunteer services related to disaster relief in accordance with applicable Illinois statutes or executive orders issued by the State of Illinois in response to emergency situations. To initiate a leave of absence, students should contact their College Dean's office, or the vice provost (or the vice provost's delegate) for any student who has no college affiliation. Following the period of volunteer service, Registration and Records will facilitate reenrollment of the student.

Students are expected to comply with each individual instructor's established attendance policy. It is recommended that students avoid registering for classes in which they would amass significant absences. In the case of an absence due to required attendance at a university-sponsored event such as a department trip, performing arts activity, ROTC function, or athletic competition, reasonable attempts shall be made by faculty members to allow the student to make up missed work. Students are responsible for completing the work assigned and/or due on the days they are absent for university-sponsored events. Both the sponsoring unit and the student should inform the faculty member as soon as possible in the semester in order for arrangements to be made for completing missed assignments, examinations or other required course work. The student is required to provide each instructor with an official notification in advance of the absence (e.g., a letter from the chair of the sponsoring department, the head of the sponsoring unit, or the coach).