Analog Electronics PHYS 360 Syllabus

Course Information
Section number: PHYS 360
Course name: Analog Electronics
Semester and year: Spring, 2011.
Days/time class meets: M-W/14:35-15:20 (lecture), and M-W/15:30-17:25 (lab).
Location class meets: Physics and Chemistry Bldg. 2212 (lecture), and 2312 (lab).

Instructor Information
Instructor's full name: Dr. Costel Constantin
Location of instructor's office: Physics and Chemistry Bldg. 2124
Instructor's office phone: 540.568.0991
Instructor's e-mail address: constacx@jmu.edu
Instructor's office hours and/or preferred contact times: 9-10 on MWF, 14-15 Tu, and 10-12 Th, or by appointment.

Course Objectives and Overview
Electronics is essential for experimental physics. Electronics can be fun, and it can lead to a very good career! Electrical devices are found ubiquitously in our everyday lives. This class is structured into lectures and labs. In the lectures we talk about the theory behind DC and AC circuits involving passive circuit elements (e.g., resistors, capacitors, inductors, diodes, and transistors). Furthermore, we will deepen our theoretical understanding about circuits involving active circuit elements (e.g., operational amplifiers, and timers).

At the end of this course, the students are expected to become proficient in principles involved in analysis, simulation (e.g., MultiSim), design and protoboard circuit building, and knowledgeable about appropriate fabrication constraints.
Course Content

Tentative topics to cover:

- Direct Current Circuits.
  - Resistors and capacitors in series and parallel.
  - Ohm’s law, Kirchoff’s equations.
  - Voltage Dividers, Current Dividers.
  - The MESH loop method.
  - Thevenin’s equivalent circuit theorem.
  - Norton’s equivalent circuit theorem.
  - RC and RL circuit transients.
  - Signal differentiation and Integration.
- Alternating Current Circuits.
  - Sine wave properties.
  - Reactance, Impedance, and Phasors.
  - AC analysis of RC circuits.
  - RLC resonant circuits.
    - The complex exponential method.
    - Transient phenomena.
    - Effect of varying the resistive term.
    - Evaluation of RLC circuits by Laplace transform and Inverse Laplace transform.
- Diodes and some applications.
  - Semiconductors.
  - P-n junction, and n-p junctions.
  - Rectification and Single Voltage Power supply.
  - Split Power Supplies.
  - Voltage Multipliers.
  - Zener Diodes.
Tentative topics to cover (cont.):

- **Test Equipment and Measurements.**
  - Analog and digital meters.
  - The oscilloscope.
  - The signal generator and frequency counter.
  - Wheatstone Bridges.
  - AC bridges.
  - Four-wire resistance measurement.
- **Transducers.**
  - Temperature, Light, Force, Pressure, Vacuum and Sound transducers.
- **Transistors.**
  - The bipolar junction transistor.
  - The common emitter amplifier.
  - Common collector-emitter follower.
  - The darlington configuration.
  - The junction field effect transistor.
  - Mosfet analog switches.
  - The TRIAC.
- **Operational amplifier.**
  - Voltage follower.
  - Inverting amplifier.
  - Non-inverting amplifier.
  - Difference amplifier.
  - Mathematical functions: Summation, Differentiation, and Integration.
- **Field Programming Gate Arrays (FPGA).**
  - FPGA Architectures.
  - Programming (Configuring) an FPGA.
  - FPGA Designs.
  - Traditional Design Flows.
  - Other Design Flows.
  - Using Design Tools.
  - Choosing the Right Device.
Requirements and Policies

Texts References:
2. The Art of Electronics (2nd ed.), by Paul Horowitz and Winfield Hill.

Prerequisite: PHYS 250 or permission of the instructor.

Academic Honesty
In this class you are required to abide by the honor code found at the Council Web site: http://www.jmu.edu/honor/code.shtml.

Contacting the Instructor
Students can contact me by email, by office phone or in person. However, I can be reach 24/7 by email.

Equipment
Equipment will be provided for work in the lab. This equipment is to be used exclusively in the lab. NO EQUIPMENT MAY BE TAKEN FROM THE LAB WITHOUT WRITTEN PERMISSION OF THE INSTRUCTOR.

