Core Engineering 1

Core Engineering 1 is the introductory course in the core engineering program. This course teaches problem-solving skills using a design development process and exposes students to the career field of engineering, as well as engineering design software. Models of product solutions are created, analyzed, and communicated using 3D CAD software. Existing state-approved courses that meet these standards include Introduction to Engineering Design (PLTW) and Introduction to Engineering (STEM Academy).

UNIT A: DESIGN PROCESS

1. Identify and apply a design process.
2. Perform structural and functional analysis.
3. Apply effective leadership and teamwork methodologies.

*History of Engineering
*Impact on Society

UNIT B: PROBLEM-SOLVING

1. Utilize problem-solving methods to solve real-world problems.
2. Evaluate design solutions based on implications to society and the environment.

*History of Engineering
*Impact on Society

UNIT C: ENGINEERING COMMUNICATION

1. Employ standard engineering documentation protocol such as engineering notebooks and/or portfolios.
2. Generate technical reports utilizing APA format.
3. Create presentations to communicate design solutions.

*History of Engineering
*Impact on Society

UNIT D: SKETCHING AND DRAWING

1. Prepare technical drawings using ANSI and/or ISO standards.
2. Apply scale, dimensioning, and tolerance standards to drawings.

*History of Engineering
*Impact on Society

UNIT E: ENGINEERING DISCIPLINES

1. Explore and differentiate among the various engineering disciplines.

*throughout the curriculum

December 2013

*History of Engineering
*Impact on Society

UNIT F: DESIGN AND MODELING

2. Create and edit an engineering model using 3D CAD software.
3. Produce acceptable deliverables.
4. Extract and interpret physical properties of a solid model from CAD software.

*History of Engineering
*Impact on Society

UNIT G: ENGINEERING COMPUTATIONS

1. Demonstrate proper use of engineering measurement tools with precision.
2. Convert between US Customary and SI units.
3. Calculate physical properties of geometric shapes and solids.
4. Calculate central tendencies and descriptive statistics including standard deviation and empirical rule.

*History of Engineering
*Impact on Society

*throughout the curriculum

Core Engineering 2

Core Engineering 2 is the second course in the core engineering sequence and helps students understand the fields of engineering and engineering technology. Students will explore various technological systems to learn how engineers and technicians use Science, Technology, Engineering and Math (STEM) in an engineering problem-solving process. Existing state-approved courses that meet these standards include Principles of Engineering (PLTW or STEM Academy).

Prerequisite: Core Engineering 1

UNIT A: SIMPLE MACHINES AND MECHANISMS

1. Identify the six types of simple machines and their parts.
2. Calculate work and power.
3. Calculate ideal mechanical advantage.
4. Calculate actual mechanical advantage.
5. Calculate mechanical system efficiency.
6. Calculate variables of gear-driven systems such as angular velocity, torque, gear ratios, number of teeth, and direction of rotation.
7. Calculate variables of belts-driven systems such as angular velocity, diameters, and torque.

*Design, build, and evaluate a compound machine.
*Engineering Documentation
*Ethics
*Design Analysis

UNIT B: FORCES

Statics and Structural Analysis

1. Identify and apply Newton's Three Laws of Motion.
2. Calculate the centroid of simple shape.
3. Calculate the centroid of a complex shape.
4. Calculate the moment of inertia for a rectangular shape.
5. Calculate beam deflection.
6. Calculate modulus of elasticity.
7. Understand vector notation.
8. Analyze a vector and calculate component forces.
9. Create a free body diagram for a system.
10. Calculate moments about an axis.
11. Calculate reaction forces for a structure.

*throughout the curriculum

December 2013

12. Calculate tensile and compressive forces in a truss.
13. Calculate strength to weight ratio.

*Design, build, test, and analyze a simple truss.
*Engineering Documentation
*Ethics
*Design Analysis

Fluid Power

1. Identify the types and applications of fluid power systems.
2. Calculate work and power.
3. Compare pneumatic versus hydraulic systems.
4. Calculate properties of a fluid power system using Pascal's Law.
5. Calculate temperature, pressure, and volume using ideal gas laws.

