

**ENGINEERING & DESIGN TECHNOLOGY IV  
OCTOBER 2008  
COURSE NUMBER 773**

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**Name of Course:** Engineering Design Technology IV

**Level of Course:** Honors

**Prerequisites:** Engineering Design Technology I, II, III

**Grades Levels Offered to:** 12

**Course Number:** 773

**Number of Credits:** 5

**Revised Date and Teachers Names:** Mr. Brian J. Drelick (October 2008)

**Purpose:**

This fourth year capstone Engineering Design Technology course which will continue to provide our students with the hands on practical knowledge of how the various types of physical technologies relate to the technological society in which we live. This capstone course will continue to emphasize the expanding need for understanding and applying the principles of structural, robotic, mechanical, fluid power, electronic, and control systems as they relate to the identification of real world needs and development of practical solutions. Furthermore, students will continue to expand on their communication, teamwork, presentation, craftsmanship, and professional skills as they approach the conclusion of their high school career.

This capstone course concentrates on student involvement in several state and national competitions. The emphasis will continue to be on hands on, problem solving activities in which students work together in lab activities designed to reinforce the content presented and complete against other schools. The students will also identify a series of real world problems and propose solutions to them. A focus on higher education and careers will culminate with extensive discussion and presentations.

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, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

**General Objectives:**

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

1. Apply technological principles as they relate to real world applications.
2. Identify the changes in technological systems over a three year period.
3. List, describe, and implement the steps in the design process.
4. Apply the design process in order to professionally document progress.
5. Utilize a variety of different forms of presentation techniques.
6. Utilize a variety of research techniques in order to justify all possible solutions to a presented problem.
7. Apply their knowledge and understanding of structural systems in order to develop and craft functional prototypes.
8. Apply their knowledge and understanding of robotic systems to meet specified goals.
9. Apply their knowledge of electrical systems to control prototypes and perform specific functions.

10. Present the details, drawings, possible solutions, and rationales of designed products to a professional panel of judges.
11. Participate in state competitions that promote active technological literacy.
12. Develop an integrated time management plan in order to meet goals and expectations.
13. Present ideas using multiple forms of Educational Technology.
14. Identify the parts and systems which comprise radio controlled transportation.

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

Classwork/Homework	Objectives 4, 10, 13
Quizzes	Objectives 1, 2, 11, 19, 21
Tests	Objectives 6, 8, 9, 12, 14, 18, 23
Projects/Labs	Objectives 3, 16, 17, 20, 24
Class Participation	Objectives 5, 7, 15, 22

## **Method of Instruction - Standards Targeted Throughout the Curriculum**

### **New Jersey Core Content Standards - Career, Science, and Technology**

**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.
4. Recognize bias, vested interest, stereotyping, and the manipulation and misuse of information while formulating solutions to problems that interfere with attaining goals.
5. Apply knowledge and skills needed to use various means of transportation within a community.

#### **B. Self-Management**

1. Revise and update the personal growth plan to address multiple life roles.
2. Apply project planning and management skills in academic and/or occupational settings.
3. 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.

**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.

#### **A. Science and Technology**

1. 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**

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

#### **C. Technological Design**

3. 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. Create documents including a resume and a business letter using professional format.
3. Construct a spreadsheet, enter data, use mathematical or logical functions to manipulate and process data, generate charts and graphs, and interpret the results.
4. Given a database, define fields, input data from multiple records, produce a report using sort and query, and interpret the data.
5. Produce a multimedia project using text, graphics, moving images, and sound.
6. Produce and edit page layouts in different formats using desktop publishing and graphics software.
7. Develop a document or file for inclusion into a website or web page.
8. Discuss and/or demonstrate the capability of emerging technologies and software in the creation of documents or files.
9. Merge information from one document to another.

#### **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. Use a computer assisted design (CAD) system in the development of an appropriate design solution.
5. Diagnose a malfunctioning product and system using appropriate critical thinking methods.
6. 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.

