General Information

• Due Date
  – **Wed 9/16 at 4pm**

• Grading
  – Grading scheme and evaluation sheets located [here](#)
  – Submit PDF to PACE

• Project Proposal also described on the grading scheme page of the ECE445 Web site

**See commented example on course Website!**
[Commented Example of Project Proposal](#)
What is the project proposal?

THE PLAN
The “plan” contains four sections whose purpose is to articulate:

1. **Introduction:** What is your problem? Why is it important? How do you propose to solve it? What is different about your approach?

2. **Design:** How will you implement your proposed solution?

3. **Requirements and Verification:** How will you know if your solution is successful?

4. **Schedule and cost:** How long will each part of this project take and how much will it cost?

As an example, we will consider the development of a system to help swimmers pace themselves when training.

Begin working on your proposal as soon as your project is approved!
1. Introduction

Title page – why are you doing this project?
• Project title, group members, TA, date, course # (1/4pt)
• Statement of Purpose (Motivation) (3/4pt)
  – Why did you select this project?

Objectives – what do you hope to accomplish?
• Goals: What problem is being solved? (1pt)
• Functions: What is the product supposed to do? (1pt)
• Benefits: How is it good for the consumer? (1pt)
  * Should be a bulleted list.
• Features: What aspects make it marketable? (1pt)
Example: Swim Pacer Objectives

Objectives

Goals
• Provide real-time visual indication of pace to swimmer.
• Modular design that can be adapted to pool of any length.

Functions
• Light a sequence of LEDs at a set pace to guide swimmers.

Benefits
• Providing feedback on pacing has been shown to improve swim training.

Features
• LED panels submersible to 2.5 meters of water.
• Lap pace ranges between 8 and 45 seconds, 0.5 second increments.
• Maintain brightness of 20 lux at 2m from LED.
2. Design

Block Diagram - what are the individual components?

- Diagram Itself (1pt)
  - Interconnections
  - Consider high-level and detailed-level diagrams (example on website)
- Modular (1pt)

Block Description - what is the function of each component?

- Summary of system followed by specific descriptions
- Describe function of each block (1pt)
  - Every block in diagram should have a description
- Describe interface between blocks (1pt)
- Describe how each block contribute to the overall design (1pt)
  - Interconnection
  - Functionality

When writing your block descriptions use quantitative and specific language
Example: Swim Pacer Block Diagram

- Multiple resolutions
- Interconnections
- Modular organization

System Diagram

- CONTROLLER
- DISPLAY MODULE A
- DISPLAY MODULE B
- DISPLAY MODULE C

Display Module Diagram

- Power Supply
  - Communications Module
  - Microcontroller
  - LED Module
Example: Swim Pacer Block Description

**Power Supply**

The power supply will provide power for all of the components in the system. The power supply will consist of 3 AA batteries wired in series to provide a 4.5 V voltage source. The power supply will have reverse voltage protection in the form of a MOSFET reverse voltage protection protection circuit. The MOSFET circuit is a much more efficient alternative to a diode reverse polarity protection circuit and will increase the lifetime of the batteries in the voltage source. A low dropout regulator (LDO) or linear regulator will be used to step down the voltage to 3 V in order to provide power for the microcontroller and communications modules. The voltage at the output of the reverse polarity protection circuit (~4 V) will be sent to the LED module.

Not quantitative
3. Requirements and Verification Table

Requirements

A number that describes the requirement for each component of the project.

• Completeness (3pts)
  – Functionality of each block is covered
  – Concise and specific – don’t need full sentences
  – Define functioning behavior
  – Project should work if all requirements satisfied

• Consistency in interconnectedness of components (2pts)

Verification

A procedure for determining whether your component meets the requirement.

• Testing plan for each requirement (2pts)
  – Is the plan sound?
  – Quantitatively define “passed” test
  – Describe how verification results will be presented (i.e. tables, graphs)

• Thoroughness (2pts)
  – If all tests passed, will the project work?
## Example: Swim Pacer Requirements and Verification Table

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply:</td>
<td>Power Supply:</td>
</tr>
<tr>
<td>Must provide $5V \pm 0.25V$ at minimum of $1A \pm 0.25A$ at output.</td>
<td>1. Place digital multimeter in parallel with the power source. Measure the voltage difference across the power source. The voltage should read $5V \pm 0.25V$.</td>
</tr>
<tr>
<td></td>
<td>2. Place digital multimeter in series with the power source and heating elements. Measure the current difference from the power source. The current should read $1A \pm 0.25A$.</td>
</tr>
</tbody>
</table>

*Quantitative values on this side*

*Procedure for measuring those values*
Tolerance Analysis

Describe one engineering component or sub-system that is critical to the performance of your project. Describe quantitatively, the conditions that this component must operate under for the system to remain functional. Test the part under these extreme conditions, report the results.

• Choose one significant component of your design (1pt)
  – Why is this component significant? BE SPECIFIC!
  – What is an acceptable tolerance and why?
    Relate back to requirements on that module.
  – What is the test procedure?

