**WOMEN IN ENGINEERING/DESIGN/TECHNOLOGY**

**AUGUST 2007**
**COURSE NUMBER 791.01**

**TEACHER: MR. MARK WALLACE**
**SUPERVISOR: MR. MARK WALLACE**
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**(First offered September 2002)**

**Name of Course:** Women in Engineering/Design/Technology
**Level of Course:** Academic
**Prerequisites:** None
**Grades Levels Offered to:** 9 through 12
**Course Number:** 791.01
**Number of Credits:** 5
**Length:** Thirty Six Week curriculum / 180 days
**Recommended class size:** Maximum 18- *(Computer restrictions)*
**Teacher Recommendation:** One-Certified Technology Education Teacher
**Revised Date and Teachers Names: Mr. Mark Wallace (August 2007)**
**Next Revision Due: August 2012**

**Purpose:**

Engineering/Design/Technology is a problem solving approach to solving problems using tools called like math, science, computers, tools and machines. The study thereof provides the key that opens the door to solving some of the most exciting problems at hand in our society (Seymour). It should be noted that "tools" include mathematical knowledge, and software applications such as PowerPoint and spreadsheet, etc. Using these tools helps to stimulate creativity and build self-confidence.

Engineering, Design, and technology have always provided a foundation upon which to build many careers. Engineering and technology skills are becoming as valuable in the courtroom, boardroom, and medical lab as in the engineering lab. However, women are under-represented in engineering/technology-related careers. Lack of access, level of math and science achievement, and emotional and social attitudes about computer technological design and engineering capabilities may be some factors that cause women to avoid high-tech careers. According to the American Association of University Women, the number of women graduating in computer sciences and information technology is decreasing despite the increased need for workers in these areas (Friedman2000). Because employment in today's workplace requires increasingly sophisticated technological skills, educators must find ways to recruit and retain all types of students in math, science, and technology courses. "In the state of New Jersey, we are not meeting the research and development and the industrial need for engineers and technologists," said Joel Bloom, vice president for academic services at NJIT. In New Jersey, where the economy is driven by technological and research-based industries, a recent survey showed that only seven percent of high school seniors intended to pursue engineering careers. That's below the national average of nine percent. This course will assist in solving the above stated problem by exciting women to enjoy and want to be technologists, engineers and designers. The skills learned will be valuable for every career.

Eliminating, or at least reducing, the social and educational factors that have created barriers to high-tech areas can help educators to move new generations of female students into the high-tech careers in which they have been under-represented (Brown 2002). This program will attempt to overcome societal mentality that engineering/design/technology are fields only for males. The program will demonstrate what engineers, inventors and innovators do and how important they are, and how they ultimately impact society. At the same time it will attempt to overcome the societal expectations that engineering and other Math/Science-dominant studies are well within the grasp of women. "The challenge for the teacher is to provide clear evidence that women can solve significant problems at hand today while bringing to bear the unique contributions; they not only can do the job, but often better with their unique insight". (Seymour)

It is the problem-solving techniques engineers learn that makes them advantageous to "non-traditional" engineering employers. People with engineering degrees are not necessarily locked into an engineering career. They have many skills that enable them to adapt very readily to various circumstances.

As of this revision, over 30% of the females in this program have taken additional studies in the department. It should also be noted that the leadership of our TSA chapter has have been females form the WIEDT course over the past three years. This is a non vocational course of study taught by a Technology Education certified instructor. It is open to both male and females. It is a replica of Engineering Design Technology 1 which is offered to males and females. It is a 100% voluntary elective.

*High Point Regional High School's curriculum and instruction are aligned to the State's Core Curriculum Content Standards and address the elimination of discrimination by narrowing the achievement gap, by providing equity in educational programs and by providing opportunities for students to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affection or sexual orientation, gender, religion, disability or socioeconomic status.*

## Method of Instruction:

This Women in Engineering/Design/Technology course will provide students with knowledge of various fields of engineering and technology, but experience with the engineering and technological method through participation in problem solving and design activities. There will be a clear connection made between the material taught in science classes and engineering/design 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/Technology process in order to solve real life problems will provide students with a better understanding of how real world situations are addressed. Furthermore, "a common reason that young people are attracted to a career field is that the career appeals to their intellect and emotions: they are intellectually aware of the benefits of the work and emotionally committed to the work because of its personal relevance in their lives" (Brown 2001).

