POE Syllabus for 2017-2018

August 2017

Dear Guardian and Student,

As we begin a new school year, I would like to take this opportunity to welcome you to the Project Lead
the Way Classes. These classes are a new and exciting curriculum being offered at the Career and Technology Center. It is my pleasure to share my enthusiasm for these classes with you.

Project Lead the Way (PLTW) is a not-for-profit organization (from the Rochester Institute of Technology), that promotes pre-engineering courses for middle and high school students. PLTW forms partnerships with public schools, higher education institutions, and the private sector to increase the quantity and quality of engineers and engineering technologists graduating from our educational system.
There is a critical shortage of engineers and engineering technologists entering the field at a time when technology is constantly reinventing itself every few years. For more information and answers to frequently asked questions about PLTW, please visit their website at: **http://www.pltw.org**

I feel it is very important for parents and teachers to communicate. Please do not hesitate to contact me with your concerns. You may call the school (847- 4121 ext. 2139) or **preferably** email me at **jdavis@andersonctc.org**.

Attached you will find information concerning the course requirements. This information should be kept inside the student's portfolio for future reference. Please read the following pages and sign and return the last page to me before the end of the month.
I am excited about the new school year in which your student will have a productive and successful experience in Principles of Engineering. I hope that upon finishing this course your student will choose to continue on to other PLTW opportunities in the engineering field being offered at the Career and Technology Center.
Sincerely,

James R. Davis
Project Lead the Way Instructor

Course Syllabus POE: Principles of Engineering

Instructor	Mr. James Davis
Room	500
Phone	(864) 847-4121 ext. 2139
Email	jdavis@andersonctc.org
Website	https://ctcdavis@weebly.com
Class time	
Extra Help	Before and after School Monday-Thursday

Vision

Welcome to Principles of Engineering. This course exposes students to some of the major concepts that they will encounter in a postsecondary engineering course of study. Students have an opportunity to investigate engineering and high tech careers. POE gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB learning challenges students to continually hone their interpersonal skills, creative abilities, and problem solving skills based upon engineering concepts. It also allows students to develop strategies to enable and direct their own learning.

Course Objective

Students will employ engineering and scientific concepts in the solution of engineering design problems. Students will develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges. Students will also learn how to document their work and communicate their solutions to their peers and members of the professional community.

Recommended Pre/Co-requisites: To be successful in POE, students should be concurrently enrolled in college preparatory mathematics and science. Students should have exceled in the Introduction to Engineering class.

Course Outline: There is no required textbook for this course. Any necessary materials will be supplied by the teacher.

*This class follows the National Science Education Standards (NSEM) which can be provided upon request.

Unit	Title	Days
1	Energy and Power	13
2	Materials and Structures	11
3	Control Systems	12
4	Statistics and Kinematics	9

Long-Range Learning Goals
To develop an ability to apply knowledge of mathematics, science, and engineering.
To increase the ability to design and conduct experiments, as well as to analyze and interpret data.
To develop an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
To develop an ability to function on multi-disciplinary teams.
To develop an ability to identify, formulate, and solve engineering problems.
To increase the understanding of professional and ethical responsibility.
To enhance the ability to communicate effectively.
To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
To enhance the ability to apply knowledge of mathematics, science, and engineering.
To develop a recognition of the need for, and an ability to engage in life-long learning.
Long-Range Developmental Goals
Demonstrate an understanding of subject content.
Investigate and engage in meaningful activities, projects, and problems.
Become independent learners.
Make their own connections between posed questions and prior learning.
Use real life technologies and resources.
Obtain ownership of their learning.
Exhibit growth in areas often ignored: social and life skills, self-management skills and the ability to learn on one's own.

Assessment Task	Evaluation Criteria	Grade Weights
Secondary – Homework, Quiz, Classwork & Major- Tests, Projects, Exam	Completion, Accuracy	60%
Notebook- Engineering Notebook, Journals, Website Portfolio (Weebly) & Employability- Attendance, Attitude, Communication, Follows Directions, Integrity, Prepared For Class, Punctuality, Respectful, Safety/Housekeeping, Self-Management, Initiative	Completion, Accuracy Or Rubric Checklist	40%

Tests Section, Unit, Midterm, and Final exams will be taken. Testing is only one part of the overall assessment plan for this course.

