Physics 244
Fall, 1993

The text is Modern Physics by Tipler. This was chosen at the suggestion of the students in previous semesters. We will not cover the whole text and we will cover some topics not in the text. Therefore lecture notes will be distributed. The material you are responsible for is that material covered in the lecture notes. The syllabus gives the approximate content for each of the lectures. The syllabus also gives the related sections in several other texts in case you want to read more or see the material in a somewhat different presentation.

Other texts at approximately the same level which you may find useful include:
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

Problems will be assigned each Wednesday and collected the following week.

There will be three one-hour exams and a two-hour comprehensive final. The exams will be at the ordinary scheduled lecture hour. The tentative hour-exam dates are Oct. 1, Nov. 1, and Dec. 1. For grading purposes the hour exams count 3/5 and the final 2/5, and the homework will be used to resolve the grade for people near the boundaries. Exceptionally good or poor homework can make a change of 1/2 a letter grade.

Office hours: M. B. Webb Rm B-317 Sterling Hall, 1:20 Tuesday and Thursday. Also your TA will announce office hours. There will be an optional discussion sections where we will answer questions, go over the homework and review. Come to as many of these as you find helpful.

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 review the appropriate parts of your general physics text as we go along. In the first section on kinetic theory, we will first use things from classical mechanics such as force, momentum, kinetic energy, pressure, Avagodro's number, the ideal gas laws, and the equipartition of energy.

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 to the discussion sections and/or office hours so we can try and help you early.

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

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

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

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

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. 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. 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. Tipler 6.1; Sproull and Phillips 4.4

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

Lect. 13 Operators, expectation values, transitions between states. 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. 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. 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. 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. Tipler 7.6, 7.7; Krane 8.4 - 8.6; Sproull and Phillips 5.4

Lect. 20 Molecules, ionic, covalent, vibration and rotation spectra. Tipler 8.1, 8.3; Krane Chapt. 13; Sproull and Phillips Chapter 6

Lect. 21 Black body radiation, Einstein coefficients, lasers. 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 Quantum free electron gas, k-space, Fermi momentum and energy, density of states. Tipler 9.2, 9.3; Sproull and Phillips 8.4

Lect. 24 Energy bands, nearly free electron approximation, Brillouin zones. Tipler 9.5; Krane 14.4; Sproull and Phillips 7.5

Lect. 25 Motion of electron in a crystal, effective mass, insulators and conductors, "holes". Sproull and Phillips 8.2, 8.6; Wert and Thomson Chapter 9

Lect. 26 Fermi-Dirac distribution function, intrinsic semiconductors. Tipler 10.1; Krane 12.5, 12.7; Sproull and Phillips 8.3, 10.2

Lect. 27 Carrier statistics, donors, acceptors, n- and p-type. Sproull and Phillips 10.3

Lect. 28 Semiconductor junctions, fields in the junction, I-V characteristics. Sproull and Phillips 10.4, 10.6

Lect. 29 Nuclear properties, constituents, empirical mass formula. Tipler 11.1, 11.2; Krane 9.1-9.4; Sproull and Phillips 11.3, 11.6

Lect. 30 Radioactivity, statistics, $\alpha$-decay, $\beta$-decay, neutrino. Tipler 11.3; Krane 9.5-9.9; Sproull and Phillips 11.2, 11.4

Lect. 31 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