• How do you check the component is operating within that tolerance? (1pt)
  – Use quantitative language

• At any point in the semester:
  – Test this component at the extremes and include results in lab notebook and final report.
  – Ex: If I choose resistors with +/- 10% tolerance, will the resulting variation in gain of my amplifier be within spec? Tolerance analysis isn’t an experiment done after the project is constructed to find the tolerance of some parameter.

Critical part of the design process
Example: Swim Pacer Tolerance Analysis

• Critical Component:
  Power Supply

• Acceptable Tolerance:
  We have identified an acceptable tolerance of 5V +/- 0.25V. Data sheets indicate that the LED panels will maintain 80% of their brightness in this range. Our client has requested that the LED panel maintain a brightness of at least 20 lux to be visible by the swimmers, the voltage has a direct impact on the brightness of the LED panel.

• Test Procedure:
  • LED Panel
    • If the voltage from my power supply can vary by +/- 0.25 V, will the brightness of the LED panel maintain a brightness of 20 lux at a distance of 2m from the panel?
    • To test, we will apply a range of voltages (4.5-5.5V in 0.05V increments) to the LED panel and measure the brightness using a hand-help photometer.
    • Empirical data will be reported in our laboratory notebooks as a plot of voltage vs. brightness at 2m as measured directly above the LED panel (in lux).
4. Cost and Schedule

Cost

There is a tendency to underestimate how much a project really costs.

- Labor = [salary] * 2.5 * [hours to complete] (1pt)
  - Average starting electrical engineering pay rate ~ $31/hour
  - Sum labor costs for each partner in the project, to compute the total labor cost
  - Multiplier might cover insurance/other costs of business

- Parts = Sum of cost of all parts (1pt)
  - Include part #

- GRAND TOTAL = LABOR + PARTS
Example: Swim Pacer Cost

<table>
<thead>
<tr>
<th>Name</th>
<th>Hourly Rate</th>
<th>Total Hours Invested</th>
<th>Total = Hourly Rate x 2.5 x Total Hours Invested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person A</td>
<td>$35.00</td>
<td>150</td>
<td>$13,125</td>
</tr>
<tr>
<td>Person B</td>
<td>$35.00</td>
<td>150</td>
<td>$13,125</td>
</tr>
<tr>
<td>Person C</td>
<td>$35.00</td>
<td>150</td>
<td>$13,125</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>450</td>
<td>$39,375</td>
</tr>
</tbody>
</table>

Actual costs include other factors such as insurance, office space, administrative costs.
### Example: Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Part Number</th>
<th>Unit Cost</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED’s</td>
<td>WP7113ZGC</td>
<td>0.42</td>
<td>30</td>
<td>12.60</td>
</tr>
<tr>
<td>MOSFET’s</td>
<td>IRF7210PBF</td>
<td>0.78</td>
<td>19</td>
<td>14.82</td>
</tr>
<tr>
<td>BJT’s</td>
<td>2N3904G</td>
<td>0.06</td>
<td>10</td>
<td>0.60</td>
</tr>
<tr>
<td>PCB’s</td>
<td></td>
<td>33.00</td>
<td>4</td>
<td>132.00</td>
</tr>
<tr>
<td>Resistors</td>
<td>RN60D6341FB14</td>
<td>0.31</td>
<td>20</td>
<td>6.20</td>
</tr>
</tbody>
</table>

- Include part number
- One entry for each part
4. Cost and Schedule

Schedule

The schedule is a weekly time-table outlining project completion.

• Specific tasks, defined in terms of deliverables (1pt)
  – Research and ordering parts not considered weekly tasks (by themselves)
  – No "To be determined" weeks
  – Be SPECIFIC

• Schedule with assignment of person in charge (1pt)
  – Only one person responsible for each task
  – At least one task per week per person
  – Responsibility ≠ workload

Use the modularity of your design to allocate responsibilities
### Example: Swim Pacer Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Task</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/6</td>
<td>Finalize and hand in proposal</td>
<td>Person A</td>
</tr>
<tr>
<td></td>
<td>Design reverse polarity and amplifier circuits</td>
<td>Person B</td>
</tr>
<tr>
<td></td>
<td>Test 315MHz frequency functionality in pool via evaluation boards</td>
<td>Person C</td>
</tr>
<tr>
<td>2/13</td>
<td>Conduct PSPICE simulations of reverse polarity and amplifier circuits</td>
<td>Person B</td>
</tr>
<tr>
<td></td>
<td>Design Review</td>
<td>Person A</td>
</tr>
<tr>
<td></td>
<td>Layout communications module</td>
<td>Person C</td>
</tr>
</tbody>
</table>

- **Ordering parts or ‘research’ are not tasks**
- **Be specific**
- **Plan for every week – no “TBD”**
- **One person per task**
- **One task every week**

Some tasks take longer than others, try to share not only the responsibility, but the workload as well.
4. Cost and Schedule

Keep careful track of all costs and schedule changes along the way—you’ll need them for the final report!
Writing Tips

• Writing Resources
  – Resources for writing the proposal can be found in “The Written Report” section [here](#)
  – Follow IEEE Citation Guidelines
  – We recommend using a LaTeX template
  – Please label figures, schematics, etc.
  – Your report should be approximately five pages (of writing) long

• Read your text out loud after you have written it.

Use the modularity of your design to allocate responsibilities