Engineering/Design/Technology projects motivate students to pursue math and science. When faced with engineering/design problems, students have to apply their math and science right away rather than in indefinite future. Engineering/Design/Technology projects give students a sense of accomplishment and require them to use skills from multiple disciplines. Engineering/Design/Technology problem solving allows students to master important life skills.

The Malcolm Baldrige process will be the means of addressing the personal relevance to the women enrolled in this course. This course concentrates on giving women an opportunity to develop personal and professional leadership skills. Emphasis is on "hands on" problem-solving activities in which students work together in lab activities designed to reinforce the content presented. Research has shown that many of the barriers to science, mathematics, engineering, and technology careers may be overcome by effective school practices. Teaching and learning practices, early intervention programs, and mentoring are just some of the ways schools can foster student participation in high-tech programs and careers. The "Women in Engineering" success will be measured by an increased female enrollment in our other Department of Technological Studies courses.

**General Objectives:**

At the conclusion of this course, the students will be able to:

1. Define engineering and technology.
2. Describe engineering and technology as a system.
3. List, describe, and implement the steps in the engineering/design process.
4. Identify how different systems operate.
5. Utilize a variety of different forms of presentation techniques.
6. Work in teams for learning, problem solving, design and presentation.
7. Prepare for life-long learning by using self-management and self-assessment strategies in terms of knowledge and skills.
8. Develop careful and precise writing.
9. Explore career-specific areas.
10. Develop skills in critical thinking, analytical reasoning and logic, and the ability to establish and recognize the validity of information.
11. Understand the complex relationship of scientific, technological, social, business, legal, historical, and artistic issues in design.
12. Carry out engineering/design/problem solving projects by using established scientific principles in the creation of functional and appealing products.
13. Become an independent leader, recognize when to follow, and know how to be a good team member.
14. Develop and apply cross-disciplinary cognitive knowledge to new problems.
15. Realize amazing feats performed by women and unique gifts women bring to the job.

| | |
|---|---|
| Lecture/Discussion | Objectives 1, 2, 4 |
| Class Projects/ Lab Sessions | Objectives 3, 6, 7, 12, 13, 14 |
| Problem-Based learning | Objectives 4, 8, 10, 11,15 |
| Computer-Base instruction | Objectives 5 |
| Homework | Objectives 4 |
| Mentor/Visitations | Objectives 9 |

**Measurement of success** in meeting these general objectives will be carried out through the following methods of assessment:

| | |
|---|---|
| Classwork/Homework | Objective 4,15 |
| Quizzes/Tests Mid Term Exam and Final Exam | Objectives 1, 2 |
| Projects/Labs | Objectives 3, 5, 6, 8, 9, 12, 14, 15 |
| Class Participation | Objectives 7, 10, 11, 13, 15 |

Quantified by credit points on projects and labs


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# Standards Targeted Throughout the Curriculum

**New Jersey Core Curriculum Content Standards and Cumulative Progress Indicators**

**Science: STANDARD 5.4** (Nature and Process of Technology) All students will understand the interrelationships between science and technology and develop a conceptual understanding of the nature and process of technology.
Strands and Cumulative Progress Indicators:

**A. Science and Technology**

Know that scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans, while technology is driven by the need to meet human needs and solve human problems.

**B. Nature of Technology**

Assess the impacts of introducing a new technology in terms of alternative solutions, costs, tradeoffs, risks, benefits and environmental impact.

**C. Technological Design**

Plan, develop, and implement a proposal to solve an authentic, technological problem.

**Technological Literacy STANDARD 8.1** (Computer and information literacy ) All students will use computer applications to gather and organize information and to solve problems.

**A. Basic Computer Skills and Tools**

1. Create a multi-page document with citations using word processing software in conjunction with other tools that demonstrates the ability to format, edit, and print.
2. Produce a multimedia project using text, graphics, moving images, and sound.
3. Produce and edit page layouts in different formats using desktop publishing and graphics software.
4. Discuss and/or demonstrate the capability of emerging technologies and software in the creation of documents or files.