Laboratory Safety
As with any lab safety is an issue. This lab is not subject to many hazards but accidents result whenever people become careless. Common sense and care are mandatory in any laboratory.

Safety Specifics:
• Circuits may become very hot! The most common hazard in this lab is from circuits that over-heat when improperly connected. Wiring elements in a circuit invariably involves mistakes. You may fry some components. Components can burn and smoke. LEDs can pop. Components may become hot enough to burn your finger. Be aware of this and look for signs that components may be overheating. Often, the first warning is that you smell it. UNPLUG YOUR POWER SUPPLY if you think a circuit is overheating.
• No bare feet in the lab. Occasionally integrated circuits are dropped on the floor, and they nearly always land with the pins pointing up. If you should step on one in bare feet, you will regret it.
• Soldering Irons Melt Solder and Skin! Allow adequate space, and use a well-controlled and comfortable work area, with good ventilation. Turn off the iron when done. Be aware that solder and the iron become very hot and burn quickly. Also, be sure to keep the electric cord of the iron away from the hot tip.
Disability Accommodations

If you need an accommodation based on the impact of a disability, you should contact the Office of Disability Services (Wilson Hall, Room 107, www.jmu.edu/ods, 540-568-6705) if you have not previously done so. Disability Services will provide you with an Access Plan Letter that will verify your need for services and make recommendations for accommodations to be used in the classroom. Once you have presented me with this letter, you and I will sit down and review the course requirements, your disability characteristics, and your requested accommodations to develop an individualized plan, appropriate for PHYS360.

JMU abides by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act, which mandate reasonable accommodations be provided for students with documented disabilities. If you have a disability and may require some type of instructional and/or examination accommodations, please contact me early in the semester so that I can provide or facilitate provision of accommodations you may need. If you have not already done so, you will need to register with the Office of Disability Services, the designated office on campus to provide services for students with disabilities. The office is located in Wilson Hall, Room 107 and you may call 540-568-6705 for more information.

Inclement Weather Policies

In case of class cancelation due to weather we will reschedule the class according to the weather policies that can be found at http://www.jmu.edu/JMUpolicy/1309.shtml

Drop/Add

The dates and deadlines for dropping or adding a class are set by the registrar and are found on the web at http://www.jmu.edu/registrar/handbook.shtml#Dates%20and%20Deadlines

Religious observance

Students who are unable to attend class due to religious observance or sanctioned JMU activity (such as sports competition, band performance, etc) may request accommodation BEFORE the expected absence.
Methods of Evaluation

Grading:
Attendance (5%) + HW (15%) + Challenges (30%) + Midterm (20%) + Final Project (30%)

- **Attendance** - One missing class will cost you 1% off from your final grade.
- **Homeworks** - There will be (~) weekly homework assignments. The due dates of the homework assignments will usually be at the beginning of the lecture period; hereafter, the class will solve the homework problems with the help of the instructor. At the end of the problem-solving lecture, the student is asked to self-grade himself/herself, followed by a grade-readjustment that will be done by the instructor. **NO LATE HOMEWORK ASSIGNMENTS WILL BE ACCEPTED.**
- **Challenges** - There will be (~) weekly challenges due. The challenges will be send electronically though a Blackboard link.
- **Midterm** - The exam period is 50 minutes, and there will be questions from the lecture, and laboratory materials.
- **Final Project** - Two weeks before the end of the eight-week session, students are required to start working on the final project. If the instructor assigns a project (at the request of the student) then a successful completion of that project will yield a maximum B as grade. For achieving a grade higher then B, the student needs to find its own project.

Final Grade Structure:
- A (93-100%)
- A- (90-92.9%)
- B+ (86-89.9%)
- B (83-85.9%)
- B- (80-82.9%)
- C+ (76-79.9%)
- C (73-75.9%)
- C- (70-72.9%)
- D+ (66-69.9%)
- D (62-65.9%)
- D- (58 - 61.9%)
- F (57.9% or lower)