Projects: Students will have various major projects which will be completed during this course. Each project will have a rubric to guide the student towards the expectations of the teacher. Projects will follow ACTC PLTW guidelines for late assignments and make up work or must have prior approval by the teacher. Late work is subject to 25 points off per day penalty.

Projects (Deviations per instructor discretion.)

1. Compound Machine Design—Student teams will design and build a mechanism using a combination of simple machines to achieve a task of their choice.
2. Bridge Building Problem—Pairs of students will design and build a truss bridge to withstand the largest load while minimizing the bridge weight.
3. Material Testing—Students will calculate, then test stress and strain on a tensile test sample using the Stress Analyzer.
4. Control System Design Problem—Teams of students will simulate an industrial sorting process using VEX-building components and RobotC programming software.
5. Self-Propelled Vehicle—Student teams will design and build a self-powered car to investigate distance, displacement, speed, velocity and acceleration.
6. Projectile Launcher Design Problem—Students will create a device that will toss a ball accurately within a given range.

Portfolio: Every student is expected to build a personal portfolio of their work, notes, and assessments throughout the year in their Engineering notebook. PLTW's mypltw.org will give students access to the full semester's curriculum.Students have access as long as they have internet so assignment could be submitted from home. In addition to each assignment being graded, the completion percentage of assignments will count towards a portfolio grade.

Engineering notebooks are given to student to take notes and document their class work. Engineering notebooks are checked for completion, neatness, and correct format. The Engineering notebook grade will be given once per quarter. Students may take notebooks home but must leave in class when told teacher will be grading after class.

Quiz: Quizzes will be administered to assess the students' progress, weekly.

Homework: Students will be expected to complete various assignments including formal drawings and sketches of assigned problems as directed by the teacher. Students should be able to complete assigned class work within the school day. After school-work time may be available with prior teacher arrangement. All assignments are required to show all work. Assessments are based on concepts learned and practiced during class, and homework assignments. Assignments will be submitted through LMS unless otherwise directed.

SUPPLIES

The student must provide a black or blue pen every day. Students are provided with a class engineering notebook, an electronic folder. Notebooks may be taken home but students must be brought back to class each day. Failure to be prepared will affect Employability grade.

AFTER SCHOOL TUTORING

Throughout the year I will be available to assist students outside the obligated class time. Students are welcome to come to my room before or after school Monday-Thursday. They only need to inform the teacher a day before the intended session of tutoring. Email: jdavis@andersonctc.org

Classroom Rules

1. Be on time, prepared, and present for class.
2. Have a good attitude about learning and actively participating in class.
3. Follow all written and oral directions and safety precautions.
4. Absolutely no horseplay!
5. Complete all assignments in a timely fashion.
6. Be respectful of others and their property.
7. Get the instructor's permission before getting/using tools or materials.
8. Do not download or access inappropriate programs or content on the internet. This includes games.
9. Refrain from eating in class. Water will be allowed as long as they have a lid. i.e. no aluminum drink cans, or open cups.
10. All students will remain in class until all classroom supplies are returned to their designated areas.
11. Leave chairs under tables. Do not roll around room, spin, or constantly adjust height.
12. Discard any trash from the seat and/or surrounding area, in the proper receptacle.
13. Follow all other school and district rules.

Consequences

- Warning
- Loss of Break
- Call home to parent/guardian
- Referral
- *If a student acts in a manner that is totally unacceptable or unsafe, he or she may be immediately removed from class with a disciplinary referral.*

Lab Use

Throughout the year students will have access to, and utilize many pieces of mechanical equipment and computers within the PLTW lab. Students will be expected to respect this equipment as per ACTC guidelines stated in the student handbook. Safety is an important aspect of this class and will be addressed throughout the year while in the lab setting.

Course Outline : this course outline is a guideline that may be changed at the discretion of the teacher.