*Design, build, test, and analyze a fluid power system.
*Engineering Documentation
*Ethics
*Design Analysis

UNIT C: ENERGY AND POWER

Electricity/Electronics

1. Identify electrical hazards.
2. Understand and demonstrate safety procedures.
3. Calculate work and power.
4. Explain and classify a material as either a conductor or insulator.
5. Identify and measure electrical components in a circuit.
6. Distinguish between conventional current and electron current flow.
7. Distinguish between AC and DC current.
8. Distinguish between analog and digital.
9. Define Ohms law.
10. Define Kirchhoff's current and voltage laws.
11. Explain the relationship between voltage, current, and resistance.
12. Calculate electrical properties using Ohm's law and Kirchhoff's laws.
13. Identify, create, and analyze series, parallel, and simple combination circuits.

*Engineering Documentation
*Ethics
*Design Analysis

*throughout the curriculum

Thermodynamics

1. Identify and explain the three methods of heat transfer (conduction, convection, and radiation).
2. Calculate rate and amount of heat transfer in thermodynamic systems.
3. Analyze a structure for heat transfer using R-values.
4. Identify and explain the laws of thermodynamics.

*Design, build, test, and analyze a simple thermodynamic system for heat loss.
*Engineering Documentation
*Ethics
*Design Analysis

UNIT D: MACHINE DESIGN AND CONTROL SYSTEMS

1. Differentiate between open and closed loop systems.
2. Identify and select appropriate inputs, outputs, and sensors.
3. Program a robot/machine to perform a task.

*Design, build, program, and test an automated system to handle materials.
*Engineering Documentation
*Ethics
*Design Analysis

UNIT E: MATERIALS ANALYSIS

1. Demonstrate knowledge of classes of materials and their properties.
2. Justify material choices for a product in terms of availability, cost, manufacturing methods, application, and environment.
3. Identify and choose appropriate processes for manufacturing, such as casting, milling, turning, forming, and grinding (additive versus subtractive processes).
4. Explain how raw materials are transformed into finished products including the product life cycle (disposal, recycling, and environmental impacts).

*Engineering Documentation
*Ethics
*Design Analysis

Destructive Testing

1. Calculate stress and strain.
2. Evaluate properties of a metal from a stress/strain curve.
3. Perform a destructive test on a metal (physically or virtually).

*Engineering Documentation
*Ethics
*Design Analysis

*throughout the curriculum

Reverse Engineering

1. Identify mechanical fasteners and corresponding tools.
2. Identify inputs, outputs, and possible processes of the system.
3. Perform a tear-down, cataloguing, and identification of a manufactured product and its parts.

*Engineering Documentation
*Ethics
*Design Analysis

UNIT F: KINEMATICS

1. Identify forces acting upon a projectile.
2. Calculate firing angle, initial velocity, and range.
3. Understand concepts of position, velocity, and acceleration.

*Design, build, test, and evaluate a ballistic device.
*Engineering Documentation
*Ethics
*Design Analysis

*throughout the curriculum

December 2013

Engineering Specialization 1

Engineering Specialization 1 is the third course in the core engineering sequence and helps students understand a specialized field of engineering/engineering technology. The course uses project-based activities and technological systems to help students learn about a specific engineering discipline. Students will use Science, Technology, Engineering and Math (STEM) in engineering problem-solving processes. Existing state-approved courses that meet these standards include specialization courses (PLTW or STEM Academy).

Prerequisites: Core Engineering 1 and 2

1. Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.
2. Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
3. Apply engineering skills in a project that requires project management, process control and quality assurance.
4. Use technology to acquire, manipulate, analyze and report data from project-based activities.
5. Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
6. Understand the nature and scope of the STEM Cluster, specifically the role of engineering in society.
7. Demonstrate an understanding of the breadth of career opportunities in engineering and avenues to reach them.
8. Demonstrate technical skills needed in a chosen engineering field.

*throughout the curriculum

December 2013

Engineering Specialization 2

Engineering Specialization 2 is the fourth course in the core engineering sequence and helps students understand an additional specialized field of engineering/engineering technology. The course uses project-based activities and technological systems to help students gain a deeper understanding of engineering processes. Students will use Science, Technology, Engineering and Math (STEM) in an engineering problem-solving process. Existing state-approved courses that meet these standards include specialization or capstone courses (PLTW or STEM Academy).

Prerequisites: Core Engineering 1 and 2 and Engineering Specialization 1

1. Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.
2. Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
3. Use STEM concepts and processes to solve engineering problems involving design and/or production.
4. Collect and analyze results from project-based activities and communicate with various stakeholders.
5. Apply processes and concepts for the use of technological tools in engineering.
6. Apply the elements of a design process.
7. Apply the knowledge learned in STEM to solve engineering problems.
8. Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

*throughout the curriculum

December 2013