

## Electronics for Scientists V85-0110 and G85-1500 (Spring 2007)

Instructor: Prof. Andrew Kent

Laboratory Instructor: N/A

Prerequisites: Physics II or permission of the instructor

Lecture and laboratory, 4 points

Meeting: Monday 5-5:30 PM, room 901 Meyer

Laboratory: Monday and Tuesday 9-11:15 AM, room 221 Meyer

### Course Description:

Introduction to basic analog and digital electronics used in modern experiment and computers for students of all science disciplines, mainly in a laboratory setting. Basic concepts and devices presented in lecture are studied in the laboratory. The course covers filters, power supplies, operational amplifiers, digital logic gates, combinatorial and sequential digital circuits, and computers. Students learn the functions of modern electronic components as well as how they are used in laboratory instrumentation and measurement.

### Who Should Take It

Students interested in learning about the operation of modern electronic circuits and their use —particularly, undergraduate and graduate students with concentrations in experimental and computer science.

### Main Text:

“The Art of Electronics,” P. Horowitz and W. Hill, (Cambridge, University Press, 2<sup>nd</sup> Edition)

### Laboratory Texts:

“Student Manual for the Art of Electronics,” T. C. Hayes and P. Horowitz (Cambridge University Press).

Supplementary Notes, A. D. Kent

Web-site: <http://classes.nyu.edu>

### Contact Information

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## Electronics for Scientists Syllabus

### **Lab 1. DC Circuits**

*Topics:* Kirchoff's Laws, Ohm's Law, non-linear devices, voltage dividers, Thevenin's and Norton models, electrical measurements; introduction to the breadboard and oscilloscope.

*Reading:* Main text: Chapter 1, sec. 1.00 to 1.10 (pp. 1 to 20), Appendices A and C  
Student Manual: Class 1 (p. 1–31)

*Exercises:* 1.1 to 1.11 (main text)

*Labs:* Complete 1.1 to 1.6 (beginning on p. 24)

### **Lab 2. AC Circuits**

Capacitors and inductors, analysis in the time domain, generalized impedance and analysis in the frequency domain, phasor diagrams, differentiators, integrators, high pass, low pass, trap and notch filters.

*Reading:* Main text Chapter 1, sec. 1.11 to 1.24 (pp. 20 to 44), Appendix B  
Student Manual: Class 2 (pp. 32–60)

*Exercises:* 1.13–1.26 (omit 1.22)

*Labs:* 2.1 to 2.8 (beginning on p. 54)

### **Lab 3. Diode Circuits and Power Supplies**

Transformers, diodes, load lines, Converting ac to dc power—half and full wave rectifiers, ripple, diode clamps and limiters.

*Reading:* Main text finish reading Chapter 1, sec. 1.25 to 1.34 (pp. 44 to 59)  
Student Manual: Class 4 (pp. 61–81)

*Exercises:* 1.27, 1.28, and 1.30

*Labs:* 3.1 to 3.7 (beginning on p. 75)

### **Lab 4. Transistors I**

Simple models of transistor operation, transistor followers, current source, common-emitter amplifier

*Reading:* Main text Chapter 2, sec. 2.00 to 2.07 (pp. 61 to 77)  
Student Manual: Class 3 (pp. 82–99)

*Exercises:* 2.1 and 2.2

### **Lab 5. Introduction to Operational Amplifiers**

Feedback, negative feedback, basic characteristics of operational amplifiers, op-amp “golden rules”, inverting amplifier, follower, non-inverting, input and output impedance, current source, current to voltage converter, summing amplifiers.

*Reading:* Main text Chapter 4, sec. 4.01-4.09 (pp. 175 to 187)

Student Manual: Class 8 (pp. 166 to 183)

*Exercises:* 4.1 to 4.5

*Labs:* 8.1 to 8.7 (beginning on p. 177)

### **Lab 6. More Operational Amplifiers**

Integrators, differentiators, some op-amp limitations and departures from the ideal.

*Reading:* Main text: Chapter 4, sec. 4.11 and 4.12 (pp. 189 to 210)

Student Manual: Class 9 (pp. 184 to 199)

*Exercises:* None

*Labs:* 9.2 to 9.4 (beginning on p. 202)

### **Lab 7. Positive Feedback**

Positive feedback, comparators, Schmitt trigger, oscillators.