Standards of Technological Literacy from the Technology (STL) 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. (STL #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. (STL #2, N)
- In order to comprehend the attributes of design, students should learn that there is no perfect design. (STL #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. (STL #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. (STL #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. (STL #17, K)

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

## **Specific Behavioral Objectives and Timelines:**

### **Unit 1: Course Introduction and Safety Guidelines**

**Time: 3 days**

Goal:

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

Objectives:

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

Audio-Visual Needs:

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

Computer Needs/Use: None

Assignments:

- Movie related worksheet

Lab Activities: None

Assessment Method:

- Safety Quiz

Standards targeted via this unit:

- NJ CCCS 8.2
- NJ CCCS 9.2

### **Unit 2: Tool and Machine Safety**

**Time: 1 Week**

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, Dremel, hand sander, 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 review sheets

Lab Activities:

- Safety Demonstrations/ Safety Rules

Audio-Visual Needs:

- None

Computer Needs/Use:

- None

Assessment:

- Traditional: Safety Tests

Standards targeted via this unit:

- NJ CCCS 8.2
- NJ CCCS 9.2

**Unit 3: Independent Study – Solving Real World Problems      Time: 5 Weeks**

Goal:

- Students will identify and suggest solutions to a real world problem.

Objectives:

- Identify a series of real world problems and clarify significance.
- Complete in depth and student centered research and investigation.
- Review the design loop and its impact on technological problem solving.
- Review the presentation techniques of formal documentation used in previous years.
- Design and construct a real world working prototype.
- Present findings to other classes with clarity and command.

Audio-Visual Needs:

- Previous examples of student work
- SmartBoard technology
- Various Internet resources

Computer Needs/Use:

- PowerPoint / Similar Presentation Software

Assignments:

- Develop and present comprehensive presentation with supplemental materials that highlights real world problem and possible solution.

Lab Activities:

- None

Assessment Method:

- Authentic: *Teacher Observation*
- Traditional: *Presentation*

Standards targeted via this unit:

- NJ CCCS 8.2
- NJ CCCS 8.1
- NJ CCCS 5.4
- NJ CCCS 9.2

**Unit 4: 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:

- NJ CCCS 5.4
- NJ CCCS 8.1
- NJ CCCS 8.2
- NJ CCCS 9.2

## **Unit 5: Higher Education and Careers**

**Time: 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
- Create a resume during this course.

**Lab Activities:**

- 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:**

- NJ CCCS 5.4
- NJ CCCS 8.1
- NJ CCCS 8.2
- NJ CCCS 9.2

**Unit 6: Review – Technical Documentation**

**Time: 1 Week**

**Goal:**

- Review with the students several elements of technical documentation, including layout, rationale, design, content, presentation, organization, and color.

**Objectives:**

- State the four design principles.
- Review orthographic projection and isometric drawing.
- Propose strengths and weaknesses of previous student work.
- Propose changes and suggestions as suggested through specific project specifications.

**Audio-Visual Needs:**

- Journal
- Photos
- SmartBoard technology

**Computer Needs/Use:**

- Instructor: PowerPoint Presentation
- Students: Internet research/Previous examples of student work

**Assignments:**

- Classwork: *Assessment/Suggestion Worksheet*

**Lab Activities:**

- None

Assessment Method:

- Authentic: Teacher observations, ability to retain information from last year
- Traditional: Class participation

Standards targeted via this unit:

- NJ CCCS 5.4
- NJ CCCS 8.1
- NJ CCCS 8.2
- NJ CCCS 9.2

**Unit 7: Comprehensive Independent Study**

**Time: 20 Weeks**

Goal:

- Apply the major concepts introduced in previous years to the design, develop, and testing of multiple real world solutions.

Objectives:

- Apply the knowledge of physical technology to the design and development of working prototypes.
- Implement the design process in order to develop a working solution to a real world problem.
- Develop an accurate and practical time management log.
- Utilize different forms of educational technology to design and present solutions to the presented problems.

