

Course Outline

Name of Course: Women in Engineering
Level of Course: Academic
Number of Credits: 5
Course Number: 791.01
Prerequisites: None

Course Description:

This Women in Engineering course will provide students with knowledge of the various fields of engineering but most importantly will be the experience with the engineering process by participating in problem solving and design activities. There will be a clear connection made between the material taught in science classes and engineering principles. In the “real world,” there are many overlaps between science and engineering, and the boundaries are often indistinct.” (Herz) Studying areas of engineering and then applying the engineering process in order to solve real life problems will provide students with a better understanding of how real world situations are addressed. Engineering projects motivate students to pursue math and science by providing context in which that are applied for practical reasons which intertwine the subjects and connect abstract knowledge to everyday life. When faced with engineering/design problem students have to apply their math and science right away rather than in indefinite future. Engineering projects give students a sense of accomplishment. They are one of few projects that students can start and finish, can touch and take pride in, and requires them to use skills from multiple disciplines. Engineering problem solving allows students to master important life skills. Employers seek workers; who can ask probing questions, generate multiple creative solutions, apply knowledge from a wide range of disciplines, work effectively in teams, effectively communicate ideas, and bring projects to a successful conclusion. Students get to practice these skills through various stages of the engineering design process

Standards Targeted Throughout the Curriculum

New Jersey Core Curriculum Content Standards and Cumulative Progress Indicators

- Demonstrate skills needed to effectively access and use technology-based materials through keyboarding, troubleshooting, retrieving, and managing information. (NJ CCCS 2.0, #3)
- Use technology and other tools to solve problems, collect data, and make decisions. (NJ CCCS 2.0, #7)
- Use technology and other tools, including word processing, spreadsheet and presentation programs, and print or graphic utilities to produce products. (NJ CCCS 2.0, #8)
- Use technology to present designs and results of investigations. (NJ CCCS 2.0, #9)
- Organize, synthesize, and evaluate information for appropriateness and completeness. (NJ CCCS 3.0, #8)
- Identify and evaluate the validity of alternative solutions. (NJ CCCS 3.0, #11)
- Apply problem solving skills to original and creative/design projects. (NJ CCCS 3.0, #15)
- Use time efficiently and effectively. (NJ CCCS 4.0, #10)

Source: New Jersey Department of Education Standards <http://www.nj.gov/njded/stass/>

New Jersey Technology Education Standards (TEANJ)

- Apply values and make rational decisions about technological issues. (NJTES 1.19)
- Design and make devices and hybrid systems that solve complex real world problems. (NJTES 2.22)
- Develop alternative plans for redesigning devices and systems. (NSTES 2.23)
- Utilize and modify existing devices and systems for use in the solution of new problems. (NJTES 3.16)
- Combine different materials in the production of products. (NJTES 3.19)
- Create computer simulations to test and explain design concepts. (NJTES 4.14)
- Create multimedia presentations to inform others about design concepts, products, and events. (NJTES 4.16)
- Access and search the Internet for relevant information while conducting research. (NJTES 6.16)
- Use advanced publication methods. (NJTES 7.38)
- Generate original ideas based on previous knowledge and research. (NJTES 7.41)
- Acquire knowledge and skills that increase aesthetic awareness as it applies to technological design and ergonomics. (NJTES 7.139)

Source: 1996 Technology Educators Association of New Jersey. (www.TEANJ.org)

Standards of Technological Literacy from the (TFAA) Technology for All Americans Project and the International Technology Education Association (ITEA)

- In order to comprehend the scope of technology, students should learn that technology is closely linked to creativity, which has resulted in innovation. (TFAA #1, H)
- In order to recognize the core concepts of technology, students should learn that systems thinking involves considering how every part relates to others. (TFAA #2, N)
- In order to comprehend the attributes of design, students should learn that are trade offs that are made in the design process. (TFAA #8, F)
- In order to comprehend the attributes of design, students should learn that the requirements for a design are made up of criteria and constraints. (TFAA#8, G)
- As part of learning how to apply design processes, students should be able to make two-dimensional and three-dimensional representations of the designed solution. (TFAA #11, J)
- In order to select, use, and understand information and communication technologies, students should learn that the use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas. (TFAA #17, K)

