ENGINEERING DESIGN/ROBOTICS 10

Description

A course in Engineering Design/Robotics which engages student teams in the process of problem solving, engineering challenges and building machines. In this half year course students will begin with a unit involving the engineering process, simple machines, tool usage and build a working trebuchet. In the following units, student teams will build a fully functional robot while learning about robotic subsystems including pneumatics, electronics, gear boxes, and radio controllers. Robots will compete in a class competition at the end of the semester. This is a great course for any student considering a career in engineering or robotics.

Course Overview

Course Objectives

Students should be able to:

- recognize and practice related safety procedures and instructions.
- describe and identify the 6 simple machines and the related math.
- explain and describe the engineering process in writing.
- use the engineering process to invent a device or process to improve the performance of a model trebuchet.
- create an engineering report using collected data and analyze results.
- understand pneumatic powered devices and fluid power systems.
- use the GEARS-IDS Invention and Design System to participate in the process of engineering design.
- develop and use fabrication skills and fastening systems.
- create and trouble shoot electrical control circuits and components.
- create and troubleshoot pneumatic circuits and components.
- engage in contextual learning opportunities involving an engineering challenge.
- employ critical thinking skills independently and in teams to solve problems and make decisions.

Essential Questions

- How is computer technology used to create designs and to effectively communicate ideas?
- How can math, science, physics, and CADD be used to solve engineering problems?
- Why use engineering steps to solve a problem or improve upon an existing design?
- How are engineered systems created and tested in a team environment?
- Why do systems and circuits need to be designed, built, and tested?
- How are engineered systems created and tested in a team environment?
- What purpose does competition play in improving engineering outcomes?

Assessments

- Safety Quiz/Test
- Trebuchet Model/Performance Testing
- Trebuchet Simulations
- Trebuchet Optimization
- Trebuchet Engineering Report
- Pneumatics Quiz/Test
- Pneumatics math Quiz/Test
- CAD Design
- Chassis Build
- Robotics Competition
- Robot Engineering Report

• develop an engineering challenge or competitive game and design and construct a machine to play the game.		
Content Outline I. Unit 1 – Introduction To Engineering II. Unit 2 – Trebuchet III. Unit 3 – Pneumatics IV. Unit 4 – Chassis Design/Construction V. Unit 5 – Robot Competition	**Standards** Connecticut State Technology Education standards have been met in the following areas: • ***Essential Skills and Knowledge*** • ***Computer Aided Drafting and Design*** • ***Manufacturing*** • ***Pre-Engineering Technology***	

Pacing Guide				
1st Marking Period			2nd Marking Period	
Unit 1 **Introduction to Engineering** 1 week	Unit 2 **Trebuchet** 5 weeks	Unit 3 **Pneumatics** 2 weeks	Unit 4 **Chassis Design/Construction** 5 weeks	Unit 5 **Robot Competition** 5 weeks

Unit 1 – Introduction To Engineering, 1 week top

Standards

Pre-Engineering Technology

ENG.06 Use engineering equipment, laboratory materials and tools appropriately and safely.

ENG.06.01 – ENG.06.06

ENG.07 Identify and demonstrate the use of various software programs used in the engineering field.

ENG.07.01, ENG.07.03 – ENG.07.05

ENG.08 Demonstrate the application of science and math principles to the electrical engineering process.

ENG.08.04 – ENG.08.09

Unit Objectives

Students will be able to:

- recognize related safety procedures and instructions.
- maintain a class journal.
- describe and identify the 6 simple machines and the related math.
- describe how a trebuchet works.

Essential Question

- How is engineering knowledge created and communicated?

Focus Questions

- What are the specific hazards and subsequent safety practices for robotics class and related environments?
- What is an engineering report?
- What defines a "machine"?
- How does a trebuchet work and what factors affect its performance?

Assessments

- Safety quiz
- Identify and explain the 6 simple machines
- Write engineering report for simple problem (lifting a weight with air cylinder)

Skill Objectives

Students will:

- practice safety procedures using lab equipment.
- demonstrate how to write an engineering journal entry.
- solve simple machine-related math problems.

Unit 2 – Trebuchet, 5 weeks top

Standards

Pre-Engineering Technology

ENG.02 Use the design process to solve problems by creating and refining prototypes.

ENG.02.01 - ENG.02.13

Essential Skills and Knowledge

EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

EKS.05.02, EKS.05.03, EKS.05.04, EKS.05.05, EKS.05.06

Manufacturing

MAN.01 Employ engineering design process to achieve desired outcomes

MAN.01.02

Unit Objectives

Students will be able to:

- explain how forces and energy in a trebuchet system are affected by scaling.
- calculate the maximum theoretical range of a trebuchet given the drop height of the counterweight and the masses of the counterweight and projectile.
- calculate the range efficiency of a trebuchet.
- explain and describe the engineering process in writing.
- use the engineering process to invent a device or process to improve the performance of a model trebuchet.
- create an engineering report using collected data and analyze results.

Essential Question

- Why use engineering steps to solve a problem or improve upon an existing design?

Focus Questions

- Why do engineers create simulations?
- How do engineers track performance and results?
- How can computers help predict the performance of a design?
- What is the value of STEM in creating better designs in engineering?

Assessments

- Trebstar software- trebuchet simulation problem
- Engineering Cycle report
- Build Report/Notebook
- Trebuchet Construction Labs
- Trebuchet Testing

Skill Objectives

Students will:

- use the TrebStar computer simulation to design and record the performance of a full sized trebuchet with a uniform beam.
- test and graph the relationship between any of the eight trebuchet independent variables (Parameters) and a dependent variable
- complete an engineering report.
- construct a trebuchet.
- test the performance of trebuchet model.
- redesign trebuchet to improve performance.

