1 Homeworks

There will be a sequence of homeworks assigned throughout the semester:

- **Problems assigned:** Homework assignments will be listed at the course web site when they are ready.
- **Due dates:** In each case, due dates will be provided at the course web site.
- **Late penalty:** There will be a deduction of 15 points per day for submission of late homework (even one minute late counts as one day), and this counts weekends also.
- **Working together:** You may talk to anyone about how to solve the homework problems, but you must solve the problems on your own and the solutions must be written by you and you only (see below). You are encouraged to watch assigned videos as a group, and discuss them, but again, written answers to questions must be entirely your own. This policy is meant to encourage cooperation, but demand that individuals learn the necessary material themselves.
- **Grading:** Grading is on a scale of 0 – 100 for each homework. Homeworks will be weighted at the end of the semester per the relative difficulty and importance of each one. The total grade for homework is defined by $g_i^h$, for the $i$th person, and will be computed as a weighted sum of your individual homework grades.

All homework must be submitted electronically to Carmen. Submit solutions as .pdf or .doc files. Carmen checks each submission against all other submissions, past and present, and internet sources, calculates the percentage overlaps, and identifies the external sources. Significant overlap problems will be taken to the Committee on Academic Misconduct.

2 Participatory Appropriate Technology Development

The central objective of this project is to learn how to cooperate in a diverse group, with full participation, to develop an appropriate technology for a specific site/country. Cooperation plays a central role in the humanitarian engineering approach to working with a community on a project and requires significant social skills. These include skills in how to work with:

1. Community members, and to encourage/promote community participation; and
2. Engineering team members, not to mention other members of the team from other disciplines. Here, to teach elements of cooperation, and participatory development of a technology, a “cooperative learning” approach to having a team design and implement an appropriate technology is used. The social aspects of a humanitarian engineering project are typically the most challenging ones, and this assignment is designed to make you confront these difficulties.

All deadlines are given at the course web site.

2.1 Team Formation, Leader Choice, and Communication Strategy Choice

Team formation and functioning issues include:

- **Number of teams**: $M$ teams will be formed from the class by the instructor. Everyone enrolled in the class is part of one and only one team, the one assigned by the instructor. Changing teams is not allowed.

- **Team member(s) with local knowledge**: It is required that you include on your team a person from the population you aim at working with (e.g., a homeless person, someone from the “diaspora” of the country you aim at working with, or a person from the developing world you know or contact over the internet). Persons from Columbus, Ohio are candidates. Electronic communications can facilitate getting their inputs and evaluations of your project. You will receive no point deductions for getting help from such people, but of course you must cite your sources.

- **Communication Strategy**: Smooth, fast, and accurate inter-team communication is crucial to team success. Of course, you should have face-to-face meetings, at least weekly; Doodle can help with scheduling such meetings. It is strongly recommended that your team devises an electronic communication strategy that people are likely to be highly responsive to (e.g., group texts, a favorite social media approach, or an email distribution list). Some students like “GroupMe.” Whatever you pick, aim at simplicity and minimizing response delays. The choice of the communication strategy should be made by, and agreed upon, by the whole group.

- **Team Leader**: The leader is the point person for corresponding with the instructor (however, of course, anyone can see the instructor at any time about the project), and may take on other responsibilities the team agrees upon, such as convening meetings. The leader’s main task is to promote and facilitate participation and cooperation on the team; no dictators allowed!

The team must select a single leader and communication strategy and report the choices to the instructor by providing him the leader’s name and email address and a single-sentence description of the communication strategy the team agreed on. Please provide this via an email to passino.1@osu.edu.

2.2 Project Choice

While your team may pick your project, each team must get the instructor’s approval for it. Discussions with the instructor before the choice is made are welcome (e.g., in person or via email). Sometimes such discussions are useful to narrow down the choices. You may pick one of two types of projects:

1. **Appropriate technology, personal or community**: Using the sections and sources identified in the book in Chapter 4, choose an “appropriate technology,” develop it, and implement it. For instance, this could be one for personal energy supply, housing, lighting, water filtration, cooking, etc. Another project would be to develop the personal spending advisor app described at the end of Chapter 1 of the book; this would require, however, development of an app on a smart phone.

