PRINCIPLES OF ENGINEERING
Course Syllabus

Course Number: ST00024  OHLAP Credit: Yes
OCAS Code: 8710
Course Length: 80 Hours
Career Cluster: Science, Technology,
Engineering and Mathematics
Career Pathway: Engineering and Technology
Career Major(s): PLTW Pre-Engineering (Comprehensive High Schools), PLTW Pre-Engineering

Pre-requisite(s): Principles of Engineering helps students understand the field of engineering/engineering technology. Students explore various technology systems and manufacturing processes helping them learn how engineers and technicians use math, science, and technology in an engineering problem solving process to benefit people. This course also includes concerns about social and political consequences of technological change. This course is approved for Computer Science/Computer Technology credit and is OHLAP approved.

Textbooks: Project Lead the Way Materials

Course Objectives: Unit 1 Energy and Power

Lesson 1.1 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
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.
Lesson 1.3 Energy Applications
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 1.4 Design Problem – Energy and Power
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 2.1 Statics
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.
PRINCIPLES OF ENGINEERING

- 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 2.3 Material Testing

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 2.4 Design Problem – Materials and Structures

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.

Unit 3 Control Systems

Lesson 3.1 Machine Control

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 3.2 Fluid Power
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 3.3 Design Problem – Control Systems

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 4.1 Statistics

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 4.2 Kinematics

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 4.3 Design Problem – Statistics and Kinematics
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.

Teaching Methods: The class will primarily be taught by the lecture and demonstration method and supported by various media materials to address various learning styles. There will be question and answer sessions over material covered in lecture and media presentations. Supervised lab time is provided for students to complete required projects.

Grading Procedures: 1. Students are graded on theory and lab practice and performance.
2. Each course must be passed with seventy (70%) percent or better.
3. Grading scale: A=90-100%, B=80-89%, C=70-79%, D=60-69%, F=50-59%.

Description of Classroom, Laboratories, and Equipment: Tulsa Technology Center campuses are owned and operated by Tulsa Technology Center School District No. 18. All programs provide students the opportunity to work with professionally certified instructors in modern, well-equipped facilities.

Available Certifications/College Credit The student may be eligible to take state, national or industry exam after completion of the program. College credit may be issued from Oklahoma State University-Okmulgee or Tulsa Community College. See program counselor for additional information.

College Credit Eligibility: The student must maintain a grade point average of 2.0 or better.