Source: International Technology Education Association (2000). *Standards for Technological Literacy*. Reston, VA: ITEA. ISBN 1-887101-02-0

Benchmarks of Project 2061

- Almost all control systems have inputs, outputs, and feedback. The essence of control is comparing information about what is happening to what people want to happen and then making appropriate adjustments. This procedure requires sensing information, processing it, and making changes. In almost all modern machines, microprocessors serve as centers of performance control

- Technological problems often create a demand for new scientific knowledge, and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances.
- Mathematics, creativity, logic and originality are all needed to improve technology.
- Technology usually affects society more directly than science because it solves practical problems and serves human needs (and may create new problems and needs). In contrast, science affects society mainly by stimulating and satisfying people's curiosity and occasionally by enlarging or challenging their views of what the world is like.
- Social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, consumer acceptance, patent laws, the availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, and tax incentives.
- Technological knowledge is not always as freely shared as scientific knowledge unrelated to technology. Some scientists and engineers are comfortable working in situations in which some secrecy is required, but others prefer not to do so. It is generally regarded as a matter of individual choice and ethics, not one of professional ethics.
- In deciding on proposals to introduce new technologies or to curtail existing ones, some key questions arise concerning alternatives, risks, costs, and benefits. What alternative ways are there to achieve the same ends, and how do the alternatives compare to the plan being put forward? Who benefits and who suffers? What are the financial and social costs, do they change over time, and who bears them? What are the risks associated with using (or not using) the new technology, how serious are they, and who is in jeopardy? What human, material, and energy resources will be needed to build, install, operate, maintain, and replace the new technology, and where will they come from? How will the new technology and its waste products be disposed of and at what costs?
- Human inventiveness has brought new risks as well as improvements to human existence.

Source: *Science For All Americans Project 2061 1990, Oxford Press, ISBN 0-19-506770-3*
<http://www.project2061.org/tools/benchol/bolframe.htm>

Engineering activities will also stress many New Jersey and National math and science standards. Math and science applications are imperative to help solve problem solving and engineering/design activities.

Proficiencies-Measurable Objectives and Estimated Timelines:

Unit 1: Course Introduction and Safety Guidelines

Time: 3 days/Ongoing

Goal:

- To introduce the students to the course expectations, discipline policy, and safety guidelines.

Objectives:

Students will be able to:

- Understand the course expectations and timeline for instruction.
- Understand the discipline policy that relates to behavior in this class.
- Outline the specific safety guidelines of the classroom and shop rules.

Unit #2: Student Expectations and Personal Relevance

Time: 1 week

Goal:

- To assist the students in developing this program of study so it appeals to their intellect and emotions.

Objectives:

Students will be able to:

- Use the Baldrige or similar process to assist with finding ways the program can be personally relevant.
- To define a metric against which efforts are to be assessed. Proper implementation will result in well-defined goals with clear markers of progress in those goals. This will also give the team the freedom to decide these measures and to help further team cohesion.
- Use the Baldrige or similar process as a way of improving their leadership and management skills.

Unit #3: Introduction to Engineering/Design/Technology

Time: 3 Weeks/Ongoing

Goal:

- Introduce the students to the systems of engineering, technology education and technological literacy.

Objectives:

Students will be able to:

- Define technology.
- Define engineering.
- List the various areas of engineering.
- Describe the difference between science, technology, and engineering.
- Describe technology as a system, and list and explain the components of these systems.
- Use various brainstorming techniques to generate ideas and solutions.
- Discuss the positive and negative impacts of different technological systems.
- Introduce the design loop and its impact on technological problem solving.
- Introduce the presentation technique of formal documentation.

