Physics 244 -- Modern Physics
Spring, 1994

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Office Hours: 8:00 a.m. TR
5242c Chamberlin

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11:00am T, 3:30pm R
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Text and References:

The text is Physics of Atoms and Quanta by Haken & Wolf (3rd edition). We will not cover the whole text and topics not in the text will be included. Lecture notes will be distributed that contain the material for which you are responsible. The detailed syllabus gives section references in several texts that are related to the lecture material, in case you want to see a different presentation or more detailed explanation.

Other texts at approximately the same level which you may find useful include:
- Modern Physics, Tipler
- Modern Physics, Sproull and Phillips (particularly for solids)
- Modern Physics, Krane
- Perspectives in Modern Physics, Beiser
- Physics of Solids, Wert and Thomson

Somewhat more advanced texts include:
- Quantum Physics, Eisberg and Resnick
- Atomic Spectra and Atomic Structure, Herzberg
- Introduction to Solid State Physics, Kittel
- Thermodynamics, Sears

Homework:

A problem set will be assigned each Friday and collected at the beginning of lecture the following Friday. Each problem set will be graded on a 0 to 5-point scale based on the level of effort put into an attempt to solve each problem. You are welcome and encouraged to work together on problem sets if you learn to use the material better this way. Note, however, that zero credit will be given for a correct answer alone or for obviously copied material. Written solutions for the problem sets will be handed out immediately after they are turned in, so arrangments for late homework, while easily made, must be made in advance. (The same is true for all exams.)

Discussion Sections:

We will use many results from your elementary physics course but we will not have time to review them in lecture. Therefore, you will want to reivew the appropriate parts of your general physics text as we go along. The optional discussion sections provide an opportunity for you to ask questions and initiate a discussion and review of any of this material you are having difficulty with. You can also ask questions about current material, go over methods of solving the homework problems, or discuss other topics of interest to you that are related to the course. Come to as many of these as you find helpful or interesting. YOU WILL FIND THE COURSE MUCH EASIER IF YOU CAN STAY UP-TO-DATE; if you have questions or feel you are having trouble, come right away to the discussion sections and/or office hours so we can try to help you EARLY.

Evaluation:

There will be three one-hour exams and a two-hour comprehensive final. The hour exams will be held during a regularly scheduled lecture hour. The total homework grade will count the same as one hour exam, while the final will count two. You may drop your lowest hour exam score, or half the weight of the final exam if it is lower than any of the hour exams. The homework score cannot be dropped.

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Lecture: 2:25 MWF B130 VanVleck

Optional Discussion Sections:
1:20 M, 1327 Sterling; 1:20 W B239 VanVleck; 3:30 W, B130 VanVleck

Calendar

January	24	Lecture 1
	26	Lecture 2
	28	Lecture 3
	31	Lecture 4
February	2	Lecture 5
	4	Lecture 5 -- Boltzmann distribution
	7	Lecture 6
	9	Lecture 7
	11	Special topic
	14	Lecture 8
	16	Exam review
	18	EXAM I
	21	Lecture 9
	23	Lecture 10
	25	Lecture 11
	28	Lecture 12
March	2	Lecture 13
	4	Lecture 14
	7	Lecture 15
	9	Lecture 16
	11	Special topic
	14	Exam review
	16	EXAM II
	18	Lecture 17
	21	Lecture 18
	23	Lecture 19
	25	Lecture 20

SPRING BREAK

April	6	Lecture 21
	8	Lecture 22
	11	Lecture 23
	13	Lecture 24
	15	Special topic
	18	Exam Review
	20	EXAM III
	22	Lecture 25
	25	Lecture 26
	27	Lecture 27
	29	Lecture 28
May	2	Lecture 29
	4	Lecture 30
	6	Lecture 31
	9	Lecture 32
	11	Special topic
	13	Exam review

May 14, 1994, 7:25 pm: FINAL EXAM

Physics 244 Syllabus

Lect. 1 Kinetic theory, pressure of a gas, ideal gas laws, mean free path, collision cross section. Tipler 2.1, 2.2, 2.6; Krane 1.1; Sproull and Phillips 2.2, 2.5; Sears "Thermodynamics" 11.2-11.5; Haaken & Wolf 2.4

Lect. 2 Transport properties, diffusion, Fick's laws, thermal conductivity, viscosity. Tipler 2.6; Sears Chapt. 13

Lect. 3 and 4 Distribution functions, expectation values, derivation of Boltzmann energy distribution. Tipler 2.4; Krane 12.1; Sproull and Phillips 2.4; Sears Chapt. 14; Haaken & Wolf 2.3

Lect. 5 Maxwell-Boltzmann distribution of molecular speed, equipartition of energy, applications. Tipler 2.5; Krane 12.3, 12.4; Sproull and Phillips 2.4; Sears Chapts. 12, 15

Lect. 6 Electromagnetic waves, classical nature of light, radiation from an accelerated charge, light scattering, Raleigh, Thomson. Your elementary physics text; Krane 3.1; Blanchard et al. Chapter 5; Crawford "Waves" Berekely Physics Course 7.5; Haaken & Wolf Ch 5

