Target Audience
This course is intended for 11th and 12th grade students and adult learners in the Commonwealth of Virginia.

Instructor
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Course Overview
Great engineering is sometimes referred to as ‘art that works’. This is because engineering, like art, requires creativity. But engineering creations, unlike art, must solve real problems and help our society meet new challenges. This course introduces students to the world of engineering, including the role of engineers in modern society, an overview of the various fields of engineering, and modern, quantitative methods used by engineers to solve problems and meet new challenges.

The key component of the course is a hands-on design-build project in which students work together in small teams to design and develop a solution to a case study problem. Much of the course will center around four large group assignments intended to introduce students to the major steps of the design process used by engineers. This activity will culminate in an oral presentation of design results and a demonstration of a prototype of the design solution.

During the course, students will explore the sources of inspiration, the methods engineers use to solve problems and the impact of engineering solutions. Reverse engineering exercises and case studies will be used to introduce students to the design process and the considerations engineers must make when designing new products. The course will also seek to make clear the distinction between science and engineering, and to demonstrate how engineers apply mathematics and science in design. At the end of the course, it is anticipated that students will be able to make clearer choices when deciding on a career path.

Course Objectives
1. Introduce students to the design method used by modern engineers to create solutions to identified problems by illustrating:
   • methods of creative problem solving and their application
   • the role of quantitative analysis (mathematics, physics, engineering analysis) in engineering practice
   • examples of open-ended (design) problems and their solution
2. **Enable students to make more informed career choices** by:
   - explaining what engineers do, why they do it and how they do it
   - describing the various engineering subdisciplinary fields and their applications
   - distinguishing clearly between science and engineering

3. **Encourage students to the study of engineering** by:
   - introducing them to the fun and challenge of engineering
   - helping them appreciate the importance of the context (social, cultural, economic, environmental, regulatory, ...) in which the technical work of engineers is accomplished.
   - emphasizing hands-on design-build-test activities

4. **Develop student skills** in:
   - oral and written communication
   - multidisciplinary teamwork
   - creativity

**Outcomes**
1. Students can explain what an open-ended (design) problem is and can apply the basic methodology for solving such problems
2. Students make better informed choices about engineering as a career path
3. Students understand the distinction between science and engineering, and understands the role of math and science in engineering
4. Students understand the importance of teamwork and are able to apply critical team forming and management techniques
5. Students have attained a basic understanding of the approach and mindset of the engineer engaged in design
6. Students have a deeper appreciation of the role that engineers can (and will) play in confronting societal challenges in the 21st century.

**Design-Build-Test Project**
Students will collaborate in small teams to construct and test a solution to a problem within a problem space of their choosing. Since the problem is not well defined, student teams must first define the problem carefully to ensure that a real problem is solved at the end of the project. Teams will then generate ideas for how to solve their problem and select the most promising concept. They will then explore the engineering viability of their concept using science, math, and engineering principles. Finally, they will report on their work and recommend whether their design is sufficiently viable to justify further development.

**Delivery Media**
This course will be made available to students using two distance learning technologies. Primary class sessions will be delivered via an on-line course management system (UVa Collab). This learning environment provides students with any time, anywhere access to prepared course materials, i.e. asynchronous learning. Students are expected to have access to high-speed internet (at least at school) and can view
multimedia clips, read prepared content, submit answers to interactive surveys, and discuss topics using text chat. Then, each week, students will use a live, on-line learning community space (Blackboard Collaborate) for ~30 minute long, real-time design team interactions with the course instructor. This environment allows students and their faculty instructor to converse with one another, via audio and text, in real time. The faculty instructor and student team members can share their computer desktops with one another as they discuss primarily elements of their semester long design and build projects. Real-time interaction time will also be used to reinforce course content delivered asynchronously. Each week of the course will involve the equivalent of two asynchronous class sessions and one live 30 minute session. The asynchronous lessons will be completed by students between Monday morning and the following Monday each week. The live classroom sessions will occur at a regularly occurring, agreed upon time.

**Grading**

Each student in this ENGR 1520 section will have both individual and team components to their grade. The table below shows the assignments, grade type, and percentage contribution to the final grade. Each of the semester-long design and build assignments include an individual and team component to grading. While working together, students will be expected to self-assess and report their contribution to the final team report. This information will be used to determine the relationship between team and individual grades on each assignment.

**Assignment Schedule**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Value</th>
<th>Type</th>
<th>Assignment Date</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Assignment #1 DEFINE</td>
<td>17.5%</td>
<td>Team/Individual</td>
<td>Early September</td>
<td>4 weeks after assignment</td>
</tr>
<tr>
<td>Team Assignment #2 GENERATE &amp; SELECT</td>
<td>17.5%</td>
<td>Team/Individual</td>
<td>Early October</td>
<td>3 weeks after assignment</td>
</tr>
<tr>
<td>Team Assignment #3 EXPLORE</td>
<td>17.5%</td>
<td>Team/Individual</td>
<td>Late October</td>
<td>4.5 weeks after assignment</td>
</tr>
<tr>
<td>Team Assignment #4 REPORT &amp; RECOMMEND</td>
<td>17.5%</td>
<td>Team/Individual</td>
<td>Early December</td>
<td>Mid-December</td>
</tr>
<tr>
<td>Weekly Assignments</td>
<td>25%</td>
<td>Individual</td>
<td>Weekly</td>
<td>Weekly</td>
</tr>
<tr>
<td>Class Participation</td>
<td>5%</td>
<td>Individual</td>
<td>Continuous</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Grades**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td>A</td>
<td>92% - 95%</td>
</tr>
<tr>
<td>A-</td>
<td>90% - 92%</td>
</tr>
<tr>
<td>B+</td>
<td>87% - 90%</td>
</tr>
<tr>
<td>B</td>
<td>82% - 87%</td>
</tr>
<tr>
<td>B-</td>
<td>80% - 82%</td>
</tr>
<tr>
<td>C+</td>
<td>77% - 80%</td>
</tr>
<tr>
<td>C</td>
<td>72% - 77%</td>
</tr>
<tr>
<td>C-</td>
<td>70% - 72%</td>
</tr>
<tr>
<td>D+</td>
<td>67% - 70%</td>
</tr>
<tr>
<td>D</td>
<td>62% - 67%</td>
</tr>
<tr>
<td>D-</td>
<td>60% - 62%</td>
</tr>
<tr>
<td>F</td>
<td>Below 60%</td>
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</tbody>
</table>
During the semester, this course will cover the following topics:

1. Teamwork in Engineering
2. The Engineering Design Method
   a. Problem Definition
   b. Concept Generation and Selection
   c. Concept Exploration
   d. Solution Reporting and Recommending
3. Product Life Cycles
4. Design for X
5. Creativity and Intellectual Property
6. Engineering Degrees and Fields of Practice
7. Engineering Ethics and Professionalism
8. Professional Report Writing and Oral Presentation

The Honor System and the School of Engineering and Applied Science

The School of Engineering and Applied Science relies upon and cherishes its community of trust. We firmly endorse, uphold, and embrace the University of Virginia’s Honor principle that students will not lie, cheat, or steal, and we expect all students to take responsibility for the System and the privileges that it provides. We recognize that even one Honor infraction can destroy an exemplary reputation that has taken years to build. Acting in a manner consistent with the principles of Honor will benefit every member of the community both while enrolled in the Engineering School and in the future.

If you have questions about the Honor System or would like to report suspicions of an Honor offense, please contact Professor Groves <jgroves@virginia.edu>. For more information on the UVA Honor System, please visit the following web resource: http://www.virginia.edu/honor/

Text
