TAMALPAIS UNION HIGH SCHOOL DISTRICT
LARKSPUR, CA

Course of Study
ENGINEERING PROJECTS

GENERAL COURSE DESCRIPTION

Engineering Projects is the capstone course of the high school engineering program and is simultaneously the first step in college-level engineering. The course is designed to replicate the introductory-level engineering course at both the community and UC level.* Students interact with a professional engineer who, with help from the instructor, works to help students look at the ***real world*** challenges through the lens of a professional engineer. The course allocates one (1) full semester and one (1) real world problem to each of the following fields of engineering:

The Four Engineering Fields (as defined by the ISMC**):

1. Mechanical Engineering
2. Civil/Structural Engineering
3. Electrical Engineering
4. Computer and Software Engineering

The course structure is as follows: each of the four fields of engineering is allotted one (1) full semester and one (1) real world problem. Each semester is paired with a professional in the semester's focus field of engineering, who is not necessarily familiar with the real world problem, but is very familiar with the engineering field, i.e., what type of work is done in that field and how one becomes a professional in the same field. This professional will be involved by providing the introductory presentation, the vetting of proposed student project ideas, email communication with the instructor throughout the semester and, ultimately, the observation/feedback of student work presentations at the end of the semester. This level of involvement is beyond that of a volunteer and likely necessitates a stipend.

Students taking Engineering Projects generate a web-based portfolio documenting their individual application of skill and their comprehension of the professional pathway in each of the four engineering fields. At the end of the high school engineering pathway, students submit the portfolio as a college and/or scholarship application supplement.

A typical semester project timeline is as follows:

- ✓ Students hear an introductory presentation from an engineering professional who works in the semester's engineering field of focus. The professional describes the type of work done and the skills applied by this type of engineer, and the pathway to becoming a professional in the field.

- ✓ Students are told the real world problem to address. They research the problem and create a list of ideas to address some aspect of the real world problem in the semester's focus field.

- ✓ At teacher's discretion, Individual students, or groupings, decide on an idea to pursue. They present their concept to the class, teacher, and to a professional in the field, detailing how they will use the

skill set of the semester's engineering focus field to address some aspect of the real world problem. Post-presentation discussion will: 1) pair the idea to a scale and size obtainable in six weeks; 2) establish clear project criteria and constraints; and 3) provide a clearly defined concept of "how we'll know we've succeeded" *aka* goal. The criteria, constraints, and project goal are documented at this time.

- ✓ Students then work toward accomplishing their project goal for the remainder of the semester. Project progress is documented and discussed weekly in the student's engineering portfolio. Student access to the professional is available through the teacher, at the teacher's discretion.

- ✓ At the end of the semester, students present their project results to the teacher, to the class and to the professional in the field. All results are documented and discussed in the student's engineering portfolio.

Schools where the course will be taught: TUHSD Comprehensive sites

Length of course: one year (alternating between versions A and B year)
Engineering Projects version A: Mechanical Engineering and Computer/Software Engineering
Engineering Projects version B: Civil/Structural Engineering and Electrical Engineering

Subject area and discipline: Engineering, applied technology

Prerequisites and/or Co-requisites: Demonstration of proficiency in Engineering Design or instructor approval

Grade levels: 11th or 12th (exceptions at instructor discretion)

Course Certification: UC Approval Pending.

Textbooks or other supporting material: none

Methods of evaluation:
Students document project progress and present their results, analysis and associated discussion to the class, instructor and engineering professional in the focus field.

Engineering Projects: Course Objectives and Proficiency Scale				
Course Objectives (Upon completion of the course, the student will be able to...)	**1 (emerging)**	**2 (developing)**	**3 (meets expectations)**	**4 (exceeds expectations)**
Evaluate personal level of interest in the semester's field of engineering focus (Mechanical, Electrical, Civil/structural, computer)	Student understands what work is done and what skills are applied in the semester's engineering field of focus	Student experiences applying the skills used in the semester's focus field of engineering. Student understands that the content of the semester is the beginning of possible further study	Student understands the traditional pathway to obtaining a career in the semester's focus field of engineering. Student thinks critically while applying skills used in that field of engineering	Student understands and reflects on the lifestyle of a professional engineer in the focus field of engineering. Student experiences a professional working environment in the same field (ex: job shadow, internship)
Apply skills in the engineering field of focus to address some aspect of a real world problem	Students understand the principle behind the provided real world problem and how this problem impacts the world around them	Students accurately ideate ways that engineers in the focus field might work to address the provided real world problem	Students critically think and apply skills from the focus field of engineering to design and fabricate a device that addresses some aspect of the provided real world problem. Results are presented and discussed with peers, instructor and professional engineer.	Students identify real world problems, independently generate ideas of ways to address these problems and then apply skills from the focus field of engineering to execute the idea. Results are presented to a public audience, soliciting authentic feedback.

Examples of real world problems and associated sample projects

Real world problem to address: ***Communities around the world need clean drinking water.***
Related links: https://en.wikipedia.org/wiki/Flint_water_crisis

Mechanical engineering example project ideas:
- ✓ Design and build a cookstove and a condenser to distill contaminated water
- ✓ Design and build a solar powered water distiller
- ✓ Design and build a water filtration system out of recycled materials such as water bottles, cans, etc.

Electrical Engineering example project ideas:
- ✓ Design and build a Reverse osmosis pump running on solar cells

Real world problem to address: ***Waste management (biological or otherwise)***
Related links: http://www.unep.org/NEWSCENTRE/default.aspx?DocumentId=2698&ArticleId=9317

Mechanical engineering example project ideas:
- ✓ Repurpose old technology or garments

Computer engineering example project ideas
- ✓ Compost monitoring and regulation through programmable control

Real world problem to address: ***Planet overpopulation-related challenges***
Related links: https://en.wikipedia.org/wiki/Human_overpopulation

Computer engineering example project ideas
- ✓ Create an application to monitor an individual's ecological footprint

Civil/Structural engineering example project ideas:
- ✓ Design and build a housing structure out of recycled materials for homeless

Real world problem to address: ***Reduce carbon emissions (clean energy)***
Related links: http://media.bze.org.au/fossileconomy/CarbonCrisis.pdf

Mechanical engineering example project ideas:
- ✓ Design and build louvers controlled by motors
- ✓ Design and build a solar panel, sun tracking device

Electrical engineering example project ideas:
- ✓ Design and build a fuel cell
- ✓ Design a monitoring system for electrical usage in a home or classroom

Computer engineering example project ideas:
- ✓ Design and build a timer or sublight based indoor light control

Civil/Structural engineering example project ideas:
- ✓ Plan and design a bike path on an existing bridge
- ✓ Redesign a classroom to better utilize natural light

UC (g) Approved

BOT Approved 2/25/92
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BOT Approved Revision 5/24/16