Unit 3 – Pneumatics, 2 weeks top

Standards

Essential Skills and Knowledge

EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

EKS.05.02, EKS.05.03, EKS.05.04

Pre-Engineering Technology

ENG.09 Demonstrate the application of science and math principles to the fluids engineering process.

ENG 09.01 – ENG 09.05

Unit Objectives

Students will be able to:

- identify safety issues and follow safety guidelines particular to pneumatics.
- identify common pneumatic components and circuits.
- understand pneumatic powered devices and systems with respect to the velocities and forces they generate.
- perform pneumatic circuit calculations.
- perform basic pneumatic experiments.

Essential Question

- Why do systems and circuits need to be designed, built, and tested?

Focus Questions

- What are the safety concerns and procedures in a lab or factory environment?
- What is a circuit?
- How are pneumatic circuits created?
- How is the performance of a pneumatic circuit predicted?

Assessments

- Tests and Quizzes on Unit subject matter
- Pneumatics Labs

Skill Objectives

Students will:

- describe safe practices to follow when working with and around pneumatic components.
- describe and apply terms including: Regulator, Flow Control Valves, Pneumatic Cylinders, Solenoid Valves, Force, Pressure, Velocity, HRT, Kilogram, Pounds, Newton, Motion, Friction,
- size pneumatic components into circuits.
- estimate and calculate velocities of moving objects.
- assemble a working pneumatic circuit.
- discriminate between speed and velocity.
- measure and calculate speed and velocity.
- evaluate and create speed and time graphs.
- understand and use the technical vocabulary of motion: Position, Vector, Average Velocity, Slope, Instantaneous Velocity, Distance, Speed, Instantaneous Position, Scalar, Speed-Time Graph, Constant Velocity, Velocity, Position-Time graph.
- calculate the Perimeter, Area and Volume of simple objects.

Unit 4 – Chassis Design/Construction, 5 weeks top

Standards

Essential Skills and Knowledge

EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

EKS.05.05, EKS.05.07 , EKS.05.10

Pre-Engineering Technology

ENG.11 Demonstrate the application of science and math principles to the mechanical engineering process.

ENG.11.01 – ENG.11.04

Unit Objectives

Students will be able to:

- use the GEARS-IDS Invention and Design System to participate in the process of engineering design.
- develop and use fabrication skills and fastening systems.
- create and trouble shoot electrical circuits and components.
- create and troubleshoot pneumatic circuits and components.
- describe how electronic controls are used to input signals and control output actions.

Essential Question

- How are engineered systems created and tested in a team environment?

Focus Questions

- What are the important considerations when constructing a gear/chain drive system?
- How do engineers optimize designs like a robot chassis?

Assessments

- Tests and Quizzes on Unit subject matter
- Engineering Cycle chassis report

Skill Objectives

Students will:

- identify, size and assemble chassis components.
- create and interpret plans, diagrams, and working drawings in the construction of a GEARS-IDS prototype mechanism.
- identify, select and use common tools safely and efficiently.
- form, bend, shape, cut and join a variety of materials to improve the quality and performance of the mechanisms.
- measure amperage voltage and current with a multimeter.
- read electrical circuit diagrams and schematic symbols.
- read pneumatic circuit diagrams and schematic symbols.
- use the GEARS-IDS components to build a motor dynamometer.
- determine the motor power and efficiency and use it to analyze the relationship between motor torque and current, as well as voltage and RPM.
- analyze and calculate the mechanical advantage and predict the performance of various drive system ratios and strategies using direct drive, chain and sprocket or 4 wheel pulley drives.
- utilize electronic inputs/outputs for control of robots.

Unit 5 – Robot Competition, 5 weeks top

Standards

Essential Skills and Knowledge

EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

EKS.05.02 - EKS.05.11

Computer Aided Drafting and Design

CADD.07 Create assemblies and views in 3-D format.

CADD.07.01, CADD.07.02

Pre-Engineering Technology

ENG.02 Use the design process to solve problems by creating and refining prototypes.

ENG.02.01 - ENG.02.13

Unit Objectives

Students will be able to:

- engage in contextual learning opportunities involving an engineering challenge.
- employ critical thinking skills independently and in teams to solve problems and make decisions.
- demonstrate knowledge of pictorial and multi-view drawings, dimensioning and symbols and CADD techniques using 3D solid models and parametric modeling techniques.
- develop an engineering challenge or competitive game and design and construct a machine to play the game.
- use computer graphic, word processing and multimedia tools to document and present the engineering processes, and strategies used in the creation of a solution to an engineering challenge.
- optimize robot design using Engineering cycle.

Essential Question

- What purpose does competition play in improving engineering outcomes?

Focus Questions

- What roles need to be filled in robot competition team environment?
- What lab/shop/factory procedures keep the environment clean and organized?

Assessments

- CAD design
- Engineering of competition robot/ quality of build
- Performance in competition
- Teamwork
- Build Report/Notebook

Skill Objectives

Students will:

- organize into teams, delegate tasks, communicate to the group (act as an effective team member).
- engage in the engineering design process.
- design a specialized robot using CADD.
- assemble competition robot using Gears Kit components.
- analyze, correct and improve the performance of a competitive machine.
- maintain a notebook detailing the chronology of the design, fabrication and game playing strategies used.
- disassemble all robot components and organize all parts.
- complete a final engineering report.