ENGINEERING & DESIGN TECHNOLOGY II
APRIL 2004
COURSE NUMBER 771

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Name of Course: Engineering Design Technology II
Level of Course: Academic Level I
Prerequisites: Engineering Design Tech/Women in Engineering/Mech. Motion
Grades Levels Offered to: 10 through 12
Course Number: 772
Number of Credits: 5
Revised Date and Teachers Names: Mr. Brian J. Drelick (May 2004)

Purpose:

Technology is the control of our environment. It involves employing technical means to use resources as we strive for solutions. Technology gives us the day to day devices that make life possible. This full year course will build on the skills and knowledge that students gained in Engineering Design Technology I, Women in Engineering, or Mechanical Motion. Engineering Design Technology II is a dynamic hands on program of study that teaches students the development and application of technology and the effects technology has on individuals, society, and the environment as it relates to electronic and mechanical systems. Its goal is to develop and use the technological literacy and capabilities of the students to solve real world problems.

This course specifically concentrates on continuing the emphasis on the areas of physical technology with focus on electronic control and mechanical systems. This content will serve to reinforce the knowledge acquired in Engineering Design Technology I, Women in Engineering, or Mechanical Motion. Students will participate in state competitions focusing on control systems, and will continue to apply their knowledge of physical technology and implement the design process to cooperatively solve challenges presented by common real-world electronic and mechanical system problems.

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. List, describe, and implement the steps in the design process.
3. State Ohm's Law as it relates to voltage, resistance, and current.
4. Recognize the real world difference between alternating and direct current.
5. Develop both series and parallel circuits.
6. Identify the different components that are required to create a closed loop circuit.
7. Define what is necessary in order to protect electronic components from damage.
8. Utilize proper soldering techniques.
9. Identify the differences between spur, helical, bevel, worm, and idler gears
10. Define mechanical advantage as it relates to gear ratio.
11. Develop gear systems which maximize speed or torque as required by project specifications.
12. Calculate gear ratio.
13. Identify the difference between a tank driven and rack and pinion drive system.
14. List the specific physical properties associated commonly used materials.
15. Perform materials processing on commonly used power tools.
16. Define cams and cam followers.

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 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)

New Jersey State Technology Education Standards

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

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

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. (Project 2061, #1)
- What use can be made of a large collection of information depends upon how it is organized. One of the values of computers is that they are able, on command, to reorganize information in a variety of ways, thereby enabling people to make more and better uses of the collection. (Project, 2061, #3)

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:

- NJSTES 1.19
- NJSTES 7.41

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 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 WRS # 5
- NJCCCS 5.1

Unit 3: Review - Technology **Time: 1 Week**

Goal:

- Review with the students the systems of technology education and technological literacy.

Objectives:

- Discuss technology.
- Review the difference between science and technology.
- Discuss technology as a system, and list and explain the components of these systems.
- Discuss the positive and negative impacts of different technological systems.
- Review the design loop and its impact on technological problem solving.
- Review the presentation techniques of formal documentation used in previous years.

Audio-Visual Needs:

- Previous examples of student work

- SmartBoard technology
- Movie "The Design Process"
- Text: Hutchinson, J. and Karsnitz, J. (1994). *Design and Problem Solving in Technology.* Albany: Delmar Publishers, Inc.

Computer Needs/Use:
- None

Assignments:
- Homework: Review of the Design Process

Lab Activities:
- None

Assessment Method:
- Authentic: *Teacher Observation*
- Traditional: *Technology Review Quiz*

Standards targeted via this unit:
- NJ CCCS 3.0,#8
- NJSTES 7.139
- STL #1, H
- STL #2, N
- STL #8, F

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.
- 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- WRS #1

Unit 5: Introduction to Electronics **Time: 10 Weeks**

Goal:

- Introduce the components, concepts, and principles associated with the electronic circuit design through lectures, software, and lab activities.

Objectives:

- Define Electronics.
- List several characteristics of alternating current.
- List several characteristics of direct current.
- Distinguish between the functions and practical applications of series and parallel circuits.
- Describe the difference between conductors and insulators.
- Define Ohm's Law.
- Define voltage; characteristics, units, and usage.
- Define current; characteristics, units, and usage.
- Define resistance; characteristics, units, and usage.

Audio-Visual Needs:

- Overhead projector
- Classroom Demonstrations
- Student Handouts
- SmartBoard technology

Computer Needs/Use:

- Instructor: PowerPoint Presentation
- Instructor: Schematic Design Software
- Students: Internet research
- Students: Schematic Design Software

Assignments:

- Classwork: *Software Tutorials*
- Classwork: *Component Function and Identification*
- Homework: *Real-World Applications*

Lab Activities:

- Design and develop individual depictions of electrical components, including function, appearance, usage, and safety concerns for compilation into a class booklet.
- Design, analyze, and diagnose electronic circuits using the Schematic Design Software.
- Design and develop working electronic circuits using electronic component/circuit activities.

Assessment Method:

- Authentic: Teacher observations,
- Traditional: Classwork, presentation, quizzes, tests

Standards targeted via this unit:

- NJ CCCS 2.0, #7
- NJ CCCS 2.0, #9
- Project 2061, #3

Unit 6: Design and Development Activity: Electronics Time: 6 Weeks

Goal:

- The students will apply their acquired knowledge in order to complete a comprehensive design and problem solving activity.