Principles Of Engineering Detailed Outline

Unit 1 Energy and Power

Lesson 1.1 Mechanisms

Concepts Addressed in Lesson:

1. Engineers and engineering technologists apply math, science, and discipline-specific skills to solve problems.
2. Engineering and engineering technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals.
3. Technical communication can be accomplished in oral, written, and visual forms and must be organized in a clear and concise manner.
4. Most mechanisms are composed of gears, sprockets, pulley systems, and simple machines.
5. Mechanisms are used to redirect energy within a system by manipulating force, speed, and distance.
6. Mechanical advantage ratios mathematically evaluate input work versus output work of mechanisms.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Differentiate between engineering and engineering technology.
- Conduct a professional interview and reflect on it in writing.
- Identify and differentiate among different engineering disciplines.
- Measure forces and distances related to mechanisms.
- Distinguish between the six simple machines, their attributes, and components.
- Calculate mechanical advantage and drive ratios of mechanisms.
- Design, create, and test gear, pulley, and sprocket systems.
- Calculate work and power in mechanical systems.
- Determine efficiency in a mechanical system.
- Design, create, test, and evaluate a compound machine design.

Lesson 1.2 Energy Sources :

Concepts Addressed in Lesson:

1. Energy source classifications include nonrenewable, renewable, and inexhaustible.
2. Energy source processes include harnessing, storing, transporting, and converting.
3. Energy often needs to be converted from one form to another to meet the needs of a given system.
4. An understanding of work, energy, and power is required to determine system efficiency.
5. An understanding of the basics of electricity requires the understanding of three fundamental concepts of voltage, current, and resistance.
6. The atomic structure of a material determines whether it is a conductor, an insulator, or a semiconductor.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible.
- Create and deliver a presentation to explain a specific energy source.
- Summarize and reflect upon information collected during a visit to a local utility company.
- Define the possible types of power conversion.
- Calculate work and power.
- Demonstrate the correct use of a digital multi-meter.
- Calculate power in a system that converts energy from electrical to mechanical.
- Determine efficiency of a system that converts an electrical input to a mechanical output.
- Calculate circuit resistance, current, and voltage using Ohm's law.
- Understand the advantages and disadvantages of parallel and series circuit design in an application.

Lesson Energy Applications

Concepts Addressed in Lesson:

1. Energy management is focused on efficient and accessible energy use.
2. System energy requirements must be understood in order to select the proper energy source.
3. Energy systems can include multiple energy sources that can be combined to convert energy into useful forms.
4. Hydrogen fuel cells create electricity and heat through an electrochemical process that converts hydrogen and oxygen into water.
5. Solar cells convert light energy into electricity by using photons to create electron flow.
6. Thermodynamics is the study of the effects of work, thermo energy, and energy on a system.
7. Thermo energy can transfer via convection, conduction, or radiation.
8. Material conductivity, resistance, and energy transfer can be calculated.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell.
- Experiment with a solar hydrogen system to produce mechanical power.
- Design, construct, and test recyclable insulation materials.
- Test and apply the relationship between R-values and recyclable insulation.
- Complete calculations for conduction, R-values, and radiation.

Lesson Design Problem – Energy and Power :
Concepts Addressed in Lesson:

1. Design problems can be solved by individuals or in teams.
2. Engineers use a design process to create solutions to existing problems.
3. Design briefs are used to identify the problem specifications and to establish project constraints.
4. Teamwork requires constant communication to achieve the desired goal.
5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Brainstorm and sketch possible solutions to an existing design problem.
- Create a decision-making matrix for a design problem.
- Select an approach that meets or satisfies the constraints provided in a design brief.
- Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
- Present a workable solution to the design problem.

Unit 2 Materials and Structures

Lesson Statics:
Concepts Addressed in Lesson:

1. Laws of motion describe the interaction of forces acting on a body.
2. Structural member properties including centroid location, moment of inertia, and modulus of elasticity are important considerations for structure design.
3. Static equilibrium occurs when the sum of all forces acting on a body are equal to zero.
4. Applied forces are vector quantities with a defined magnitude, direction, and sense, and can be broken into vector components.
5. Forces acting at a distance from an axis or point attempt or cause an object to rotate.
6. In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces.
7. Free body diagrams are used to illustrate and calculate forces acting upon a given body.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Create free body diagrams of objects, identifying all forces acting on the object.
- Mathematically locate the centroid of structural members.