*Reading:* Main text Chapter 4, sec. 4.23 to 4.26 (pp. 229 to 236)

Student Manual: Class 10 (pp. 207 to 231)

*Exercises:* 4.10 and 4.11

*Labs:* 10.1, 10.2 and 10.6 (beginning on p. 234)

### **Lab 8. Introduction to Combinatorial Digital Electronics**

Logic states, binary representations, Boolean algebra, logic gates, universal gates, combinatorial digital logic.

*Reading:* Main text Chapter 8, sec 8.01 to 8.13 (pp. 471 to 493)

Student Manual: Class 13 (pp. 283 to 308)

*Exercises:* 8.1 to 8.9, 8.11 to 8.13

*Labs:* 13.1 and 13.2 (beginning on p. 309)

### **Lab 9. Sequential Digital Electronics**

Sequential digital logic, flip-flops, latches and registers.

*Reading:* Main text Chapter 8, sec 8.16 to 8.19 (pp. 504 to 517) focus on sec. 8.16, 8.17

Student Manual: Class 14 (pp. 320 to 333)

*Exercises:* 8.24 and 8.25

*Labs:* 14.1 to 14.6 (skip 14.5) (beginning on p. 334)

### **Lab 10. Counters**

Counters

*Reading:* Main text Chapter 8, sec 8.24 to 8.26\* (pp. 523 to 527)  
Student Manual: Class 15 (pp. 342 to 362)

*Exercises:* None (follow worked exercises in the Student Manual p. 351)

*Labs* 15.1 to 15.5 (beginning on p. 362)

\*For this lab the material in the book is not that relevant, focus on the text in the student manual.

### **Lab 11. Elements of a Computer**

Memory, Buses and State Machines

*Reading:* Main text Chapter 8, sec 8.18 (again) concentrating on state machines. (pp 512 to 516)

Student Manual: Class 16 (pp. 375 to 402)

*Exercises:* None

*Labs* 16.1 to 16.3 (beginning on p. 394)

## **Electronics for Scientists Syllabus**

### **DC circuits**

Kirchhoff's Laws, Ohm's Law, non-linear devices, voltage dividers, Thevenin's and Norton models, electrical measurements.

### **AC circuits**

Reactive components (capacitors and inductors), analysis in the time domain, generalized impedance and analysis in the frequency domain (phasors), differentiators, integrators, high pass, low pass, trap and notch filters.

### **Diode circuits and power supplies**

Transformers, diodes, load lines, ac to dc power conversion—half and full wave rectifiers, ripple, diode clamps and limiters.

### **Transistors**

Simple models of transistor operation, transistor followers, current source, common-emitter amplifier

### **Operational amplifiers**

Feedback, negative feedback, basic characteristics of operational amplifiers, op-amp "golden rules," inverting amplifier, follower, non-inverting, input and output impedance, current source, current to voltage converter, summing amplifiers. Integrators, differentiators, op-amp limitations.

### **Positive feedback**

Positive feedback, comparators, Schmitt trigger, oscillators.

### **Introduction to combinatorial digital electronics**

Logic states, binary representations, Boolean algebra, logic gates, universal gates, combinatorial digital logic.

### **Sequential digital electronics**

Sequential digital logic, flip-flops, latches and registers.

### **Counters**

Counters

### **Elements of a Computer**

Memory, Buses and State Machines

BZV85C4V3. 4.3. 4...4.6. 4 1500. 4 1500. 4 2000. 4 2000. Semtech electronics ltd. Subsidiary of Sino-Tech International (BVI) Limited. After developing circuits and analog electronics in the early chapters of this text, we continue with digital electronics and conclude with chapters on the digital computer and on digital communications---chapters that are normally not included in books for non-EEs. The text is intended for students who need to understand modern electronics and communication. Much of the material in the book is developed from the first principles, so previous courses on circuits, for example, are not required; only freshman math and physics courses, and the elementary treatment of circuits that freshman physics basic electronics basic electronic make electronics and Engineers.pdf Linear Partial Differential Equations for Scientists and Engineers [4th Ed.] Tyn Myint- An Analog Electronics Companion: Basic Circuit Design for Engineers and Scientists. 670 Pages 2003 4.64 MB 2,477 Downloads New! Engineers and scientists frequently have to get involved in electronic circuit design even though Introduction to Basic Electricity and Electronics Technology, 1e. 624 Pages 2013 22.96 MB 41,425 Downloads. Introduction to Basic Electricity and.