**B. Application of Productivity Tools**

**Social Aspects**

1. Describe the potential and implications of contemporary and emerging computer applications for personal, social, lifelong learning, and workplace needs.
2. Exhibit legal and ethical behaviors when using information and technology, and discuss consequences of misuse.
3. Make informed choices among technology systems, resources, and services in a variety of contexts.
4. Use appropriate language when communicating with diverse audiences using computer and information literacy.

**Information Access and Research**

1. Select and use specialized databases for advanced research to solve real world problems.
2. Identify new technologies and other organizational tools to use in personal, home, and/or work environments for information retrieval, entry, and presentation.
3. Evaluate information sources for accuracy, relevance, and appropriateness.
4. Compose, send, and organize e-mail messages with and without attachments.

**Problem Solving and Decision Making**

1. Create and manipulate information, independently and/or collaboratively, to solve problems and design and develop products.
2. Identify, diagnose, and suggest solutions for non-functioning technology systems.
3. Identify a problem in a content area and formulate a strategy to solve the problem using brainstorming, flowcharting, and appropriate resources.
4. Integrate new information into an existing knowledge base and communicate the results in a project or presentation.

**Technological Literacy STANDARD 8.2** (Technology Education) All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual, society, and the environment.

**A. Nature and Impact of Technology**

1. Use appropriate data to discuss the full costs, benefits and trade-offs, and risks related to the use of technologies.
2. Explain how technological development is affected by competition through a variety of management activities associated with planning, organizing, and controlling the enterprise.
3. Provide various examples of how technological developments have shaped human history.

**B. Design Process and Impact Assessment**

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.
3. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities.
4. Diagnose a malfunctioning product and system using appropriate critical thinking methods.
5. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.

**C. Systems in the Designed World**

1. Explain the life cycle of a product from initial design to reuse, recycling, remanufacture, or final disposal, and its relationship to people, society, and the environment, including conservation and sustainability principles.
2. Analyze the factors that influence design of products, systems, and environments.
3. Compare and contrast the effectiveness of various products, systems, and environments associated with technological activities in energy, transportation, manufacturing, and information and communication.

**Career Education and Consumer, Family and Life Skills STANDARD 9.1** (Career and Technical Education) All students will develop career awareness and planning, employability skills, and foundational knowledge necessary for success in the workplace.

**A. Career Awareness/Preparation**

1. Re-evaluate personal interests, abilities, and skills through various measures including self assessments.
2. Evaluate academic and career skills needed in various career clusters.
3. Analyze factors that can impact an individual's career.
4. Research current advances in technology that apply to a selected occupational career cluster.

**B. Employability Skills**

1. Communicate and comprehend written and verbal thoughts, ideas, directions, and information relative to educational and occupational settings.
2. Select and utilize appropriate technology in the design and implementation of teacher-approved projects relevant to occupations and/or higher educational settings.
3. Evaluate the following academic and career skills as they relate to home, school, community, and employment:

- Communication
- Punctuality
- Time management
- Organization
- Decision making
- Goal setting
- Resources allocation
- Fair and equitable competition
- Safety
- Employment application skills
- Teamwork

4. Demonstrate teamwork and leadership skills that include student participation in real world applications of career and technical education skills.

**Career Education and Consumer, Family and Life Skills STANDARD 9.2** (Consumer, Family, and Life Skills) All students will demonstrate critical life skills in order to be functional members of society.

**A. Critical Thinking**

1. Apply communications and data analysis to the problem-solving and decision making processes in a variety of life situations.
2. Describe and apply constructive responses to criticism.
3. Apply the use of symbols, pictures, graphs, objects, and other visual information to a selected project in academic and/or occupational settings.

**B. Self-Management**

1. Apply project planning and management skills in academic and/or occupational settings.
2. Compare and contrast methods for maximizing personal productivity.

**C. Interpersonal Communication**

1. Model interpersonal and effective conflict resolution skills.
2. Communicate effectively in a variety of settings with a diverse group of people.

**D. Character Development and Ethics**

1. Analyze how character influences work performance.
2. Discuss consequences and sanctions when on-the-job rules and laws are not followed.

