

## PHY 311 – ANALOG and DIGITAL ELECTRONICS

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Office Hours: Tuesdays: 1:00 p.m. - 3:00 p.m., Thursdays: 11:00 a.m. - 12:00 noon

Text: Faissler, William, An Introduction to Modern Electronics, J. Wiley, 1991.

Laboratory Text: Electronics Lab. Manual (2002).

### Course Objectives:

1. understand the nature and scope of modern electronics.
2. describe physical and mathematical models of electrical and electronic circuits.
3. design and construct simple electronic circuits to accomplish a specific function, e.g., a computer interface for collection of temperature data.
4. understand the capabilities and limitations of electronic instrumentation and make decisions regarding their best utilization in a specific situation.

### General Course Content:

1. Basic physical concepts of electronics.- (Ch. 2)  
Charge. Current. Voltage. Resistance. Ohm's law. Power.  
Homework problems: 2.5, 2.7, 2.8,2.9,2.11
2. Circuit analysis.- (Ch. 3,4,6)  
Circuit elements. Schematic diagrams. Kirchhoff's laws. Sign conventions. Series and parallel circuits. Equivalent resistors. Voltage divider. Current divider. Thevenin's theorem. Norton's theorem.  
Homework problems: 3.6,3.7,4.7,4.8,4.9,4.11,4.13,6.5,6.7, A1, A2, A3
3. Alternating current circuits.- (Ch. 8-11)  
Measures of periodic signal amplitudes. Capacitors. Inductors. Impedance. Power. Reactance. Voltage divider. Resonance. RCL circuit. Transformers. Semiconductor diodes. Rectification. Wheatstone bridge.  
Homework problems: 8.3,8.5,9.1,9.3,11.2,11.3, A4,A5,A6
4. Step function analysis.- (Ch. 12)  
RC circuit. RL circuit. RLC circuit. Power supply filters.  
Homework problems: 12.1, 12.3,12.6, A7,A8A9.
5. Understanding and measuring analog signals  
Digital multimeter. Resistance measurements. Analog meters. Assessing errors in analog data measurements.

### Midterm

6. Introduction to digital logic.- (Ch. 19)  
Logic operations: AND, OR, NOT, NAND, NOR, XOR. Boolean algebra. Logical gates.

Homework problems: 19.2,19.3, 19.4, 19.5.

7. Designing logical networks.- (Ch. 20)

Examples. Simplification of logical networks. Karnaugh maps.

Homework problems: 20.1, 20.2.

8. Operational amplifiers.- (Ch. 28, 29, 33, 34)

OpAmps. Basic inverting amplifier circuit. Inverting amplifier. Noninverting amplifiers. Voltage follower. Summing amplifier. Current-to-voltage converter. Integrator.

Differentiator. Formal amplifier theory. Comparators.

Homework problems: 29.2, 29.4, 29.5, 29.6.

9. Solid state devices.- (Ch. 40-42)

What is a semiconductor. The pn junction. Diodes. Transistors. Operation of a transistor.

The common base configurations as an amplifier.

10. Registers, shift registers, and counters.- (Ch. 24-26)

Storage registers. Shift registers. Binary counters. Decoders. Multiplexers/Demultiplexers.

Adders. Memories.

11. Digital-to-analog and analog-to-digital converters.- (Ch. 35,36)

Purpose of DAC. Purpose of ADC.

**Laboratories:**

- Lab. 1 Use of the digital multimeter.
- Lab. 2 Familiarization with the oscilloscope.
- Lab. 3 The Basic StampII: thermistor application.
- Lab. 4 Analog voltage and binary States.
- Lab. 5 Introduction to bit crunching.
- Lab. 6 Build your own digital DC voltmeter.
- Lab. 7 RC circuits and filters.
- Lab. 8 Rectifiers: half-wave and full wave.
- Lab. 9 Basic digital to analog conversion.
- Lab. 10 Time varying signals.
- Lab. 11 Recording Frequency data.
- Lab. 12 Digital to analog the easy way using PWM.
- Lab. 13 Light meter gizmo with RC time constant.
- Lab. 14 Robotics competition.

**Laboratory:**

Laboratory work is a necessary aspect of the course. Every student must complete all lab assignments or they will be considered not to have completed all the requirements to pass the course. All lab and homework assignments to be handed in for grading and credit must be done thoroughly, according to the instructions, neatly, and on time. Assignments done carelessly will be returned without credit.

**Assignment/Grading Procedure:**

1 Quiz	5%
1 Midterm Test	20%
1 Final Examination	30%
Lab work	20%

Homework	10%
Robotics competition	15%

Grading Scale	
Final Score	Letter Grade
92.5 - 100	A
89.5 – 92.4	A-
86.5 – 89.4	B+
82.5 – 86.4	B
79.5 – 82.4	B-
76.5 – 79.4	C+
72.5 – 76.4	C
69.5 – 72.4	C-
66.5 – 69.4	D+
59.5 – 66.4	D
0 – 59.4	F

Homework problems are due one week after a chapter is completed. Late homework will not be accepted.

#### IV. Attendance

Students are expected to attend class but if they choose not to this will have no negative effect on their grade. Students that do attend and participate or show effort in class may receive extra credit on their tests. No makeup labs, tests, or exams will be given unless there is an emergency situation. In that case students are expected to contact the instructor no later than 24 hours after the missed lab or test; otherwise they will be given a zero grade for the missed evaluation.

TCNJ's attendance policy can be found at: <http://www.tcnj.edu/~recreg/policies/attendance.html>

#### V. Academic Integrity Policy

*Academic dishonesty is any attempt by the student to gain academic advantage through dishonest means, to submit, as his or her own, work which has not been done by him/her or to give improper aid to another student in the completion of an assignment. Such dishonesty would include, but is not limited to: submitting as his/her own a project, paper, report, test, or speech copied from, partially copied, or paraphrased from the work of another (whether the source is printed, under copyright, or in manuscript form). Credit must be given for words quoted or paraphrased. The rules apply to any academic dishonesty, whether the work is graded or ungraded, group or individual, written or oral.*

TCNJ's academic integrity policy is available on the web:  
<http://www.tcnj.edu/~academic/policy/integrity.html>.

#### VI. Americans with Disabilities Act (ADA) Policy

**Any student who has a documented disability and is in need of academic accommodations should**

**notify the professor of this course and contact the Office of Differing Abilities Services (609-771-2571). Accommodations are individualized and in accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1992.**

*TCNJ's Americans with Disabilities Act (ADA) policy is available on the web:*

<http://www.tcnj.edu/~affirm/ada.html> .

### **Bibliography:**

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- Johnson, D. E., Johnson, D. R. and Hilburn, J. L., Electric Circuit Analysis, Englewood Cliffs, NJ: Prentice Hall, 1989.
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- Purcell, E. M., Electricity and Magnetism, 2<sup>nd</sup> ed., New York: McGraw Hill, 1985.
- Smith, K. C. A. and Alley, R. E., Electrical Circuits: An Introduction, Cambridge, England: Cambridge University Press, 1992.
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