Lect. 7 Wave-particle duality, photoelectric effect, Einstein hypothesis, x-rays. Tipler 3.5, 3.6; Krane 3.3; Sproull and Phillips 3.3, 3.5; Haaken & Wolf 6.5, 5.3

Lect. 8 Compton Scattering, de Broglie hypothesis, electron diffraction. Tipler 3.6, 5.2; Krane 3.4-3.6, 4.1; Sproull and Phillips 3.8-3.10

Lect. 9 de Broglie waves for a free particle, wave packets, group velocity, Born interpretation, Uncertainty principle. Haaken & Wolf Ch 7, Ch 9; Tipler 5.4-5.9; Krane 4.2-4.6; Sproull and Phillips 4.4

Lect. 10 Uncertainty Principle, Bohr Model of the Hydrogen atom. Haaken & Wolf Ch 8; Tipler 4.3, 5.7; Sproull and Phillips 3.4, 4.2

Lect. 11 Schroedinger equation, time dependent, time independent, separation of variables, review of potential energy. Haaken & Wolf 9.2; Tipler 6.1; Sproull and Phillips 4.4

Lect. 12 Square well, quantization. Haaken & Wolf 9.1; Tipler 6.2; Krane 5.3, 5.4; Sproull and Phillips 4.3

Lect. 13 Operators, expectation values, transitions between states. Haaken & Wolf 9.3; Tipler 6.4, 6.5; Sproull and Phillips 4.6, 4.7

Lect. 14 Boundary conditions, finite wells and barriers, tunneling. Tipler 6.3, 6.7; Krane 5.7; Sproull and Phillips 4.5

Lect. 15 Simple harmonic oscillator. Haaken & Wolf 9.4; Tipler 6.6; Krane 5.5; Sproull and Phillips 4.8

Lect. 16 Hydrogen atom, Schroedinger eqn. in polar coordinates, separation of variables, eigenfunctions, quantum numbers. Haaken & Wolf Ch 10; Tipler 7.1-7.3; Krane 6.4, 6.5, 7.1, 7.2, 7.4; Sproull and Phillips 5.2

Lect. 17 Physical interpretation of the quantum numbers, orbital angular momentum and magnetic moment. Haaken & Wolf Ch 12; Tipler 7.1-7.3; Krane 7.2, 7.3, 7.4; Sproull and Phillips 5.2

Lect. 18 Electron spin, exclusion principle, periodic table, electron configurations. Tipler 7.4, 7.6; Krane 7.5, 7.6, 8.1, 8.2; Sproull and Phillips 5.3, 5.4

Lect. 19 Properties of many electron atoms, x-ray spectra. Haaken & Wolf Ch 16, 18.1-18.4; Tipler 7.6, 7.7; Krane 8.4-8.6; Sproull and Phillips 5.4

Lect. 20 Molecules, ionic, covalent, vibration and rotation spectra. Haaken & Wolf 23.1-23.2; Tipler 8.1, 8.3; Krane Chapt. 13; Sproull and Phillips Chapter 6

Lect. 21 Black body radiation, Einstein coefficients, lasers. Haaken & Wolf 5.2, Ch 21; Tipler 3.4, 8.4; Krane 3.2, 8.8; Sproull and Phillips 3.2, 5.7

Lect. 22 Geometry of Crystals. Krane 14.1; Kittel "Intro. to Solid State Physics" Chapt. 1

Lect. 23 Classical free electron gas, conductivity, mobility, Hall effect, Einstein relation. Tipler 9.2; Sproull and Phillips 8.6, 10.4

Lect. 24 Quantum free electron gas, k-space, Fermi momentum and energy, density of states. Tipler 9.2, 9.3; Sproull and Phillips 8.4

Lect. 25 Energy bands, nearly free electron approximation, Brillouin zones. Tipler 9.5; Krane 14.4; Sproull and Phillips 7.5

Lect. 26 Motion of electron in a crystal, effective mass, insulators and conductors, "holes". Sproull and Phillips 8.2, 8.6; Wert and Thomson Chapt. 9

Lect. 27 Fermi-Dirac distribution function, intrinsic semiconductors. Tipler 10.1; Krane 12.5, 12.7; Sproull and Phillips 8.3, 10.2

Lect. 28 Carrier statistics, donors, acceptors, n- and p-type. Sproull and Phillips 10.3

Lect. 29 Semiconductor junctions, fields in the junction, I-V characteristics. Sproull and Phillips 10.4, 10.6

Lect. 30 Nuclear properties, constituents, empirical mass formula. Tipler 11.1, 11.2; Krane 9.1-9.4; Sproull and Phillips 11.3, 11.6

Lect. 31 Radioactivity, statistics, α-decay, β-decay, neutrino. Tipler 11.3; Krane 9.5-9.9; Sproull and Phillips 11.2, 11.4

Lect. 32 Nuclear reactions, cross section, nomenclature, direct reactions, compound nucleus formation, fission, fusion. Tipler 11.4, 11.5; Krane Chapt. 10; Sproull and Phillips 11.7