3. Compare and contrast a professional code of ethics or code of conduct from various work fields and discuss similarities and differences.
4. Apply a professional code of ethics to a workplace problem or issue.

**F. Safety**

1. Engage in an informed discussion about rules and laws designed to promote safety and health.
2. Describe and demonstrate basic first aid and safety procedures.
3. Analyze the occurrence of workplace hazards.
4. Practice the safe use of tools and equipment.
5. Implement safety procedures in the classroom and workplace, where appropriate.

**Over and Above Sate Standards**

- Use technology and other tools to solve problems, collect data, and make decisions.
- Identify and evaluate the validity of alternative solutions.
- Apply problem solving skills to original and creative/design projects.
- Use time efficiently and effectively.

## 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\Design\ Technology 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.**

## Specific Behavioral Objectives and Timelines:

***Current school structure: One day = One 42 minute period. Many units of study are woven together to simulate the real world.***

**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.

Assignments:

- Movie related worksheet

Lab Activities:

- None

Audio-Visual Needs:

- Overhead projector
- Movie "UVEX PPE Eyewear Training Video/Technology Department Eye Safety"

Computer Needs/Use: None

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Assessment Method:

- Safety Quiz

Standards targeted via this unit:

- NJCCCS 9.1,9.2
- NJTES 1.19
- NJTES 7.41

**Unit #2: Introduction to Engineering/Design/Technology** Time: 4 Weeks/Ongoing

Goal:

- Introduce the students to the systems of engineering, technology 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.

Assignments:

- Homework: *The Design Loop*
- Classwork: *Creating a Design Brief/Technological Outputs/Decision making*
- Classwork: *Coloring and Shading*
- Homework: *Isometric and Orthographic Projection*
- *Great Achievements www.engineeringgirl.org/nae/cw…/cgmh4T2HYL*

Lab Activities:

- Guest speakers
- Field of Engineering Power Point Presentation
- Isometric Drawing and Orthographic drawing
- Sketching rendering demonstration and practice

Audio-Visual Needs:

- PowerPoint / Smart board technology
- Previous examples of student work
- Movie "What's Up In Technology"-
  - Produced by Thirteen-WNET - Ed. Resource Center-450 W. 33rd. Street NY, NY 1001
- Movie "Exploring The Design Process"-#V710-1994 Hearlihy & Co.
- Text: Hutchinson, J. and Karsnitz, J. (1994). *Design and Problem Solving in Technology*. Albany: Delmar Publishers, Inc. *(A good intro to technology text. Also good for middle school.)*

Computer Needs/Use:

- Internet research

Assessment Method:

- Authentic: *Teacher Observation*
- Traditional: *Introduction to Technology Test/future problem solving projects*

Standards targeted via this unit:

- NJCCCS 5.4, 8.2,9.1,9.2
- TFAA #1, H
- TFAA #2, N
- STL #8, F

**Unit #3: 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.

Assignments:

- Web Page Design

- Publication Design
- Documentation of engineering design projects
- Sketching and Rendering
- Isometric and Orthographic drawing
- CAD/Parametric introduction

Lab Activities:

- Guest speakers
- Field of Engineering Power Point Presentation
- Design a Web Page- www.engneergirl.org
- Design a publication on famous women engineers
- Documentation
- Drawings, Models, and Prototypes

Audio-Visual Needs:

- None

Computer Needs/Use:

- Computers, Smart board technology, projectors, software

Assessment Method:

- Authentic: Documentation, drawings, presentations
- Traditional: Teacher Observation

Standards targeted via this unit:

- NJTES 4 .13, 4.14, 4.15, 4.16
- NJCCCS 5.4, 8.2, 9.1, 9.2

**Unit #4: 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.

Assignments:

- Find/Keep & Relationships with a Mentor (In Person, Phone, Internet and/or Email)
- Active participation in Girls E Mentoring in Science Engineering and Technology www.gem-set.org

Lab Activities:

- Guest speakers
- Gem-Set participation Http://www.GEM-SET.org
- MENTORNET http://www.mentornet.net/Documents/About/index.html
- Field of Engineering Power Point Presentation
- A Girl's Guide To Mentoring www. engineeringgirl.org
- Women of NASA- http://questdb.arc.nassa.gov/content_search_women.htm

