

PHYS*4240 Statistical Physics II

Fall 2017 Course Outline

Department of Physics
University of Guelph

Instructor Information

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Calendar Description

A continuation of PHYS*2240 including a discussion of the grand canonical distribution, quantum statistics, and transport theory.

Prerequisites

PHYS*2240 (Thermal Physics) [or PHYS*3240 (Statistical Physics I)] and PHYS*3230 (Quantum Mechanics I). It is assumed that the student has a good knowledge of thermodynamics and some statistical mechanics as introduced in PHYS*2240. You should have a working knowledge of classical mechanics, quantum mechanics, and E&M.

Objectives

This course is a continuation of the study of the laws of statistical mechanics and thermodynamics begun in PHYS*2240, Thermal Physics. Statistical Physics is the study of the physical properties of systems consisting of a very large number of atoms, molecules, or other particles. In spite of the enormous complexity of macroscopic bodies when viewed from an atomistic viewpoint these bodies obey quite definite laws. Macroscopic observable quantities such as temperature and pressure are averages over microscopic properties and the macroscopic laws which these quantities obey are of a statistical nature. The objectives of this course are to develop an understanding of the statistical nature of the laws of thermodynamics, to examine the basic theory of statistical mechanics and to apply this theory to a wide variety of interesting problems.

Course Texts

There is no course text. Lecture notes will be posted on Courselink. These are taken from a typed set of notes by Eric Poisson which can be found on his web site (see faculty link on the departmental web site). Your thermal text from PHYS*2240 will also cover some of these topics.

An Example of a Previous Course Text

Roger Bowley and Mariana Sánchez, *Introductory Statistical Mechanics*, 2nd ed. (Oxford University Press, 1999, Oxford).

Some of the Classic References

1. F. Reif, *Fundamentals of Statistical and Thermal Physics* (McGraw-Hill, 1965, QC 175.R43).
2. F. Mandl, *Statistical Physics*, Second Edition (Wiley, 1988, QC 174.8.M27).
3. D.L. Goodstein, *States of Matter* (Prentice Hall, 1975; Dover, 1985, QC 173.3.G66).
4. K. Huang, *Statistical Mechanics*, Second Edition (Wiley, 1987, QC 174.8.H83).
5. C. Kittel and H. Kroemer, *Thermal Physics*, Second Edition (Freeman, 1980, QC 311.5.K52).
6. L.D. Landau and E.M. Lifshitz, *Statistical Physics*, Third Edition, Part 1 (Pergamon, 1980, QC 175.L32).
7. P.K. Pathria, *Statistical Mechanics* (Pergamon, 1972, QC 175.P35).

At this stage of your education, you should be consulting more than one text to enhance your learning and understanding of the material. No particular book is perfect in all respects and scientists regularly refer to several books and papers to understand a concept.

Topics for PHYS*4240

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| a) Review of thermodynamics | d) Paramagnetism |
| b) Statistical mechanics of isolated systems | e) Quantum statistics of ideal gases |
| c) Statistical mechanics of interacting systems | f) Black-body radiation |
| | g) Heat capacity of solids |
| | h) Bose-Einstein Condensation |

Evaluation

Assessment	% of Grade
Quizzes (best 9 out of 11)	15%
Assignments	15%
Midterm Test	35%
Final Examination	35%

Final Examination

The final examination has been set for Wednesday, December 13 from 11:30-1:30am (location to be announced).

Midterm Test

The midterm test is scheduled for Monday, October 30 from 7:00-9:00pm. If the midterm test is missed because of illness or for compassionate reasons, the student should obtain a medical certificate or similar documentation and consult me.

Quizzes

There will be eleven ten-minute quizzes. Each will have about 10 multiple choice or short answer questions which will test the material covered in the previous week's lectures, assignment work, and the Monday lecture before the quiz. The quizzes will be given in the last ten minutes of the Wednesday class starting in week 2 of the course. The best 9

marks out of 11 quizzes will be used to determine the quiz grade out of 15 for the final mark. Therefore, up to two quizzes may be missed without penalty and no make-up quizzes will be offered for missed quizzes.

Assignments

Assignments will be due approximately every two weeks, at beginning of class on the date of the deadline (no late assignments accepted). High presentation standards are expected.

Getting Help

At present, I do not have fixed office hours for consultation, however, should it become necessary, I will post office hours outside my door and inform you in class of these hours. You can, of course, always make an appointment to see me.

Collaboration versus Copying

Scientists work alone or in groups, very often consulting fellow scientists and discussing their research problems with peers. Collaboration is a feature of scientific activity and there are many benefits to working with others. However, no ethical scientist would ever publish or claim the work of others as his or her own and generally scientists give reference to the appropriate source of ideas or techniques which are not their own.

You are a young scientist and, in this spirit, I encourage you to discuss with others as you learn the material and work on the problem assignments. However, the work that you submit as your assignment must be your own and not a copy of someone else's work. Identical scripts will be given a mark of zero and plagiarism will be dealt with severely. I encourage you to cite your references, citing books and other articles when they are used and acknowledging discussions with those who have helped you in your understanding and completion of the problem. This is good scientific practice.

Academic misconduct

The University of Guelph takes a serious view of academic misconduct and will severely penalize those who are found guilty of offenses associated with misappropriation of others' work, misrepresentation of personal performance and fraud, improper access to scholarly resources, and obstructing others in pursuit of their academic endeavours. Each student is assumed to be familiar with the regulations surrounding academic misconducts, as spelled out in the Undergraduate Calendar.