

PHYSICS 5500: Thermal Physics
COURSE OUTLINE: Fall 2014

LECTURER: Ashis Mukhopadhyay

OFFICE: Room 258, Physics Research Building

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OFFICE HOURS: Friday from 1:30 PM to 2:30 PM and by appointment.

TEXT: *Classical and Statistical Thermodynamics*, by Ashely H. Carter (Prentice-Hall)

MEETING PLACE: M, T, Th, F from 10:40 AM to 11:35 AM in Room 185 Physics.

A copy of the text book has been kept at UGL desk. You can borrow it for 1 day at a time.

Other References:

- (1) *Thermal Physics* by C. Kittel and H. Kroemer (W. H. Freeman and Company)
- (2) *Thermodynamics, Kinetic Theory and Statistical Thermodynamics* by F. W. Sears and G. L. Salinger (Addison-Wesley)
- (3) *Statistical and Thermal Physics* by F. Reif (McGraw-Hill)

TOPICS TO BE COVERED IN THE COURSE (Guidance only)

Chapter 1. Definitions, temperature and temperature scales.

Chapter 2. Equation of state of an ideal gas and van der Waals gas.

Chapters 3, 4 & 5. Work, heat, internal energy, first law of thermodynamics -- applications and consequences.

Chapters 6 & 7. Entropy and the second law of thermodynamics, applications of the combined first and second laws.

Chapter 8. Thermodynamic potentials, Maxwell's relations and applications.

Chapters 9 & 10. Chemical potential and the third law, consequences of the third law.

Chapter 11. Kinetic theory of gases: pressure, equipartition of energy, specific heat capacity.

Chapter 12. Statistical thermodynamics: concepts of thermodynamic probability and entropy, quantum states and energy levels.

Chapter 13. Quantum statistics: the Boltzman distribution, the Fermi-Dirac distribution and the Bose-Einstein distribution.

Chapter 14. Ideal gas, diatomic gas, applications of the Maxwell-Boltzman distributions.

Chapters 15, 16 & 17. Heat capacity of a solid and the thermodynamics of magnetism.

Chapter 18. Black-body radiation, Bose-Einstein gases.

Chapter 19. Fermi-Dirac gases, free electrons in a metal.

LEARNING OBJECTIVES

At the completion of this course, you should be able to

- a) apply 1st Law & 2nd Law of thermodynamics for simple systems.
- b) use Maxwell-Boltzmann distribution to determine statistical averages and standard deviations.
- c) derive and use particle distribution function for ideal classical and quantum systems.

GRADE DETERMINATION:

Approximately, I will assign 10 homeworks. Late homework will not be accepted and all homeworks will count for your grade. I will post the solutions on the web. Homework will be graded satisfactory/non-satisfactory basis only. Time to time, I will assign DIY reading assignment. You are responsible to complete those.

There will be a total of 5 midterms, four best will count. No make-up exams will be given. Graduate students will get one extra question in each exam. This is required by a university policy.

There will be about two quizzes every week. It will take about 5 minutes to complete those. No make-up quizzes will be given. You can drop two lowest scoring quizzes.

The final will consist of a written part (25% point) and an essay writing based upon literature survey or you can choose to write a computer program (10 pts). I will give you a list of topics later in the semester. This is due by 12th December (Friday) by email only. In the final, the graduate students will get two extra questions.

Homework: 10 points; In-class quizzes: 15 points; Midterm exams: 40 points; Final Exam: 35 pts

MID-TERM EXAM SCHEDULE

1. September 15 (Monday);
2. October 6 (Monday);
3. October 27 (Monday);
4. November 10 (Monday)
5. November 24 (Monday)

Last class: December 8 (Monday)

Final Exam: According to university schedule: December 16 (Tuesday), 8:00-10:30 AM.

Grade determination

A: 90 – 100%; A-: 85 – 89%
B+: 80 – 84%; B: 75 – 79%; B-: 70 – 74%
C+: 65 – 69%; C: 60 – 64%; C-: 55 – 59%
D+: 50 – 54%; D: 45 – 49%; D-: 40 – 44%
F: 0 – 39%