Audio-Visual Needs:

- None

Computer Needs/Use:

- Computer Lab/ email capabilities

Assessment Method:

- Authentic: Classroom projects/Mentor dialogue
- Traditional: None

Standards targeted via this unit:

- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJTES 1.13
- NJTES 6.16, 1.8 1.121.13,1.14, 1.15, 1.161.21
- TFAA #4 E, F

Note: GEM SET is a group mentoring system email gemset@uic.edu for more information or Call 212-337-2389. It is important that the students talk directly with female mentors as part of their design development and for presentations via email. Male engineers may also be used.

**Unit #5: 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.

Assignments:

- Brainstorm a code of conduct
- Research via the internet current codes of conducts used in industry
- Identify the differences between the student code of conduct and the industry models.

Lab Activities:

- Develop a mutually agreed upon, engineering code of conduct.
- Guest speakers
- Field of Engineering Power Point Presentation

Audio-Visual Needs:

- None

Computer Needs/Use:

- CPU
- Internet access

Assessment Method:

- Authentic: Teacher observation
- Traditional: Code of conduct/class participation

Standards targeted via this unit:

- NJCCCS 5.4, 8.2, 9.1, 9.2

**Unit #6: 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

Assignments:

- Guest speakers
- Newspaper research
- Classroom problems

Lab Activities:

- Current event research
- Class problem solving activities
- Invention/innovation activity
- Genetic engineering research-
- TSA medical and biological competitions

Audio-Visual Needs:

- Video on engineering that has failed.

Computer Needs/Use:

- Smart Board Technology for presentations
- Computer/Internet research
- Newspapers/online for current events

Assessment:

- Authentic: Class activities- documentation
- Traditional: Oral presentation

Standards targeted via this unit:

- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJSTES 2,3,4,5,6
- TFAA #13
- Project 2061, #1

**Unit 7: 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 tolls, 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.

Assignments:
- Tool and Machine Safety

Lab Activities:
- Safety Demonstrations/ Safety Rules

Audio-Visual Needs:
- None

Computer Needs/Use:
- None

Assessment:
- Traditional: Safety Tests

Standards targeted via this unit:
- NJTES 3.16, 3.17, 3.18, 3.19
- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJCCCS 5.1

**Unit #8: 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

Assignments:
- Group engineering and design projects

Lab Activities:
- Team success model
- Guest Speakers
- Visitations to work sites

Audio-Visual Needs:
- None

Computer Needs/Use:
- None

Assessment:
- Authentic: Teacher observation
- Traditional: none/ class participation

Standards targeted via this unit:
- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJSTES 1.19
- NJSTES 6.16

**Unit 9: 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.

Assignments:

- Class work /homework to reinforce concepts
- Interim due dates
- Oral presentations
- How to find a problem or opportunity

Lab Activities: (Chosen activities will be based on student teacher selection and Baldrige process. Design projects need to be exciting and not gender typical. Activities must help to break the gender gap, not create one.)

- Paper Bridge or Paper Tower Opening day
- Clothing Designs for the disabled/Sporting Apparel
- Computer Programming-Mind Storm, Robot Control)
- Structures- Bridge/Tower
- Fluid Controlled Robots
- Power/Energy Problem
- Transportation problem (Mouse Trap Vehicle)
- Interior Design
- Burglar Alarm-electronic
- Rocket design
- Pop-Up-Book Different textures or sounds for the visually impaired.
- Court yard/ school design project
- Handicapped children design project
- Children's day care problem
- Technology Student Association Activities: Medical, Biotechnology, Engineering, & Agriculture An Invention process similar to SITE and Invent America, TSA. Odyssey of the Mind

Desktop publishes a news article that is geared to inventions that ended up outside the box and conceived by women.

