

**Student Syllabus for EGN 1935 Engineering Design and Problem Solving  
Summer B 2008 (1 credit)**

**Class Schedule:**

Monday through Thursday: Period 5 (2.00-3.15 PM)

**Location:** Weil 270

**Section Numbers:** 4985, 5006, 5020, 5032

**Principal Instructor:** Dr. Daniel Dickrell, MAE-B 206, 392-1196, [djd3@ufl.edu](mailto:djd3@ufl.edu)

**Director:** Jeff City, M.Ed., Weil 204, 352-392-0944 (ex.1034), [jcitt@eng.ufl.edu](mailto:jcitt@eng.ufl.edu)

**Assistant Instructor:** Dr. Vikram Shishodia, Weil 312, 392-2177, [vshis@eng.ufl.edu](mailto:vshis@eng.ufl.edu)

**Programming Instructor:** Mike

**Course Grader:** J.D. Yamokoski

**Office Hours:** Students will receive contact information and regular availability times from their group mentors. Additional office hours for lecture instructors are available by appointment.

**Course Description:** This course is a one credit lecture and laboratory course with the purpose of assisting freshman engineering students with concepts of problem solving, drafting, computer skills and technical communication skills using a design project. Students will work in groups and follow the engineering design process in order to build and test a rubber-band powered vehicle. Upon completion students should be equipped with knowledge of the engineering approach to problem solving and familiarized with the design process. Students will be required to complete both individual and group assignments to gain both individual development and the experience of working in teams.

The course is designed to deliver fundamentals of engineering design and problem solving. Based on the knowledge of design process provided in this course, students are expected to work in teams and design the assigned project. The project includes programming a robotic arm. Relevant theory regarding programming is covered in the lecture series. Students are expected to demonstrate the performance of their design project at a competition event scheduled during the last week of the course. Vehicle performance is cost weighted in terms of the materials used with the intent that as practicing engineers there will be both a cost and benefit associated with incorporating materials into designs. Theory and various tools are provided so that cost and performance can be optimized. The course also provides for an opportunity to communicate the various facets of the designed project, including a poster presentation where students are expected to professionally present their work.

The knowledge gained in AutoCAD/MATLAB and Engineering Success courses go in conjunction with Engineering Design and Problem Solving course. It is expected that the students will be using the knowledge from these engineering computational programs to design their projects. Skills from technical communications course will be utilized for the presentation/poster component of the problem solving course. Engineering design,

engineering success and AutoCAD/MATLAB are all integrated courses as the knowledge gained from one is applied in the other courses.

**Textbook:** There is no required textbook, however students will have to investigate online and library resources on the design process, rubber band powered vehicles, trigger mechanisms and other research question topics. These types of references will be immensely useful in research and design of the most successful vehicles. Students will need to include formalized references to resources in their final design report, so they should document sources and notes appropriately.

**Attendance:** Student attendance is mandatory for all lecture and laboratory periods. A portion of each student's grade is based on class attendance and participation.

**Assignments:** Class assignments are due according to the attached syllabus. All assignments are due at the beginning of class on the due dates outlined on the syllabus. There are multiple individual and group assignments, an individual programming quiz, individual attendance and participation, a group poster presentation, a group final report and group vehicle competition performance components comprising each student's final grade.

**Honor Code:** *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."*

On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

<http://www.dso.ufl.edu/studentguide/studentrights.php#studenthonorcode>

**Accommodation for Disabilities:** Students requesting disabilities accommodations must first register with the Dean of Students Office. The Dean of Students Office will provide the student with documentation, which should be turned in to all teaching instructors. This must be done as early as possible in the semesters (preferably in the first two weeks of class) so that there is adequate time to make proper accommodations. For more information: <http://www.dso.ufl.edu/drp/>

**Disclaimer:** This printed course information is tentative. The principal instructor, director, and weekly instructors reserve the right to make corrections, additions, and/or deletions as the semester progresses. Syllabus corrections will be announced as they occur.