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:

- Demonstrations
- Schematic Software
- SmartBoard technology

Computer Needs/Use:

- Schematic Software
- Internet Research

Assignments:

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

Lab Activities:

- Design a working Point of Purchase display for a local display that will effectively and aesthetically promote a school organization.

Assessment Method:

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

Standards targeted via this unit:

- NJ CCCS 2.0, #3
- NJ CCCS 2.0, #8
- NJ CCCS 3.0, #11
- NJ CCCS 4.0, #10
- NJSTES 3.19
- NJSTES 2.23
- STL #1, H
- STL #8, F
- STL #8, G
- STL #11, J
- Project 2061, #3

Unit 7: Mechanical Systems and Movements Time: 2 Weeks

Goal:

- Introduce the fourth component of physical technology: mechanical movement as it relates to gear systems and mechanical advantage.

Objectives:

- Define mechanical advantage.

- Define gear ratio.
- Identify the five different types of gears: spur, helical, bevel, worm, and idler.
- State the five primary purposes of having gears operating within a mechanical system.
- Calculate gear ratio and reduction as it relates to speed and power.
- Identify real life applications of gear systems.

Audio-Visual Needs:

- SmartBoard technology
- Demonstration Tools

Computer Needs/Use:

- Internet Sources

Assignments:

- Classwork reviewing information
- Test Review

Lab Activities:

- Fabricate a simple gear system that performs a visible output function

Assessment:

- Authentic: Teacher observation, creativity
- Traditional: Test, class participation,

Standards targeted via this unit:

- NJ CCCS 2.0, #3
- NJ CCCS 2.0, #7
- NJ CCCS 2.0, #9
- NJSTES 1.19
- NJSTES 2.22
- NJSTES 6.16

Unit 8: Introduction to Technical Documentation Time: 1 Week

Goal:

- To introduce the students to major concepts, layouts, and the content required for technical writing and documentation.

Objectives:

- Review the four design principles
- Define annotation.
- Review the grammatical concepts necessary for completion.
- Review proper drawing techniques.
- Review the steps of the design process as it relates to specific project requirements.

Audio-Visual Needs:

- SmartBoard technology
- Previous examples of student work
- Professional examples of work

Computer Needs/Use:

- Internet Research

Assignments:

- Classwork-Format pages

Lab Activities:

- None

Assessment:

- Authentic: Teacher observation, diligence
- Traditional: Classwork

Standards targeted via this unit:

- NJ CCCS 2.0, #3
- NJ CCCS 3.0, #8
- NJSTES 1.19
- NJSTES 6.16

Unit 9: Comprehensive Design and Development Activity Time: 14 Weeks

Goal:

- The students will apply their acquired knowledge to design and develop solutions to a real life competitive event.

Objective:

- List, describe, and implement the steps of the design process in order to develop a comprehensive documentation portfolio.
- Utilize a variety of different forms of presentation techniques.
- Apply their knowledge of the four types of physical technology to successfully complete the tasks presented.
- Implement strong teamwork skills in order to complete the tasks in a diligent manner and restricted time frame.
- Apply their knowledge of technical writing and documentation to rationalize and present implementation of the design process.

Audio-Visual Needs:

- Internet resources via SmartBoard technology
- Models and previous examples
- Annotated and developmental orthographic and isometric drawings
- Photos
- Textbook Resources

Computer Needs/Use:

- Word/Publisher for documentation development
- Digital camera
- Scanner
- Extensive Internet usage
- Schematic Software

Assignments:

- Classwork/homework
- Interim due dates
- Class presentations
- Complete documentation development

Lab Activities:

- As a large team, design and develop a series of transportation vehicles that work cooperatively to transport cargo and perform certain tasks.

Assessment:

- Authentic: Teacher observation, documentation portfolio, teamwork performance, daily journals, cooperation, time management
- Traditional: Class participation, Classwork

Standards targeted via this unit:

- NJ CCCS 2.0, #3
- NJ CCCS 2.0, #8

- NJ CCCS 3.0, #11
- NJ CCCS 3.0, #15
- NJ CCCS 4.0, #10
- NJSTES 2.23
- NJSTES 3.19
- NJSTES 7.38
- NJSTES 7.139
- STL #1, H
- STL #8, F
- STL #8, G
- STL #11, J
- STL #17, K
- Project 2061, #3

Materials/Resources:

Text: None

Labs:

- Introduction to Control Systems
- Introduction to the Electronic Components
- Introduction to Schematic Design Software
- Electronic Systems Activity
- Introduction to Gear Systems and Mechanical Advantage
- Physical Technology Design and Development Activity

People: None

Audio-Visual:

- SmartBoard technology
- Presentation techniques
- System/Component/Gear Demonstration
- Multiple models
- Previous student work
- Pertinent publications
- Resources from previous competitions.

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: **2009**

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:

Dugger, William. Electronics Technology-Devices and Circuits. (Goodheart-Wilcox Company, South Holland, Illinois). 1994. ISBN 0-87006-085-6.

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.retek.com
www.interactiv.com/html/proprodg.html
www.howstuffsworks.com
www.panasonic.com/creativedesign

www.teanj.com
www.iteawww.com
www.tsawww.org
webhome.idirect.com/~jadams/electronics
www.hpregional.org/departments/tech/index.html

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
- Electrical outlets
- Testing area
- Teamwork areas
- Scanner and digital cameras
- 3D Rendering Software
- Diagnostic Equipment
- Schematic Development Software