Audio-Visual Needs:

- SmartBoard technology
- Examples of student work
- Internet

Computer Needs/Use:

- Student Internet research
- Documentation development
- Word/Publisher
- Digital Camera
- Student presentation using Smartboard
- Computer lab
- Word-processing, data base, spreadsheet, internet, & presentation software


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Assessment Method:

- Authentic: Comprehensive documentation, teacher observation, teamwork performance, student self and group assessment, daily logs
- Traditional: Class participation

Standards targeted via this unit:

- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJTES 3.19, 1.17, 1.18, 1.19, 1.20, 2.22, 2.23, 2.24
- NJTES 6
- NJTES 4.7, 4.8, 4.9 4.10, 4.13, 4.14, 4.15, 4.16
- TFAA #1, H; #8, F; 10; #8, G; #11, J
- Project 2061, #3

Note: Several design projects are assigned by the instructor to align with what is taught in our Engineering Design Technology 1(EDT) course offering because these students are permitted to bypass EDT 1 and go directly to EDT 2. We currently participate in the Technology Student Association competitive events. This allows the students to select another design project that they may be interested in solving. We may enter other competitive events if appropriate problems are available. Using the Baldrige process of having personal relevance helps guide problem selection. A simple problem solving activity for the very first day or two helps to stimulate excitement in the program.

**Unit #10: 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 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.

Assignments:

- Read biographies of famous female inventors/engineers (http://inventors.about.com/cs/womeninventors/)
- Power point presentation development portion of mid term on famous inventors, engineers and scientists.
- Read: http://www.tucson.org/~michael/hm_2.html The Gilberts
- Check out http://www.thewomensmuseum.org Tour the Women's Museum on line

Lab Activities:

- Guest speakers
- Field of Engineering Power Point Presentation (Individual or Group)
- Research case studies of amazing feats performed by women

Audio-Visual Needs:

- Videotapes. VCR. Monitor

Computer Needs/Use:

- Computers

Assessment Method:

- Authentic: Power Point presentations
- Traditional: Test on Women Engineers

Standards targeted via this unit:

- NJCCCS 5.4, 8.2, 9.1, 9.2
- NJTES 1.13
- NJTES 6.16, 1.8 1.121.13,1.14, 1.15, 1.161.21
- TFAA #4 E, F

**Unit #11: 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.

Assignments:

- Research higher education institutes and scholarships for women
- Research careers in engineering
- Use math and scientific knowledge/skills to solve an engineering design problem.
- Current research on career salaries
- Research women friendly employees of engineers
- Create a resume during this course.

Lab Activities:

- Guest Speakers/Visitation
- Field of Engineering Power Point Presentation
- Discuss Co-op options and company internships
- Bridges career research software
- Discuss daily life with guest speakers: What is their daily life like? Work indoors, outdoors; travel, Office work, Visit customers, Team work or alone, Specialists, paper and computer or physical work with equipment.

Audio-Visual Needs:

- VCR/Tapes- Engineering Fields

Computer Needs/Use:

- Internet, Computers, Presentation Software, Projector

Assessment Method:

- Authentic: Documentation/Presentation
- Traditional: Essay, Teacher observation

Standards targeted via this unit:

- NJCCCS WRS 1

Note: Be careful not to make “women engineer” seem too unusual. I would emphasize that about 25% of engineering students are female. This is true and does not make pursuing engineering seem outlandish”. (*Hirasaki)*


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**Assessment:**

a. The assessment of student progress in the objectives cited on the previous pages will be primarily by, but not limited to, the following criteria.

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

i. Observation

Systematic, wherein the observer gathers data on one or more precisely defined behaviors;
Nonsystematic, in which the observer watches the child at school in the setting of concern and notes the behaviors, characteristics, and personal interactions that seem significant;

ii. Authentic Assessment Measures Progress in Applied Skills

Authentic assessment rates students' performance on real world tasks. To perform successfully on these tests, students must know the subject area and be able to use that knowledge to perform problem solving tasks.
Activities used in authentic assessments may include:

Conducting research; Designing a solution to a problem;
Writing a news article, poem, or short story;
revising and discussing papers;
Performing an oral presentation based on a project or analysis; and collaborating with others

b. How will you measure the effectiveness of this course?

i. Increased enrollment in upper level course.
ii. Increases in final exam grades
iii. Increase in final grades.
iv. Student end of course evaluation.

c. When was the last mid term exam written/ or revised? 2008
d. When was the last final exam written/ or revised? 2008