2. **Appropriate technology for STEM education**: Read the sections in Chapters 3 and 4 of the book on international education and humanitarian STEM education and develop an experiment/project that can be used for STEM education. For instance, see the experiments at iSTEM, with more details are
given here. For instance, you could consider the design of a communication system that helps to teach how a cell phone works. This could start with a string-cups approach, and then the construction of a radio-receiver system. Cell phones seem to be one of the most complex and ubiquitous technologies on earth; this shows that people value them, and hence they likely will want to learn about them.

The teams incur all project costs (e.g., for materials and supplies); this is meant to encourage teams to minimize the cost of the proposed technological solution. Be careful to schedule sufficient time to buy parts and have them delivered.

The team must achieve a whole array of objectives given below, but two key aspects that will drive your choice of a project are a requirement to:

- Implement the technology in hardware (in some cases it is acceptable to have a focus on software development for a given piece of hardware such as in the app case mentioned above). This implementation is required.

- Use Matlab/Simulink to simulate the technology for development, evaluation, impact on social context, or impact of social context on the technology. This is strongly encouraged, but not required.

Each team must pick their project and report the choice to the instructor for him to evaluate/approve it; report your choice via an email to passino.1@osu.edu that is no more than a few paragraphs. It is highly recommended that before that date, at least the team leader discusses project options with the instructor.

### 2.3 Project Steps

The project has four associated steps, each of which is graded. Each step has both individual and team components. Any imaginable information source can be used, and at any time, for project work, but cite your sources. All written assignments for the project must be submitted electronically. Carmen checks each submission against all other submissions, past and present, and internet sources, calculates the percentage overlap, and identifies the external sources. Significant overlap problems will be taken to the Committee on Academic Misconduct.

#### 2.3.1 Design Review 1

Pick a target developing country, city, or village location for your project. **It is required that you have someone on your team from that location or who has visited the location (see above per team composition).** The team must decide which team members are doing which of the following tasks, and each task must be completed by **only one individual** on the team (that is, the report for each must be written by **only one team member**), though intra-team oral consultations are allowed:

1. **Evaluate needs and priorities:** To the greatest extent possible, easier as you have a member of the target population on our team, evaluate needs and priorities of the people. Make this for a specific community or region.

2. **Evaluate needs and priorities, broadly:** To the greatest extent possible evaluate needs and priorities of a much broader region for the need you identified above. This evaluation should be at the country level, and is done to consider if it is possible to scale up your technology.

3. **Evaluate relevance of culture:** To the greatest extent possible, via a member of the target population on our team, evaluate the impact of culture on constraints for your technology design problem.

4. **Evaluate context:** Here, context includes many things, such as weather (temperature, humidity, rainy vs. dry seasons), local housing situations, availability of local materials/resources, etc. It is everything but the people, social and physical environment.

5. **Evaluate design options #1:** Evaluate options for the technology your project will focus on. Consult the literature and brainstorm. **This must** have significant technical content (e.g., science, math, and engineering).
6. **Evaluate design options #2+:** Same as last item, if there is an extra person(s) in your group. All other tasks besides evaluating design options must be covered first before assignment of more people to consider other design options.

7. **Develop specifications:** Specifications quantify the characteristics of the physical make up and operation of the technology. They specify desirable characteristics of the technology that your design aims to achieve. You should, as appropriate, include the social context. You should make these technical/scientific specifications, quantifications of desired features in an accurate and scientifically-accepted manner (e.g., ppm contaminants in output of a water filtration system).

8. **Evaluate impact on environment:** This can include resources used (e.g., materials), pollution during operation, and how environmentally-friendly it is to recycle the technology at end-of-life.

9. **Evaluate cost:** This should evaluate the costs of all aspects of the technology, from materials, construction, and operation. You must include an analysis of whether local people could afford to buy the technology. You must include a spreadsheet with the budget on it.

10. **Develop project schedule:** Use a Gantt chart, get concurrence from your team, and match it to deadlines given at the web site. Include all team member's subprojects, and tasks to integrate these into the Midterm, Design Reviews, and Final Project.

Written reports are required in all cases, submitted via Carmen. Some thought should be given to coordinating which word processor is used so that reports can be combined and modified to form a single report for the Midterm Project below. It is recommended that you use Microsoft Word, though Latex is a good choice.

See course web site for deadline for Design Review 1.