## Memorandum

**To:** EFTP/STEPUP Design Teams  
**From:** U.S. Nuclear Regulatory Commission Office of Advanced Projects  
**Date:** 4/1/2009  
**Re:** Contracting Opportunities, solicited proposals

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With the acknowledgment that new sources of energy are needed, the innovation and investment in nuclear energy methods is on the rise. There is a new type of nuclear reactor plant called Pebble Bed Modular Reactor (PBMR) that seems to be very safe and highly efficient. Briefly, the PBMR consists of 70mm diameter (tennis ball size) nuclear fuel spheres in a reactor core; an inert gas circulates carrying away heat which is used to turn a generator. The project is being evaluated by the U.S. Nuclear Regulatory Commission; however, the transfer of the spent fuel spheres from the plant and into a storage facility is not clearly defined and is our current biggest challenge.

The U.S. NRC is currently seeking proposals, from each of the EFTP/STEPUP teams at the University of Florida, on the removal of the spent fuel spheres by means of an elastic/rubber powered vehicle (RPV). Explicitly, your team's goal is to build a vehicle powered by elastic materials. The vehicle must transport a sphere once placed in the cargo area by a robotic arm. The vehicle should travel as far as possible from the plant into a geologic permanent disposal facility. The performance of the vehicle will be weighted by the associated materials cost of construction., with an overall goal of the best ratio of performance to cost.

In addition to the design and construction of the vehicle, this project involves the design and construction of a sphere-grabbing grip and the programming of a robotic arm. The robotic arm is composed of a small microcontroller and three separate servomotors. Your team will be challenged with modifying an existing programming code in order to precisely deliver the sphere onto the RPV's cargo area. It is very important to understand that the system (RPV and the robotic arm) is hands-off; that is, once that robotic arm is set into motion, it should do the necessary movement to grab the sphere and place it into the cargo area of the RPV. The delivery of the sphere must trigger the RPV into motion. Each RPV should be designed to travel the maximum distance in a straight line, hold the sphere in a cargo area and travel on a multitude of surfaces (example: wood) while using as little cost associated materials as possible.

**Schedule:** This day by day schedule indicates which lecture topics and assignments are associated with each class meeting.

DATE	DAY	TOPIC COVERED IN CLASS	HOMEWORK/PROJECT PORTION DUE
30-Jun	M	syllabus discussion, project overview, demonstration	
1-Jul	T	design process, engineering drawing, research questions	assignment 1 & 2 given (individual)
2-Jul	W	(workday) brainstorming with sketches	
3-Jul	R	(workday) library visit	
7-Jul	M	vehicle part list, material explanation, cost vs. benefit relation	<b>assignment 1 &amp; 2 due (individual)</b>
8-Jul	T	collaborative design process, machine shops and manufacturing	assignment 3 & 4 given (group)
9-Jul	W	(workday) example vehicle assembly practice	
10-Jul	R	(workday) project brainstorming, sketching and vehicle planning	
14-Jul	M	robotic arm and programming (I)	<b>assignment 3 &amp; 4 due (group)</b> , assignment 5 given (individual)
15-Jul	T	(workday) vehicle planning/design with robotic arm integration	
16-Jul	W	robotic arm and programming (II)	<b>assignment 5 due (individual)</b> , assignment 6 given (group)
17-Jul	R	(workday) vehicle planning/design with robotic arm integration	
21-Jul	M	programming quiz, report/poster/presentation discussion	<b>programming quiz, assignment 6 due (group)</b>
22-Jul	T	(workday) vehicle construction and report outlining	assignment 7 given (group)
23-Jul	W	(workday) vehicle construction	
24-Jul	R	review final report and poster expectations	<b>assignment 7 due (group)</b>
28-Jul	M	(workday) vehicle construction	
29-Jul	T	(workday) vehicle practice and fine-tuning	
30-Jul	W	(workday) vehicle practice and fine-tuning	
31-Jul	R	(workday) final trial run of vehicle and robotic arm	<b>group final reports due</b>
<b>1-Aug</b>	<b>F</b>	<b>vehicle performance competition 2:30 - 5:30 PM</b>	<b>vehicle competition</b>
5-Aug	T	no class	
6-Aug	W	<b>poster session and reception 2:00 - 4:00 PM</b>	<b>poster session</b>
8-Aug	F	no class	

### **Assignments:**

Below are brief descriptions of the assignments. Keep in mind that clarification and expectations of more detailed student responsibilities for each assignment will be discussed during the lecture periods. Students are responsible for all announcements made in class, which will include details and/or modifications to assignments, so be sure to attend all lectures.

