SPECIAL PROJECT

Toward the end of the semester, you will design and build a circuit of your own, to meet whatever purpose you like.

Project planning: This project is not like an ordinary lab assignment. It is more like a part of a thesis project. To be successful, you must do project planning.

Project planning entails:

- making a schedule for yourself
- allowing time to receive purchased supplies
- allowing time to assemble, test, and debug your experiment, and finish it on time
- budgeting for costs.

An original idea: The circuit you design may be analog, digital, or both. The circuit could arise from your thesis project, or it could complement an existing instrument, for example your telephone or stereo. You could make a game, a circuit that demonstrates some mathematical or scientific concept, or something for a hobby, such as a temperature controller for a photographic darkroom. It is up to your imagination.

Warning: Your design must be your own. Be prepared to identify which portion of your circuit is your idea, and which portion is copied from another source. Students who are unimaginative and copy entire designs (from books, the internet, or someone they know) are usually unable to answer questions about their project at the time it is graded, and they receive a poor grade.

Requirements: Your circuit must include a minimum number of electronic components that will be agreed upon when you discuss your ideas with the instructor.

Money: Purchase your own components from vendors such as the following:

- UI Engineering Electronics Shop http://www.icaen.uiowa.edu/~eshop/
- Radio Shack,
- DigiKey (tel 1-800-DIGIKEY), http://www.digikey.com
- Insight Electronics (tel. 1-800-677-6011).

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Two ways to build: You must choose either to (a) build it on a prototype board and disassemble it afterwards, or (b) to build it hardwired in a box with a battery or power supply. If your final project is built on a prototype board, it must be more ambitious. If it is hardwired in a box, it must meet good standards for safety and quality of construction.

Hardwired projects:

Safety: use a grounded box
use grommets & strain relief for power cord
cover all 110 VAC so that it is unreachable when the box is closed
Connectors: use a terminal strip with crimp-on lugs for 110 VAC

Holes: de-burr holes after drilling sheet metal
Wires to front panel:
bundle them with tie-wraps for neatness
Circuit boards:
line up ICs and other parts in neat rows
don't cross wires over chips
use sockets for chips
Testing: test your ideas on prototype boards first
show the instructor that your prototype-board version works
(for partial credit, in case your final circuit doesn't work)

Special Project Tips:

Planning

As with all research projects:

- Plan ahead.
- Procrastinators will learn a hard lesson.
- Expect your project to require 3× as long as you expect.
- Expect things to go wrong.

Designing

A simple idea that works is better than a grand idea that fails.

Avoid designing circuits with high speed, high frequency, high voltage, or high current.

Design a circuit mainly or entirely based on components that you already understand, like op-amps and digital gates.

Many successful projects begin with a fairly simple idea, then add "bells and whistles." After your basic circuit is tested successfully, extra features such as displays or adjustable settings can be added. Do this if your basic circuit idea does not have enough components.

Purchasing

- Buy from local sources wherever possible.
- Plan well ahead if you buy by mail.
- Buy several spares for every semiconductor, chip, or high-power item.
- Obtain data sheets for all semiconductors and chips.

Testing

Begin by testing your circuit, one section at a time, on a prototype board. Don't assemble a big circuit all at once and expect it to work. You will have bugs to work out, and this is easiest to do if you assemble it in stages, one section at a time.

Use an oscilloscope to observe AC signals in an analog circuit.

If you wish, you may test your design on a computer, using Spice-based circuit simulation software (such as Multisym) before you build it.

Buy a small prototyping board of your own so that you can keep your project assembled as you work on it. Otherwise you will have to disassemble it so that other students can use your board. A single strip or two may be enough.

If your circuit's inputs are to come from a transient source, such as pushbuttons or random pulses, test your circuit with a repetitive waveform from a function generator.

Special Project Grading:

At the end of your project, you will:

- Present a schematic diagram
  - label every part
  - identify function of switches, etc. (e.g. reset, power)

- Present a list of specifications
  - at least 3 numbers
  - example:
    - frequency bandwidth [Hz @ 3 dB flatness]
    - max input voltage [V]
    - input impedance [W]
  - identify whether measured or computed
    - measured is better
  - include error estimate and units

- Demonstrate how your circuit works
  - plan how to show it in 5 minutes
  - in case it doesn't entirely work:
    - demonstrate that part of it works
    - hope for partial credit for the part that does work

Here is a grading scheme that your instructor might use:

grading factor	prototype	hardwired
design cleverness of idea how well it works how ambitious it is	80 %	60 %
schematic diagram	10	10
specifications	10	10
quality of construction	-	15
safety	-	5