**Design Review 1 Resubmissions:** The reports turned in for Design Review 1 may be improved and resubmitted for grading at any time up until the date given at the web site. There is no penalty for a resubmission. The team members should help each other improve the grades on the individual assignments as much as possible; of course, primary responsibility to improve the assignment rests with individuals (and see below, for how the final grade is computed). This is a key element of cooperative learning: there is a demand that students help each other learn (“positive interdependence”). A key issue here can be the willingness of someone who has a low grade, and hence needs to do more work and resubmit, to seek the help of others.

### 2.3.2 Midterm Project

The team should synthesize and improve the reports from Design Review 1 and:

1. **Midterm Project written report:** Submit a single report on the project that everyone on the team contributes to via their individual contribution in the first design review and help in combining all the ideas in the group into one cohesive whole. Fill in any holes. This group report should be created with a collaborative authoring tool so that everyone on the team can easily contribute (e.g., MS Word). There are no specific requirements on length/format; just get the job done and be concise.

2. **Midterm Project oral report:** Two team-chosen members should email the instructor to set up a design review within one week after the due date for the written Midterm Project report given at the course web site. This review is oral, limited to one hour in the instructor’s office, and will impact the grade given on the Midterm Project written report. Only two persons may be present. No slides are allowed. You may, however, have the written report available in electronic form (no paper). One key function of this meeting is for the instructor to provide feedback on how to improve the project.
The oral report will be viewed as your way to highlight what is important and good about your work. The oral and written reports will be graded as a whole, not individually.

Due date for written Midterm Project report: See course web site.

Midterm Project grading: Let $g_{i}^{dr1}$ denote the grade you receive on your Design Review 1 assignment, after possible resubmission, and let $g^{mpt}$ denote the team’s grade on the Midterm Project (written and oral portion). Then, your individual grade $g^{mp}$ for the Midterm Project is computed as

$$g^{mp} = \frac{1}{2} \min\{g_{j}^{dr1}\} + \frac{1}{2} g^{mpt}$$

This way, your grade for the Midterm Project depends on your individual performance, the performance of other group members (notice the minimum taken across team members), and the performance of the group that depends on how well the team works together on the team report and oral report. Clearly, then, everyone has an incentive to help low-performers in the group, and low-performers have a motivation to improve their own grade, and this contributes to a better group outcome. This grading strategy encourages all individuals to contribute/participate, and all individuals to cooperate. By federal law, the instructor cannot provide all team members each others’ grades; however, the team may be able to overcome this problem on their own.

To determine the final Midterm Project grade of the members of a team, however, there is one more modification. The following rule will be applied to encourage competition between teams:

If your team’s grade $g^{mp}$ is the highest of all the teams in the class, then $g^{mp}$ will be elevated to $g^{mp} = 100$ no matter what the grade was.

Competition is added to give each team a tangible reward for cooperating to provide excellent work.

Important: You may opt out of this situation where your grade depends on others’ grades in two ways: Change your enrollment to an audit, or drop the class. It is quite unacceptable in this class not to try your best, as lack of good effort will adversely affect other students’ grades. This is not the normal team-graded approach where some individuals can “coat-tail” their way to a good grade (even though they have poor performance) by the good efforts of others. However, with bad performance and bad attitude by a bad-performer, this approach may require more effort by a good performer, but perhaps less than “carrying” a bad performer without helping them improve. This feature of interdependence of grades is a natural consequence of cooperation and a cooperative learning approach. In fact, such grade interdependencies are not uncommon in engineering, for capstone design classes, for other classes that require team work, and for classes where individuals work on their own but where the final grade is determined “using the curve” (i.e., the mean of the final grades is determined and then grades set relative to that mean assuming a Gaussian distribution).

2.3.3 Design Review 2

Repeat the assignments for Design Review 1 above, but the team must assign persons to a task different from those tasks assigned for Design Review 1. This will involve a reconsideration of all the key issues by other team members, making clear additions or reconsideration in other ways, of all issues. Individuals should seek to avoid any repeats of the work done in the past, and try to take a fresh look; it is acceptable to look at all previous assignments from Design Review 1, the Midterm Project report, and even use as a start electronic pieces of these documents from others. There should be a more significant focus on adding technical/scientific analyses of aspects of the project, especially the technical design, and Matlab/Simulink.
simulations for evaluations. If some parts of your Midterm Project were particularly strong, and do not really need much (or any) change, then no one should work on that part. Other issues aside from the ones listed for Design Review 1 could have arisen and you may want to assign a team member (or members) to new aspects of the project (ones not in the above task list). That is up to the team. Likely, Design Review 2 will have one or more persons construct a prototype of the technology; indeed, the prototype must be built by the due date for Design Review 2 and reported on. Clearly, the goal is simply to make all components of the project as strong as possible, so that after Design Review 2 the team can integrate the pieces into a cohesive whole. Finally, of course, each individual must write up their own evaluation/work in their own words, and reference all sources used, including past reports.