For each individual assignment, student must both clearly print their name: **LAST NAME, FIRST NAME** on each page of the assignment and clearly write and label their eight-digit **UF STUDENT ID NUMBER** on each page. For each group assignment a separate cover page include the assignment number, names and student ID numbers of all group members must be included.

#### **Assignment 1: Individual Brainstorming Sketches**

Each student must individually create three distinct potential vehicle sketches based on the overall project description in class and the demonstration of engineering sketching. These three sketches must be completed on engineering paper. Try to be creative in your approach to vehicle and trigger mechanism design, keeping in mind your potential “vehicles” can have any number of wheels, rubber bands, axels, frame material, etc. You need to include hand labeling of integral parts and estimated dimensions on your engineering sketches. Be sure to photocopy your sketches so you can keep a copy of your ideas for vehicle design. Additional instructions and clarification of assignment expectations will be included in the lecture on July 1st.

#### **Assignment 2: Research Questions**

Students must individually complete the following ten research questions using the library and other resources. You must type your answers to these research questions and properly document the references you used to answer them (MLA-style covered in class). Keep in mind the overall design project and how these research questions may relate to a good engineering design of a rubber band powered vehicle. Additional instructions and clarification of assignment expectations will be included in the lecture on July 1st.

#### Chassis

- 1) What is a coefficient of friction? First write a definition and then explain it in your own words.
- 2) What is the major equation that involves the coefficient of friction? Explain each of its components.
- 3) What is the coefficient of friction of :
  - a. rubber against concrete
  - b. rubber against wood (polished)
  - c. balsa wood against 100grit sand paper
  - d. balsa wood against balsa wood

#### Trigger Mechanism

- 4) Do a search on simple machines and explain the principles behind their effectiveness (levers, pulley, etc).
- 5) Find and explain the function of three trigger mechanisms.

## Elasticity

- 6) What is the definition of angular velocity  $\omega$ , its equation and units?
- 7) How would you determine the angular velocity of a rubber band rolled about an axis (rod).
- 8) What is the definition of moment of inertia,  $I$ ? What is the equation for moment of inertia and what are the units. What is the moment of inertia of a cylindrical rod?
- 9) The kinetic energy of rotation of a rubber band attached to an axis (rod) can be found using the equation:  $K=(1/2) I \omega^2$ . Describe the components of this equation and how you could maximize the kinetic energy of a designed rubber band powered vehicle.
- 10) How does kinetic energy of rotation relate to work and power?

### **Assignment 3: Group Brainstorming Sketches**

Each group will brainstorm and complete labeled sketches of their three best vehicle ideas. Further explanation of this assignment will occur during lecture 6.

### **Assignment 4: Group Progress Report 1**

Each group will type a one page report describing the progress on their design project.

### **Assignment 5: Individual Memo and Work Order**

Each individual student will type a one page engineering memo and sketch a sample work order.

### **Assignment 6: Group Progress Report 2**

Each group will type a one page report describing the progress on their design project.

### **Assignment 7: Group Progress Report 3**

Each group will type a one page report describing the progress on their design project.

### **Individual Programming Quiz**

Each individual student will take a quiz based on robotic arm programming lectures.

### **Group Final Report**

Each group will type a formal technical report on their rubber band powered vehicle project. This report will utilize combined knowledge from the design, construction, experimental vehicle evaluation, cost/benefit analysis, AutoCAD, and MATLAB portions of the summer courses. An outline and much more detailed information about final report expectations will be covered.

### **Group Vehicle Performance**

The performance of each group's vehicle will be evaluated on competition day. This vehicle performance (longest point to point distance) will be weighted by the vehicle cost. Group vehicle performance grades will be determined from the cost-weighted vehicle performance. More details on the cost weighting, performance criteria and vehicle constraints for competition will be covered during multiple lecture periods.

**Individual Participation and Attendance**

Each student will be individually evaluated on their class attendance and participation in the design project by their group mentors.

**Final Poster Presentation**

Each group will make a technical poster and present their results at an informal poster reception at the conclusion of the semester. Groups will be graded solely on attendance and participation.