IED Mini-Project  
Competition for Groups of Two/Three

The IED Mini Project will help teach you critical engineering skills:

1. Familiarity with tools and processes needed to practically apply the engineering techniques learned in your other classes.
2. The steps of the Engineering Design Process.
3. The essentials of Public Speaking and Engineering Communication.
4. Teamwork and the challenges of working with different personalities.

These skills, which are the basis of real-world engineering design, are best learned by doing. Thus, the activity requires you to design, construct, test, present, and compete with a project of your own design in one of three categories. It is an opportunity to “warm up” before jumping into the full-blown IED team project which comprises the latter two-thirds of the course.

For this first project the class will be divided into groups of two (or three if needed based on class size). You and your partner will design a system for entry into the IED Mini Project Competition. In-class competitions will be held during your lab classes in Week 4. Class finalists will go on to the final competition, held during the Wednesday group lecture in Week 5.

The basis for the competition is three projects, each of which requires you to demonstrate engineering design skills. Your goal is to achieve competitive results despite minimal previous design and manufacturing experience. You will choose a project and a partner with whom to construct and execute the project.

## Competition choices:

There will be 3 competition projects, summarized below. More information is available for each individual project in the rules document for that project on LMS. Additionally, each project has a separate “Tips and Tricks” document with hints for success.

* + Set-Distance Mousetrap Car – Pairs will construct a mousetrap-powered car that will travel a specific distance, regardless of speed (within 2 minute maximum). The Mousetrap Car must also be capable of traveling the full length of the course - 15 feet. The competition’s goal distance (between 3 and 15 feet) will not be announced until the morning of the competition so the car's travel distance must be adjustable. Accuracy and repeatability count. For your convenience, mousetraps are available for $1 through the Design Lab (see the *Line-Follower Kit & Mousetrap Purchase Form* for more details).
  + Line-Follower – Pairs will assemble a line-following vehicle. It may be constructed with or without programmable electronics. The speed around the course will be measured, and going off course will count against you. Your line-follower will be tested on multiple courses of increasing difficulty. Design focus is on the sensor and motor-control circuitry. To enable teams to focus on the circuitry (rather than on mechanical design and construction), a dual motor gearbox, set of tires, caster wheel (third wheel), an attachment plate, and a solderless protoboard are available as a kit for $20 through the Design Lab (see the *Line-Follower Kit & Mousetrap Purchase Form* for more details).
  + Launcher – Pairs will construct a launching device to hurl a large sized marshmallow a specific distance. The launcher must also be capable of hurling the marshmallow the full length of the target area - 20 feet. The competition’s goal distance (between 5 and 20 feet) will not be announced until the morning of the competition so the launcher’s firing distance must be adjustable. Accuracy and repeatability count.

You are encouraged to use readily available materials (available at the local hardware store, campus bookstore, Radio Shack, Home Depot, Trojan Electronics, etc.) and software (available on laptops, open source, or the RPI web) for this project. Physical elements should be easy to construct with simple hand tools (i.e. the tools available in the IED shop, JEC 2232). For those materials and parts not readily available, you are strongly encouraged to order them as soon as possible -- shipping time can hamstring a team, and your grade depends on your performance, which requires a working (completed) project.

It is acceptable and you are encouraged to identify a pre-existing design to **analyze** in order to learn about how similar devices, systems, or processes work. Your project results will be partially judged based upon your prediction of the specified performance characteristics (distance/accuracy/line-following ability). The competition is a demonstration that your mini-project successfully and reliably achieves the required performance target.

In addition to predicting and actually demonstrating the key performance parameters, your project results will also be assessed based upon a number of factors that include

* how well it solves the problem
* the design methodology you followed
* creativity and initiative
* clear communication and professional behavior
* aesthetics and perceived quality of your project
* consistency of your results

Be aware that you will need to show that your project works repeatedly and does not fail after consecutive uses of the device – robustness counts.

## Timeline:

Week 1: Analyze problem, develop solution, order parts.

Week 2: Open lab hours start. Begin construction. All parts should be acquired.

Week 3: Finish construction/implementation. Test and document. Prepare for presentation and final technical memo, due week 4.

Week 4: Final technical memo and presentation due. In-class presentations and competition.

Week 5: Final IED Competition during Wednesday lecture. Participation will be based on in-class performance and grading in week 4.

## Sectional Competition Details:

* The mousetrap car distance, launcher distance, and line follower course will be disclosed on the day of the competition. The distance/course may not be the same on both days.
* Presentation - Teams will have 3-5 minutes each to present their projects plus 2-3 minutes for Q&A.
* Competition - Teams will have 10 minutes each to complete the competition portion of the class.

## Final Competition Details:

* Student finalists from each IED section will come together in Week 5 for the Final Competition.
* Each section’s three top performers (the highest ranked team on each project) will be selected by their instructor to represent their section in the final competition.
* Instructors choose based on: quality of engineering process, implementation of solution, and the performance of the solution.
* The mousetrap car distance, launcher distance, and line follower course will be disclosed on the day of the competition.

## Mini-Project Deliverables

* Final Presentation
* Final Technical Memo
* Competition Entry

## Notes on Grading

The engineering design process requires more than “trial and error” or guesswork. Thus, in addition to competition performance, each pair/group will be judged on the engineering merits of their project, with the competition performance making up only a portion of the mini-project grade.

The bulk of the grade will derive from:

* Assessment of your Engineering design skills and how well the process was followed. This should include the following.
  + - Conduct background research
      * Compare existing technologies
      * Benchmark/evaluate competing designs
    - Consider alternative concepts and use a rational process (e.g. selection matrix) to decide on your approach
    - Mathematically Model and/or simulate design choices
      * Predict your design’s performance
      * Optimize your design to achieve its best performance
    - Verify your design’s performance through experimentation (i.e. test it)
* Engineering Communication: This will test how well you can communicate the design decisions you made.
  + Presentation skills: You will be expected to concisely explain your project using the public speaking skills you learned in Week 2. Justify your design decisions; explain why your project is better and/or how it is unique.
  + Technical Writing: You will be expected to write a final technical memo, including all the diagrams, figures, and tables necessary to describe your project, your concept generation and selection, to justify your design decisions, and your testing to demonstrate your success (or failure) to achieve the project specifications. The final technical memo template is available in the Templates - Writing Resources section of LMS. The template contains notes to help you construct your memo. Your final technical memo will include some of the documentation generated during the activities in Weeks 1-3, including, but not limited to those for concept generation and selection.