Unit #4: Presentations Techniques

Time: 3

weeks/Ongoing/Interwoven

Goal:

- To allow students to develop their ability to effectively communicate technological information and ideas through a variety of media.

Objectives:

Students will be able to:

- Create diagrams and sketches by hand and electronically to express design ideas and solutions.
- Create multi-media presentations to inform others about design concepts, products, and events.
- Create electronic databases and spreadsheets to gather, sort, analyze, and present data.
- Communicate orally and in writing the results of their design work.
- Create two and three-dimensional technical drawings by hand and electronically to develop and express design proposals.

Unit #5: Professional Engineering Associations/Mentors

Time: 1 Week/Ongoing

Goal:

- To further women's progress in scientific and technical fields through the use of a dynamic, technology-supported mentoring program.
- To advance women and society, and enhance engineering and related sciences, by promoting a diversified, expanded and talented workforce.

Objectives: Students will be able to:

Realize the importance of seeking assistance from a mentor

- Find a professional engineering mentor for various classroom projects.

Unit #6: Engineering Code of Conduct

Time: 3 Days

Goal:

- Introduce the students to the “Engineering Code of Conduct”
- Comparisons to misconduct in financial world
- Gravity of misconduct (lawsuits, personal danger, professional stunting)
- To understand that good designs may fail
- Understand the least negative solution may be the best solution.

Objectives:

Students will be able to:

- Develop as a class, an engineering code of conduct.
- Research current engineering codes of conducts.
- Understand why an engineering code of conduct is needed.

Unit #7: Engineering for Service and Social Implications

Time: 3 days

Goal:

- To give students the ability to make decisions that affect people and the environment in a positive way.
- To emphasize how engineers are working to improve our lives (robots in the operating room, artificial limbs and organs and the manufacturing of pharmaceuticals, water purification, irrigation systems in developing countries).

Objectives:

Students will be able to:

- Select the best solution to a problem based on how the solution affects people and the environment.
- Describe solutions that effect people and the environment in a negative fashion.
- Develop solutions to a problem that help people.
- Select current events and determine the positive and negative effects on people and the environment
- Design activities based on :TSA competitive events and/or robots in the operating room, artificial limbs and organs and the manufacturing of pharmaceuticals, water purification, irrigation systems in developing countries.
- Understand that even good designs may fail via Murphy’s Law human error, or material fatigue. Titanic, Tacoma Narrows Bridge

Unit 8: Tool and Machine Safety

Time: 1 Week/Ongoing

Goal:

- To introduce students to the safe and proper operation of hand tools and power machines so that they may fabricate solutions to engineering problems. In the process of using these tools, the student will view automation and operator safety as significant engineering problems to brainstorm as well as the effect of gender or hand dominance on operations.

Objectives:

Students will be able to:

- Safely operate a band saw, scroll saw, drill press, disk and belt sander, brake, metal roller, shear, soldering gun, hand drill, etc.
- Safely use hand tools- claw hammer, screw driver, hand saw, coping saw, hack saw
- Read a metric and English ruler.

Unit #9: Team-Work/Performance

Time: 1 day/On Going

Goal:

- To have students understand and demonstrate the importance of good teamwork skills.

Objectives:

Students will be able to:

- Demonstrate effective skills for interaction with others
- Demonstrate the ability to work with people who are different from oneself
- Demonstrate a positive attitude about self
- Demonstrate skills in responding to criticism and providing constructive criticism to others
- Demonstrate an understanding of the importance of personal skills and attitudes towards job success
- Demonstrate positive work attitudes and behaviors

Unit 10: Engineering /Design Project/ Invention & Innovation:

Time: 15 Weeks On-Going

Goal:

- The students will apply their acquired knowledge in order to complete several comprehensive design and problem solving activities.
- The students will realize the importance of having a team approach to a problem.
- To allow students to find and solve current problems at home, school, or in the workplace.

