# Stevens Institute of Technology
Syllabus

## PEP 555: Statistical Physics and Kinetic Theory

| **Semester taught:**<br><br>**Fall** | **Start and end date of the semester:**<br>See Stevens web site |
|---|---|
| **Name: Professor Knut Stamnes**<br>**Office address: 627 Burchard**<br><br>**Office phone number: 201-216-8194**<br>**E-mail address: kstamnes@stevens.edu** | Office Hours: By Appointment<br><br>Course Web Address:<br>To be assigned. |

## Overview

Course Description:
Kinetic theory: ideal gases, distribution functions, Maxwell-Boltzmann distribution, Boltzmann equation, H-theorem and entropy, simple transport theory. Thermodynamics: review of first and second laws, thermodynamic potentials, phase transitions, Elementary statistical mechanics: introduction to microcanonical, canonical and grand canonical distributions, partition functions, simple applications including ideal Maxwell-Boltzmann, Einstein-Bose and Fermi-Dirac gases, paramagnetic systems, blackbody radiation. Text: Reif, *Statistical and Thermal Physics*.
The course is suitable for beginning graduate and upper-level undergraduate students.

## Learning Goals

After taking this course, the student will be able to:

- Appreciate the fundamentals of statistical physics and kinetic theory
- Make estimates of transport phenomena
- Understand how macroscopic thermodynamics can be derived from a molecular point of view

## Pedagogy

The course will employ lectures, in-class discussion, e-mail exchange, homework assignments, and tests. Students will do weekly assignments, a mid-term exam plus a final exam.

## Required Text(s)

F. Reif: "Fundamentals of Statistical and Thermal Physics", 1965, Waveland Press, Inc. ISBN 978-1-57766-612-7.

## Required Readings

Readings will be assigned for each week. These will be found on the course website.

## Assignments

The course will emphasize homework, a midterm exam, and a final exam with equal weight.
1. Homework – Homework must be completed by the required date and submitted in class.
2. A mid-term exam must be completed when due.
3. A final exam must be completed when due.

The assignments and their weights are as shown below:

| | |
|---|---|
| 1. Homework | 33% |
| 2. Mid-term | 33% |
| 3. Final exam | 34% |
| **TOTAL** | **100%** |

Final letter grades will be calculated based on the following distribution:

| Letter Grade: | % Grade: |
|---|---|
| A | 90-100% |
| A- | 85-89.9% |
| B+/B/B- | 70-84.9% |
| C+/C/C- | 50-69.9% |
| D+/D/D- | 30-49.9% |
| F | <30% |

## Course Schedule (Sample)

| Week | Subject | Assignment Due |
|---|---|---|
| 1 | Introduction to statistical methods: random walk and binomial distribution | Beginning of next class |
| 2 | Statistical description of systems of particles: statistical formulation of the mechanical problem | Beginning of next class |
| 3 | Statistical thermodynamics: Irreversibility and the attainment of equilibrium | Beginning of next class |
| 4 | Macroscopic parameters and their measurement | Beginning of next class |
| 5 | Simple applications of macroscopic thermodynamics | Beginning of next class |
| 6 | Basic methods and results of statistical | Beginning of next class |

| Week | Subject | Assignment Due |
|---|---|---|
| | mechanics | |
| 7 | Simple applications of statistical mechanics | Beginning of next class |
| 8 | Equilibrium between phase or chemical species | Beginning of next class |
| 9 | Quantum statistics of ideal gases (i) | Beginning of next class |
| 10 | Quantum statistics of ideal gases (ii) | Beginning of next class |
| 11 | Magnetism and low temperature | Beginning of next class |
| 12 | Elementary kinetic theory of transport processes | Beginning of next class |
| 13 | Review | Beginning of next class |
| 14 | Final Exam Preparation | Final exam. |