- Calculate moment of inertia of structural members.
- Differentiate between scalar and vector quantities.
- Identify magnitude, direction, and sense of a vector.
- Calculate the X and Y components given a vector.
- Calculate moment forces given a specified axis.
- Use equations of equilibrium to calculate unknown forces.
- Use the method of joints strategy to determine forces in the members of a statically determinate truss.

Lesson Material Properties :
Concepts Addressed in Lesson:

1. Materials are the substances with which all objects are made.
2. Materials are composed of elements and area categorized by physical and chemical properties.
3. Materials consist of pure elements. Compounds and mixtures and are typically classified as metallic, ceramic, organic, polymeric, and composite.
4. Material properties including recyclability and cost are important considerations for engineers when choosing appropriate materials for a design.
5. Material selection is based upon mechanical, thermal, electromagnetic, and chemical properties.
6. Raw materials undergo various manufacturing processes in the production of consumer goods.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Investigate specific material properties related to a common household product.
- Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure.
- Calculate weight, volume, mass, density, and surface area of selected common household product
- Identify the manufacturing processes used to create the selected common household product.
- Identify the recycling codes.
- Promote recycling using current media trends.

Lesson Material Testing :
Concepts Addressed in Lesson:

1. Engineers utilize a design process and mathematical formulas to solve and document design problems.
2. Material testing aids in determining a product's reliability, safety, and predictability in function.

3. Engineers perform destructive and non-destructive tests on material specimens for the purpose of identifying and verifying the properties of various materials.
4. Material testing provides a reproducible evaluation of material properties.
5. Tensile testing data is used to create a test sample stress strain curve.
6. Stress strain data points are used to identify and calculate sample material properties including elastic range, proportional limit, modulus of elasticity, elastic limit, resilience, yield point, plastic deformation, ultimate strength, failure, and ductility.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Utilize a five-step technique to solve word problems.
- Obtain measurements of material samples.
- Tensile test a material test sample.
- Identify and calculate test sample material properties using a stress strain curve.

Lesson Design Problem – Materials and Structures :

Concepts Addressed in Lesson:

1. Design problems can be solved by individuals or in teams.
2. Engineers use a design process to create solutions to existing problems.
3. Design briefs are used to identify the problem specifications and establish project constraints.
4. Teamwork requires constant communication to achieve the desired goal.
5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Brainstorm and sketch possible solutions to an existing design problem.
- Create a decision making matrix for the design problem.
- Select an approach that meets or satisfies the constraints given in a design brief.
- Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team's decision matrix.
- Present a workable design solution.

Unit3 Control Systems
Time Days:

Lesson Machine Control :

Concepts Addressed in Lesson:

1. Flowcharts provide a step by step schematic representation of an algorithm or process.

2. Control systems are designed to provide consentient process control and reliability.
3. Control system protocols are an established set of commands or functions typically created in a computer programming language.
4. Closed loop systems use digital and analog sensor feedback to make operational and process decisions.
5. Open loop systems use programming constants such as time to make operational and process decisions.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Create detailed flow charts utilizing a computer software application.
- Create control system operating programs utilizing computer software.
- Create system control programs that utilize flowchart logic.
- Choose appropriate inputs and output devices based on the need of a technological system.
- Differentiate between the characteristics of digital and analog devices.
- Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.
- Design and create a control system based on given needs and constraints.

Lesson Fluid Power :

Concepts Addressed in Lesson:

1. Fluid power systems are categorized as either pneumatic, which utilizes gas, or hydraulic, which utilizes liquid.
2. Fluid power is possible because in a system of confined fluid, pressure acts equally in all directions.
3. The most basic components of all fluid power systems include a reservoir or receiver, a pump or compressor, a valve, and a cylinder.
4. Fluid power systems are designed to transmit force over great distances, multiply an input force, and increase the distance that an output will move.
5. Laws about the behavior of fluid systems and standard conventions for calculating values within fluid systems aid in the design and understanding of such systems.
6. Standard schematic symbols and conventions are used to communicate fluid power designs.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Identify devices that utilize fluid power.
- Identify and explain basic components and functions of fluid power devices.
- Differentiate between the characteristics of pneumatic and hydraulic systems.
- Distinguish between hydrodynamic and hydrostatic systems.
- Design, create, and test a hydraulic device.

