CHINO VALLEY UNIFIED SCHOOL DISTRICT
INSTRUCTIONAL GUIDELINES
PRINCIPLES OF ENGINEERING

Course Number	5937
Department	Project Lead the Way
Prerequisite	Concurrent enrollment in Algebra II or higher
Length of Course	Two (2) semesters/One (1) year
Grade Level	10-12
Credit	5 units per semester/10 total credits - elective
Repeatable	Not repeatable for credit
UC/CSU	Meets the “g” elective requirement
Board Approved	December 10, 2009
Revised	July 14, 2011

Description of Course – Principles of Engineering is a course that helps students understand the fields of engineering and engineering technology. Exploring various technology systems and manufacturing processes help students learn how engineers and technicians use math, science, and technology in an engineering problem solving process to benefit people. The course also includes concerns about social and political consequences of technological change. This course is aligned to the Project Lead the Way Program.

Rationale for Course – Principles of Engineering (POE) is a high school-level survey course of engineering. The 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 technology 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, which is the ultimate goal of education.

Standard 1 – (Energy and Power) Students understand mechanical and thermodynamic principles and understand the ways in which a system gains or losses energy.

1.1 Objective: Use the six simple machines to calculate mechanical advantage and drive ratios.

1.1.1 Performance Indicator: Students will differentiate between engineering and engineering technology.

1.1.2 Performance Indicator: Students will conduct a professional interview and reflect on the interview in writing.

1.1.3 Performance Indicator: Students will identify and differentiate among different engineering disciplines.

1.1.4 Performance Indicator: Students will distinguish between the six simple machines, their attributes, and components.

1.1.5 Performance Indicator: Students will calculate mechanical advantage and drive ratios of mechanisms.

1.1.6 Performance Indicator: Students will design, create, and test gear, pulley, and sprocket systems.

1.1.7 Performance Indicator: Students will calculate work and power in mechanical systems.

1.1.8 Performance Indicator: Students will determine efficiency in a mechanical system.

1.1.9 Performance Indicator: Students will design, create, test, and evaluate a compound machine design.

1.2 Objective: Learn how systems lose energy and how such losses affect the overall efficiency of the system.

1.2.1 Performance Indicator: Students will identify and categorize energy sources as nonrenewable, renewable, or inexhaustible.

1.2.2 Performance Indicator: Students will create and deliver a presentation to explain a specific energy source.

1.2.3 Performance Indicator: Students will write a summary pertaining to information collected during a visit to a local utility company.

1.2.4 Performance Indicator: Students will define the possible types of power conversion.

1.2.5 Performance Indicator: Students will calculate work and power.

1.2.6 Performance Indicator: Students will demonstrate the correct use of a digital multimeter.

1.2.7 Performance Indicator: Students will calculate power in a system that converts energy from electrical to mechanical.

1.2.8 Performance Indicator: Students will determine efficiency of a system that converts an electrical input to a mechanical output.

1.2.9 Performance Indicator: Students will calculate circuit resistance, current, and voltage using Ohm's law.

1.2.10 Performance Indicator: Students will understand the advantages and disadvantages of parallel and series circuit design in an application.

1.3 Objective: Investigate thermal energy and alternative energy applications.

1.3.1 Performance Indicator: Students will test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell.

1.3.2 Performance Indicator: Students will experiment with a solar hydrogen system to produce mechanical power.

1.3.3 Performance Indicator: Students will design, construct, and test recyclable insulation materials.

1.3.4 Performance Indicator: Students will test and apply the relationship between R-values and recyclable insulation.

1.3.5 Performance Indicator: Students will complete calculations for conduction, R-values, and radiation.

1.4 Objective: Understand how the design process is used to create solutions to design problems.

1.4.1 Performance Indicator: Students will brainstorm and sketch possible solutions to an existing design problem.

1.4.2 Performance Indicator: Students will create a decision making matrix for their design problem.

1.4.3 Performance Indicator: Students will select an approach that meets or satisfies the constraints provided in a design brief.

1.4.4 Performance Indicator: Students will create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.

1.4.5 Performance Indicator: Students will present a workable solution to the design problem.

Standard 2 – (Materials and Structures) Students calculate the internal and external forces of a system in equilibrium and understand the basic categories and properties of materials.

2.1 Objective: Identify and calculate forces acting on a body when it is in static equilibrium.

2.1.1 Performance Indicator: Students will create free body diagrams of objects, identifying all forces acting on the object.

2.1.2 Performance Indicator: Students will mathematically locate the centroid of structural members.

2.1.3 Performance Indicator: Students will calculate moment of inertia of structural members.

2.1.4 Performance Indicator: Students will differentiate between scalar and vector quantities.

2.1.5 Performance Indicator: Students will identify magnitude, direction, and sense of a vector.

2.1.6 Performance Indicator: Students will calculate the X and Y components given a vector.

2.1.7 Performance Indicator: Students will calculate moment forces given a specified axis.

2.1.8 Performance Indicator: Students will use equations of equilibrium to calculate unknown forces.

2.1.9 Performance Indicator: Students will use the method of joints strategy to determine forces in the members of a statically determinate truss.