Audio-Visual Needs:

- Various websites
- Previous examples of student work
- Community resources
- Smartboard technology
- Hewitt, Paul. Conceptual Physics. (Addison-Wesley Publishing Company, New York.) 1997. ISBN 0-201-46697-X.

Computer Needs/Use:

- Internet research
- Microsoft PowerPoint
- Schematic Software
- Smartboard Technology
- Rendering Software

Assignments:

- None

Lab Activities:

- Design and development of working prototype.
- Oral Presentations locally and at Event site

Assessment:

- Authentic: Teacher observations
- Traditional: Testing and Documentation Evaluation

Standards targeted via this unit:

- NJ CCCS 5.4
- NJ CCCS 8.1
- NJ CCCS 8.2

- NJ CCCS 9.2

## **Unit 8: Final Open Ended Project**

**Time: 10 Weeks**

### **Goal:**

- Students will have input to the nature of a final project which will serve to culminate the knowledge and experience acquired over the three year cycle to successfully design and develop a solution to a real world problem.

### **Objectives:**

- Implement the steps in the design process.
- 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.

### **Audio-Visual Needs:**

- SmartBoard technology

### **Computer Needs/Use:**

- Rendering Software
- Internet Research
- Schematic Software

### **Assignments:**

- Design rationale statement
- Working drawing approval
- Incremental due dates

### **Lab Activities:**

- Design and development of working prototype.

### **Assessment Method:**

- Authentic: Teacher observations
- Traditional: Design of final product, class participation and diligence

### **Standards targeted via this unit:**

- NJ CCCS 5.4
- NJ CCCS 8.1
- NJ CCCS 8.2
- NJ CCCS 9.2

### **Materials/Resources:**

Text: None

### **Labs:**

- Several Presentations
- Independent Activities
- Career Overview Presentation
- Physical Technology Culminating Activity

People: None

### **Audio-Visual:**

- SmartBoard technology
- Presentation techniques
- Multiple models

- Previous student work
- Pertinent publications

**Assessment:**

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

Classwork/Homework	10%
Quizzes	10%
Tests	15%
Projects/Labs	35%
Class Participation	30%

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

With the evaluation of a new text every five years, administration requests a curriculum re-write in: **2014**

**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.

**Supplementary Readings and Instructors Bibliography:**

Hewitt, Paul. Conceptual Physics. (Addison-Wesley Publishing Company, New York.) 1997. ISBN 0-201-46697-X

Karsnitz, John and Hutchinson, John. Design and Problem Solving in Technology. (Delmar Publishers, Albany, New York.) 1994. ISBN 0-8273-5244-1.

Smith, Howard. Understanding Technology. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1998. ISBN 1-56637-374-3.

Wright, Thomas. Technology Systems. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1966. ISBN1-56637-263-1.

**Homework, Extra Credit Policy:**

Due to the periodic nature of homework in this course, homework will be 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.

### **Web pages that support learning:**

[www.tsawww.org](http://www.tsawww.org)  
[www.panasonic.com/cdc](http://www.panasonic.com/cdc)  
[www.rubgoldberg.com](http://www.rubgoldberg.com)  
[www.rctek.com](http://www.rctek.com)  
[www.njtea.org](http://www.njtea.org)  
[www.teachtechnj.org](http://www.teachtechnj.org)  
[www.iteawww.com](http://www.iteawww.com)  
[www.careercornerstone.org](http://www.careercornerstone.org)  
[www.tryengineering.org](http://www.tryengineering.org)

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

This course will be taught implementing a variety of different and state of the art instructional technologies such as:

- Multiple computers
- Multiple workbenches
- SmartBoard technology
- Projection screen and device
- Portable laptops and projectors
- Electrical outlets
- Testing area
- Teamwork areas
- Scanner and digital cameras