CAD 3: ENGINEERING DESIGN & PROTOTYPING

COURSE DESCRIPTION

Course Justification:

Core Conceptual Understandings Acquired:

The major skills and concepts learned in the first 2 courses for the Engineering Design Pathway converge in the Engineering Design & Prototyping course. In this concentration course, students will work as part of a race team subjugated into smaller workgroups to develop an energy-efficient urban concept vehicle. This vehicle will be tested against similar designs at the Shell Eco-Marathon Americas (SEMA) event. In order to develop a solution to the SEMA technical problem, students will also work cooperatively with business and industry partners as well as mentor engineers from various engineering firms. Students will each be tasked with the responsibility to identify an issue, problem, or need and, using the engineering design process, research, design, build, test, and present their solution to their workgroup and or team of peers, faculty, and mentor engineers as the team develops and builds the Urban Concept Vehicle. Students do extensive technical reading, writing, research, and are required to develop a portfolio of their individual and teamwork as part of the design process and competition. At the conclusion of the event, students will analyze data acquired at the event and continue their design process and create a formal review and recommendations document that will be made available to the following year's students.

Learning Skills Acquired:

- Define Problem

An accurately written Design Brief identifies a problem to be solved, its criteria, and its constraints. A well written Design Brief is used to encourage thinking of all aspects of a problem before attempting a solution.

Product development and marketing needs, time and capital that are not always available to individuals which makes it necessary to communicate the need and prospective market to entities that can provide needed and necessary resources.
Engineers use math and science to solve problems.

- Generate Concepts

Employ basic scientific principles in the discovery and application of new knowledge that will have commercial or economic value
Market research is used to make decisions about product development and marketing.
An engineering notebook is used to organize and record drawings and/or sketches that communicate ideas.
The commercial success of a product is affected by multiple factors.
A decision matrix is used to compare design solutions against one another, based on specific criteria.

- Develop a Solution

Working drawings are used to convey the information needed to make an individual part, subassembly, or complete assembly of a possible solution.
Design solutions must be reviewed by peers in order to provide feedback and implement necessary revisions.
Engineers are ethically responsible to their clients, peers, and the general public.

- Construct and Test Prototype

Engineers using software can create virtual solutions to their designs in order to plan, test, and prepare for building a prototype.
Materials and cost analysis is used to determine material and equipment requirements.
Prototypes can generally be broken down into subsystems in order to isolate problems and conduct testing.
Step-by-step instructions are generated for the prototype assembly to guide the fabrication of the design solution.
A specific aspect of the design solution can be evaluated by performing a controlled test of the prototype.
A detailed prototype testing procedure needs to be documented to ensure that the testing results of the design solution are valid.
Testing data can be either quantitative or qualitative.

- Evaluate Solution

Prototype testing results are used to improve the design solution.
At each step of the engineering design process, design reviews are used to gather data in order to determine the next steps in the design. [Return to prior design process steps, if necessary]
Reflect on and evaluate the effectiveness of the design solution.

- Present Solution

An engineering notebook is used to gather and organize sketches, drawings, research, data and information of the design solution.
Presentation software is used by the engineer t preset the project in a professional way.
Presentations promote the implementation of a design solution.

Social Skills Acquired:

Students are required to work in cohesive groups which are all working individually toward a common goal.
Students will be entrenched in a collaborative environment that will improve and test their verbal and written communication skills, ability to both lead and follow as a member of a collaborative group, and self-regulate to assure the timely completion of a common goal.

Measurable Goals:

This course is driven by an open-ended design problem; therefore goals will be established by students after full review of the design constraints. Project management timeline goals will be measured through a Ganett chart; after completion of the SEMA event, students will evaluate and create a document that makes recommendations for vehicle improvements or redesign specifications for the following years students. Evaluation of the vehicle will be Real-World and will take place at the Shell Eco-Marathon competition at the designated location. During the race, data will be collected along with empirical evidence as to the vehicle's performance. Students will then perform a "strength, weakness, opportunities & tendencies (SWOT) analysis on the team vehicle design and performance for inclusion in the final recommendations report.

Alignment to CA Frameworks or Common Core Standards:

The entire course will be driven by an open-ended design problem. The design problem will require students to employ the major themes of the course which are based on the engineering design process that is grounded in the science and engineering practices of the Next Generation Science Standards. The science and engineering practices (SEP) are:

SEP 1: Asking Questions and Defining Problems
SEP 2: Developing and Using Models
SEP 3: Planning and Carrying Out Investigations
SEP 4: Analyzing and Interpreting Data
SEP 5: Using Mathematics and Computational Thinking
SEP 6: Constructing Explanations and Designing Solutions
SEP 7: Engaging in Argument from Evidence
SEP 8: Obtaining, Evaluating, and Communicating Information

Students will work in a design team to read, research, write and create solutions and prototypes.

21st Century Skills for College and Career Acquired:

During this class student will acquire the following 21st Century Skills for College and Career:

* Critical Thinking and Creativity through real-world problem-solving.
* Collaboration, Leadership, and Initiative through a year-long collaborative project.
* Communication and Social Skills through group activities and development as well as mentoring for industry partners.

SUSTAINABLE AG: SUSTAINABLE AGRICULTURE

COURSE DESCRIPTION:

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Course Justification: Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly on our environment. Sustainable Agriculture is a one year course designed to integrate biological science practices and knowledge into the practice of sustainable agriculture.

Course Outline Requirements

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This section is a guide for creating a course outline that meets both the requirements for Board adoption and A-G approval.

Overview: The course is organized into four major sections, or units, each with a guiding question. Unit one addresses the question: What is sustainable agriculture? Unit two, how sustainable agriculture fits into our environment. Unit three: What molecular biology principles guide sustainable

agricultural? Unit four: How do we make decisions to maximize sustainable agricultural practices within a functioning ecosystem?

Course Goals: Within each unit specific life science principles will be identified with agricultural principles and practices guiding the acquisition of this knowledge, culminating in the development of a sustainable farm model and portfolio of supporting student research.

Expected Outcomes: The course is organized into four major sections, or units, each with a guiding question. Unit one addresses the question: What is sustainable agriculture? Unit two, how sustainable agriculture fits into our environment. Unit three: What molecular biology principles guide sustainable agricultural? Unit four: How do we make decisions to maximize sustainable agricultural practices within a functioning ecosystem?