**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.

**Periodic evaluation of objectives and this curriculum guide:**

With the evaluation curriculum every five years, administration requests a curriculum re-write in the year **2007.**

**Labs:** **Supporting materials will b developed for all labs to help the new teacher.**

- Engineering Design Activities
- Invention and Innovation Product Design
- Area of Engineering
- Publication- Famous Women Engineers
- Power Point Presentation- Area of Engineering
- Engineering Code of Conduct
- Famous Engineers -Power Point
- Spreadsheet Analysis of design )graphing Calculator/CPU
- Word-processing
- Smart board Technology
- Publishing
- Pro-DESK TOP or Inventor Parametric 3-D design software

**Lab/Classroom set up and special needs:**

The recommended maximum class size is eighteen students. This course will be taught implementing a variety of different and state of the art instructional technologies such as:

- Multiple computers- One computer for every student.
- Scanner
- Digital camera
- Multiple workbenches
- SmartBoard technology
- Projection screen and device
- Electrical outlets
- Testing area- Structure Tester
- Teamwork areas
- Table top: scroll saw, drill press, band saw, sander
- Hand tools
- Software: word processing, presentation, electronic workbench, internet digital camera, scanner, publishing, spreadsheet, Pro-DESK TOP or Inventor Parametric 3-D design software,
- Movie "What's Up In Technology"-
    - Produced by Thirteen-WNET - Ed. Resource Center-450 W. 33rd. Street NY, NY 1001
- Movie "Exploring The Design Process"-#V710-1994 Hearlihy & Co.

Note: A current technology education lab would be suitable. School budget is used to currently fund this program This class would be considered a 1st level course. Students could then enter our Engineering Design Technology 2 and 3 programs. Gender equity funding may be another source of funding.

**Materials/Resources:**

**Program Audio-Visual/ Computer Needs:**

- Smart board technology



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- Presentation techniques
- Series of videos
- Multiple models
- Previous student work

**People Resources:**

- Future Scientist and Engineers of America (FSEA)- George Westrom
- IEEE - Women in Engineering
- Society of Women Engineers
- February- National Engineers Week
- Society of Women Engineers
- Technology Educators Association of NJ
- International Technology education Association
- Technology Student Association

**Possible Visitations:**

**Lore El Center for Women in Engineering and Science**
Stevens Institute of Technology
Castle Point on Hudson
Hoboken, NJ 07030
201-216-5182
IDEAS program
http://attila.stevens-tech.edu/lore-el/pre-college/

**New Jersey Institute of Technology**
Engineering Career Day
University Heights
GITC 2104
Newark, NJ 07102
973-642-7155
Careers in Engineering program

**Engineering Career Day-**
NJ Society of Professional Engineers Educational Foundation
Engineering Career Day
March
Rutgers College of Engineering-Piscataway
Steven A. Tardy, P.E.

**County College of Morris**
Woman Who Dare Conference
May
Dom D'Stefan- Tech Prep Project Director
973-328-5303/5762

**DeVry College of Technology**
American Association of University Women-
Teen Tech Day
March

**Supplementary Readings and Instructors Bibliography:**

- Hutchinson, John Design and Problem Solving in Technology. (Delmar, Albany, New York). 1994. ISBN 0-8273-5244-1.
- Norman, Eddie, Advanced Design and Technology Second Addition. (Pearson Education Limited, Essex, England(, 1995. ISDN 0 582 24496 4
- Smith, Howard. Understanding Technology. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1998. ISBN 1-56637-374-3.
- Todd, Ronald. Introduction to Design and Technology. (Thompson Learning Tools, Cincinnati, Ohio). 1996. ISBN 0-538-64465-6
- Wright, Thomas. Technology Systems. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1966. ISBN1-56637-263-1.
- Henry Petroski's recent books on engineering.
- The Comforts of Home: The American House and the Evolution of Modern Convenience by Merritt Ierley
- Wondrous Contrivances; Technology at a Threshold by Merrit Ierley
- Open House: A guided Tour of the American Home, 1637-Present By Merritt Ierley
- The Existential Pleasures of Engineering by Samuel Florman
- INVENTING AMERICA: A History of the United States was published in 2002 by *W. W. Norton & Co.*
- Mark Devaney of Grafica. "Careers in Engineering"
- American Heritage puts out a superb magazine called Technology and Invention