Objectives:

Students will be able to:

- Utilize a variety of forms of presentation techniques.
- Apply acquired knowledge into the development of a working prototype.
- Implement the teamwork performance model to maximize group efficiency.
- Introduce a variety of different materials for usage and processing.
- Use the problem solving process to develop and innovation or invention
- Present the solution to a problem to a group of judges.

Unit #11: History of Engineering/Famous Women Engineers

Time: 1 Week/Ongoing

Goals:

- To acquaint the student with influences of engineering, technology and women engineers on history.
- To identify the differences in problem solving and engineering results based on gender.

Objectives:

Students will be able to:

- Students will develop an understanding of the cultural, social, economic, and political effects of engineering.
- To identify the unique gifts women bring to the job in Engineering and academia.

Unit #12: Higher Education and Careers (Life after formal schooling)

Time: 1-2 weeks

Goal:

- To allow the student time to examine higher education requirements for a variety of career possibilities.
- To demonstrate the importance of mathematical and scientific knowledge and skills.
- To allow students to realize the differences of salaries based on fields and versus courses taken (BS, MS < PhD & licenses PE, Professor of Engineering).
- To allow the student to understand there are many engineering fields.

Objectives:*Students will be able to:*

- Identify institutes of higher education with engineering degree programs.
- Identify the many career opportunities an engineering degree supports. Vision of their daily life.
- Identify throughout the course the roll of mathematics and scientific knowledge/skills.
- Identify what produce a larger income.
- Identify careers where engineering thinking would play a vital role.

Assessment:

Design Portfolios & Presentations	40%
Homework	10%
Tests	15%
Class Participation/Code of Conduct	15%
Knowledge Logs/Notebooks	10%
Engineering Mentor Communication	10%

Homework, Extra Credit Policy:

Due to the periodic nature of homework in this course, homework will not be accepted late unless a legitimate excuse exists. Extra credit will be available during the design and problem solving activities in the form of additional research/development and competitive events.

Special Course Policies:

Success in this course will be based on a variety of factors, however the instructor will most directly assess the student's performance in comprehensive design and problem solving activities, teamwork performance, and class participation as the means of determining a grade. A typical week in class will consist of formal instruction on a variety of material, students working in groups to complete work pertaining to the lecture, research and development, teamwork to generate possible solutions to and solve problems, and in some cases the development of different products and prototypes. Quizzes and tests will be given to re-emphasize and assess the student's understanding of the presented information.

Materials/Resources- Text: Problem Solving and Design- Hutchinson 1996**Web Sites:**

- <http://www.ieee.org>
- <http://www.engineergirl.org>
- <http://www.energy.gov>
- <http://www.nasa.gov>
- www.dot.gov
- <http://attila.stevens-tech.edu/lore-el/pre-college/>
- <http://www.teanj.org>
- <http://www.iteawww.org>
- <http://www.state.nj.us/njded/cccs/02/>
- <http://www.fsea.org> after school club
- <http://www.swe.org/SWE/StudentServices/CareerGuidance/ForStudents/UsefulWebsites.html>
- <http://www.quality.nist.gov>
- <http://www.prek-12engineering.org>
- [Http://www.GEM-SET.org](http://www.GEM-SET.org)
- <http://www.girlstart.org>
- <http://www.asee.org>
- <http://engr.oregonstate.edu/pubs/docs/CoE-AR-2002.pdf>
- http://www.ieee.net/organizations/history_center/related_sites/women.html - IEEE Virtual Museum Women

College Search Sites:

- <http://encarta.msn.com/college/collegeFind.asp>
- <http://www.petersons.com/ugchannel/?ppcse=looksmart>
- <http://www.gocollege.com/>
- <http://www.usnews.com/usnews/edu/college/cohome.htm>
- <http://www.aesmentor.org/>
- <http://www.search4careercolleges.com/?affiliateid=603>