Due date for Design Review 2 assignments: See course web site.

The reports turned in for Design Review 2 may be improved and resubmitted for grading at any time up till the resubmissions deadline at the course web site. There is no penalty for a resubmission. The team members should help each other improve the grades on the individual assignments as much as possible.

Due date for resubmission of Design Review 2 assignments: See course web site.

2.3.4 Final Project
The team should synthesize and improve the reports from the design reviews and:

1. Final Project written report: Submit a single report on the project that everyone on the team contributes to via their individual contributions in the design reviews, the Midterm Project, and help in combining all the ideas in the group into one cohesive whole. This group report should be created with a collaborative authoring tool so that everyone on the team can easily contribute. Final project reports will be posted at the course web site after grades are assigned.

2. Final Project oral report: A designated team member (only one person) gives an electronic presentation on the project during the Final Examination period in front of the entire class (see course web site for that date). All team members assist in adding points of clarification and in answering questions. Also, other team members should help make up the e-presentation slides. The number of slides must be less than 10 including the title slide (after the 10th slide, the presentation will be terminated) and presentation time will be strictly limited to 10 minutes. The person who is to deliver the talk must practice it beforehand in front of the team at least once. You should minimize the number of words on the slides as no one can effectively listen and read at the same time. Use pictures and diagrams as they are worth a thousand words. Questions will be allowed from the whole class after the talk for 3 minutes. An outside expert or experts may be invited to evaluate the projects, and their assessments may be used in setting grades. Final project oral presentations and slides will be posted at the course web site after grades are assigned.

The oral report will be viewed as your way to highlight what is important and good about your work. The oral and written reports will be graded as a whole, not individually. The Final Project oral reports will be presented in front of the whole class so you will learn about all class projects.

Due dates: See course web site.

Final Project grading: Let \( g_{dr2} \) denote the grade you receive on your Design Review 2 assignment, after possible resubmission, and let \( g_{fpt} \) denote the team’s grade on the Final Project (written and oral portion).
Then, your individual grade $g^{fp}$ for the Final Project is computed as

$$g^{fp} = \frac{1}{2} \min \{ g^{dr2}_j \} + \frac{1}{2} g^{fpt}$$

As with the midterm, to encourage competition between teams:

If your team’s grade $g^{fp}$ is the highest of all the teams in the class, then $g^{fp}$ will be elevated to $g^{fp} = 100$ no matter what the grade was.

This rule should encourage students to provide constructive criticism of the results reported in another team’s presentation during the Final Examination period.

**Agreement:** It must be agreed that the instructor may share the solution materials for your project (reports, presentation, photos, movies, etc.) by posting it on the web, and for these please provide MS Word or .pdf files. If you do not want your name on the project, please remove it. Of course, the project grades will not be shared with anyone.

## 3 Final Grade

The final numeric grade for the course is computed for the $i$th person as

$$g_i = \frac{1}{2} g_i^h + \frac{1}{4} \left[ \frac{1}{2} \min \{ g^{dr1}_j \} + \frac{1}{2} g^{mpt} \right] + \frac{1}{4} \left[ \frac{1}{2} \min \{ g^{dr2}_j \} + \frac{1}{2} g^{fpt} \right]$$

or, half the grade is due to homework and the half due to both the design review assignments (after possible resubmissions) and the Midterm and Final Projects.

Per the “OSU Standard Scheme,” the assigned letter grade for the course is set according to:

- $0 \leq g_i < 60$: E
- $60 \leq g_i < 67$: D
- $67 \leq g_i < 70$: D+
- $70 \leq g_i < 73$: C-
- $73 \leq g_i < 77$: C
- $77 \leq g_i < 80$: C+
- $80 \leq g_i < 83$: B-
- $83 \leq g_i < 87$: B
- $87 \leq g_i < 90$: B+
- $90 \leq g_i < 93$: A-
- $93 \leq g_i \leq 100$: A