**Web pages that support learning:**

- http://www.ieee.org Institute of Electrical and Electronics Engineers, Inc.
- http://www.engineergirl.org Web page for girls interested in engineering.
- http://www.energy.gov Energy web pages
- http://www.nasa.gov NASA Web Page
- www.dot.gov US Department of Transportation
- http://attila.stevens-tech.edu/lore-el/pre-college/ Stevens Institute of Technology
- http://www.teanj.org NJ professional teachers association for technology education
- http://www.iteawww.org National professional teachers association for technology education
- http://www.fsea.org After school club
- http://www.swe.org/SWE/StudentServices/CareerGuidance/ForStudents/UsefulWebsites.html
- http://www.quality.nist.gov Baldrige National Quality Program
- Http://www.GEM-SET.org e-mentoring program for girls.
- http://www.girlstart.org Empowering Girls in Math Science and Engineering
- http://www.asee.org American Society of Engineering Education
- 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
- http://www.greatachievements.org/ Greatest Engineering Achievements of the 20th Century
- http://www.nae.edu/ National Academy of Engineering
- http://www.witi.com/ Women in Technology International (Prof. Assn)
- http://questdb.arc.nasa.gov/content_search_women.htm Women of NASA
- http://www.siemens-foundation.org/ Siemens Foundation
- http://www.jets.org/ Junior Engineering Technical Society
- http://www.discoverengineering.org/home.asp Discover Engineering On Line
- http://www.womentechworld.org/ WomenTech World, Role Model, Career Tips
- http://www.iwitts.com/html/iwitts.html Inst. of Women in Trades, Technology and Science
- http://www.inventionatplay.org/playhouse_main.html Lemeison Center for the Study of Invention & Innovation
- http://www.engineeringk12.org/ ASEE Engineing k-12 education web page

**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

## Reviewers Quotes

"A strong K-8 technology education experience and a well educated high school and middle school guidance department is imperative for the success of this course. An outreach program to the middle school would ensure an adequate flow of students. *Mark Wallace Supervisor, Technological Studies, High Point Regional High School*

"This type of program should be required for all freshmen. By igniting the passion in problem solving coupled with the knowledge they are eligible to participate in math and science". *Ed Seymore Computer Chip Integrator for Power-4 Series microprocessors, IBM*

"Some aspects of the course could be more science and math intensive. Many units, especially the design project, have a societal relevance that will be obvious to high school students". *Lori Herz Technical Investigator, Bristol-Myers Squibb*

"Your Student Expectations and Personal Relevance unit is good. Students are more likely to retain knowledge if they can see its relevance. It is important for the students to study famous female engineers so they get a sense that others have "paved the way". It is just as important for a student to realize that they do not want to be an engineer as it is to realize that they do". *Nancy Smith NJ-P.E., Harold E. Pellow & Associates, Inc.*

"This course should absolutely be valued equally with other academic courses. There is insufficient emphasis on this subject matter in today's schools". *Peter J. Sibilski, P.E., Principal Project Engineer - Schering-Plough Corp., Chair - North Jersey AIChE*

"One of the best ways to gain student interest, whether it is male or female, is to involve them quickly in a course". *Ronald Rockland Associate Dean Newark College of Engineering, NJIT*

"Engineering is fun and exciting and the program must focus on the engineering, design and problem solving activities. The other details of the program should be incorporated when necessary to support the learning and experience". *George Westrom, Founder of Future Scientists and Engineers of America*

"Thinking outside the box, it's easy to see how a program like this has much more value than many of the academic courses". *Parrish Nelson Hirasaki WIE Program Director University of Huston*

"Diversity of ideas, and willingness to listen to those ideas, is what makes this country strong". *Lisa Kurzejeski eServer Technology IBM*

"It is obvious the power of the TEANJ- Technology Education Standards will help to turn more students on to the excitement of engineering. Engineers and engineering associations should look at technology education programs and support them to be included in every child's education.
*William Emmerling William J. Hughes Technical Center Federal Aviation Administration*