2.2 Objective: Investigate the categories and properties of materials and how products are made and recycled.

2.2.1 Performance Indicator: Students will investigate specific material properties related to a common household product.

2.2.2 Performance Indicator: Students will conduct investigative non-destructive material property tests on selected common household product including testing for continuity, ferrous metal, hardness, and flexure.

2.2.3 Performance Indicator: Students will calculate weight, volume, mass, density, and surface area of selected common household product.

2.2.4 Performance Indicator: Students will identify the manufacturing processes used to create the selected common household product.

2.2.5 Performance Indicator: Students will identify the recycling codes.

2.2.6 Performance Indicator: Students will promote recycle using current media trends.

2.3 Objective: Understand how engineers use destructive and non-destructive testing to identify the properties of various materials.

2.3.1 Performance Indicator: Students will utilize a five-step technique to solve word problems.

2.3.2 Performance Indicator: Students will obtain measurements of material samples.

2.3.3 Performance Indicator: Students will tensile test a material test sample.

2.3.4 Performance Indicator: Students will identify and calculate test sample material properties using a stress strain curve.

Standard 3 – (Control Systems) Students control mechanical, pneumatic, and hydraulic processes using computer software and hardware.

3.1 Objective: Understand that control systems are designed to provide process control and reliability.

3.1.1 Performance Indicator: Students will create detailed flow charts utilizing a computer software application.

3.1.2 Performance Indicator: Students will create control system operating programs utilizing computer software.

3.1.3 Performance Indicator: Students will create system control programs that utilize flowchart logic.

3.1.4 Performance Indicator: Students will choose appropriate inputs and outputs devises based on the need of a technological system.

3.1.5 Performance Indicator: Students will differentiate between the characteristics of digital and analog devices.

3.1.6 Performance Indicator: Students will judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.

3.1.7 Performance Indicator: Students will design and create a control system based on given needs and constraints.

3.2 Objective: Learn the basic components of pneumatic and hydraulic systems and how they are designed to manipulate work and power.

3.2.1 Performance Indicator: Students will identify devices that utilize fluid power.

3.2.2 Performance Indicator: Students will identify and explain basic components and functions of fluid power devices.

3.2.3 Performance Indicator: Students will differentiate between the characteristics of pneumatic and hydraulic systems.

3.2.4 Performance Indicator: Students will distinguish between hydrodynamic and hydrostatic systems.

3.2.5 Performance Indicator: Students will design, create, and test a hydraulic device.

3.2.6 Performance Indicator: Students will design, create, and test a pneumatic device.

3.2.7 Performance Indicator: Students will calculate values in a fluid power system utilizing Pascal's Law.

3.2.8 Performance Indicator: Students will distinguish between pressure and absolute pressure.

3.2.9 Performance Indicator: Students will distinguish between temperature and absolute temperature.

3.2.10 Performance Indicator: Students will calculate values in a pneumatic system utilizing the perfect gas laws.

3.2.11 Performance Indicator: Students will calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.

Standard 4 – (Commercial Building Design) Students investigate objects in motion by comparing theoretical calculations to actual test data.

4.1 Objective: Learn the processes of gathering, organizing, and interpreting data.

4.1.1 Performance Indicator: Students will calculate the theoretical probability that an event will occur.

4.1.2 Performance Indicator: Students will calculate the experimental frequency distribution of an event occurring.

4.1.3 Performance Indicator: Students will apply the Bernoulli process to events that only have two distinct possible outcomes.

4.1.4 Performance Indicator: Students will apply AND, OR, and NOT logic to probability.

4.1.5 Performance Indicator: Students will apply Bayes' theorem to calculate the probability of multiple events occurring.

4.1.6 Performance Indicator: Students will create a histogram to illustrate frequency distribution.

4.1.7 Performance Indicator: Students will calculate the central tendency of a data array, including mean, median, and mode.

4.1.8 Performance Indicator: Students will calculate data variation, including range, standard deviation, and variance.

4.2 Objective: Predict the motion of projectiles using kinematic equations.

4.2.1 Performance Indicator: Students will calculate distance, displacement, speed, velocity, and acceleration from data.

4.2.2 Performance Indicator: Students will design, build, and test a vehicle that stores and releases potential energy for propulsion.

4.2.3 Performance Indicator: Students will calculate acceleration due to gravity given data from a free fall device.

4.2.4 Performance Indicator: Students will calculate the X and Y components of a projectile motion.

4.2.5 Performance Indicator: Students will determine the needed angle to launch a projectile a specific range given the projectile's initial velocity.