- Design, create, and test a pneumatic device.
- Calculate values in a fluid power system utilizing Pascal's Law.
- Distinguish between pressure and absolute pressure.
- Distinguish between temperature and absolute temperature.
- Calculate values in a pneumatic system, utilizing the perfect gas laws.
- Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.

Lesson Design Problem – Control Systems :

Concepts Addressed in Lesson:

1. Design problems can be solved by individuals or in teams.
2. Engineers use a design process to create solutions to existing problems.
3. Design briefs are used to identify the problem specifications and to establish project constraints.
4. Teamwork requires constant communication to achieve the desired goal.
5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Brainstorm and sketch possible solutions to an existing design problem.
- Create a decision-making matrix for a design problem.
- Select an approach that meets or satisfies the constraints provided in a design brief.
- Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
- Present a workable solution to the design problem.

Unit 4 Statistics and Kinematics

Lesson_Statistics :

Concepts Addressed in Lesson:

1. Engineers use statistics to make informed decisions based upon established principles.
2. Visual representations of data analyses allow for easy distribution and understanding of data.
3. Statistics is based upon both theoretical and experimental data analysis.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Calculate the theoretical probability that an event will occur.
- Calculate the experimental frequency distribution of an event occurring.
- Apply the Bernoulli process to events that only have two distinct possible outcomes.
- Apply AND, OR, and NOT logic to probability.
- Apply Bayes' theorem to calculate the probability of multiple events occurring.
- Create a histogram to illustrate frequency distribution.
- Calculate the central tendency of a data array, including mean, median, and mode.
- Calculate data variation, including range, standard deviation, and variance.

Lesson_Kinematics :

Concepts Addressed in Lesson:

1. When working with bodies in motion, engineers must be able to differentiate and calculate distance, displacement, speed, velocity, and acceleration.
2. When air resistance is not taken into account, released objects will experience acceleration due to gravity, also known as freefall.
3. Projectile motion can be predicted and controlled using kinematics equations.
4. When a projectile is launched, velocity in the x direction remains constant; whereas, with time, the velocity in the Y direction in magnitude and direction changes due to gravity.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Calculate distance, displacement, speed, velocity, and acceleration from data.
- Design, build, and test a vehicle that stores and releases potential energy for propulsion.
- Calculate acceleration due to gravity given data from a free fall device.
- Calculate the X and Y components of a projectile motion.
- Determine the angle needed to launch a projectile a specific range given the projectile's initial velocity.

Lesson Design Problem – Statistics and Kinematics :

Concepts Addressed in Lesson:

1. Design problems can be solved by individuals or in teams.
2. Engineers use a design process to create solutions to existing problems.
3. Design briefs are used to identify the problem specifications and establish project constraints.
4. Teamwork requires constant communication to achieve the desired goal.
5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.

Performance Objectives Addressed in Lesson:

It is expected that students will:

- Brainstorm and sketch possible solutions to an existing design problem.
- Create a decision-making matrix for their design problem.
- Select an approach that meets or satisfies the constraints provided in a design brief.
- Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
- Present a workable solution to the design problem.

First homework assignment for Mr. Davis' Class
Get signed and returned before the end of the 3rd day of class.
Due: 8/28

I have read the 3 class starter documents and have discussed the contents with my son/daughter:

1) Class syllabus (see ctcdavis.weebly.com)

   Circle one: IED POE AEO EDD

2) Parent/Student handbook (see andersonctc.org)

3) Internet Use Agreement (see andersonctc.org student tab)

Student Name

Student Signature

Parent/Guardian Name

Parent/Guardian Signature

Parent/Guardian Email *(please print clearly)*