Grades 10-12 Principles of Engineering, Quarter 3, Revised 2015-16

**Big Ideas/Key Concepts:** In this unit, students will explore mechanical process control using computer software and hardware. They will also use pneumatic and hydraulic power components related to the manipulation of work and power. The final project in this quarter will be the design problem related to control systems.

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<tr>
<th>Standards</th>
<th>Student Friendly “I Can” Statements</th>
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<tbody>
<tr>
<td>The following standards are addressed in this unit.</td>
<td>Unit 3.1 - Machine Control – 16 Days</td>
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<tr>
<td><strong>Math Standards (will shift to common core at the end of 12-13 SY)</strong></td>
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<td><strong>Number Operations:</strong> understand numbers, ways of representing numbers, relationships among numbers, and number systems; understand meanings of operations and how they relate to one another; and compute fluently and make reasonable estimates.</td>
<td>I can create detailed flow charts that utilize a computer software application.</td>
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<td><strong>Measurement:</strong> understand measurable attributes of objects and the units, systems, and processes of measurement; and apply appropriate techniques, tools, and formulas to determine measurements.</td>
<td>I can create control system operating programs that utilize computer software.</td>
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<td><strong>Problem Solving:</strong> build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; monitor and reflect on the process of mathematical problem solving.</td>
<td>I can create system control programs that utilize flowchart logic.</td>
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<td><strong>Communication</strong> – organize and consolidate thinking through communication, communicate students mathematical thinking clearly to peers, teachers, and others, analyze and evaluate the mathematical thinking and strategies of others, and use the language of math to express mathematical ideas precisely.</td>
<td>I can choose appropriate input and output devices based on the need of a technological system.</td>
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<td>I can differentiate between the characteristics of digital and analog devices.</td>
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<td>I can judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.</td>
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<td></td>
<td>I can design and create a control system based on given needs and constraints.</td>
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**Connections**: recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; recognize and apply mathematics in contexts outside of mathematics.

**Representation**: Create and use representations to organize, and communicate mathematical ideas, select, apply, and translate among mathematical representations to solve problems.

**National Science Education Standards**

**Unifying Concepts and Processes:**
- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and Equilibrium
- Form and function

**Standard A: Science as an Inquiry** –
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry.

**Standard B: Physical Science**
- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter

**Science and Technology Standard E** –
- Abilities of technological design
- Understanding about science and technology

**Standard G: History and Nature of Science**
- Historical perspectives

### Unit 3.2 – Fluid Power – 15 Days

- I can identify devices that utilize fluid power.
- I can identify and explain basic components and functions of fluid power devices.
- I can differentiate between the characteristics of pneumatic and hydraulic systems.
- I can distinguish between hydrodynamic and hydrostatic systems.
- I can design, create, and test a hydraulic device.
- I can design, create, and test a pneumatic device.
- I can calculate values in a fluid power system utilizing Pascal’s Law.
- I can distinguish between pressure and absolute pressure.
- I can distinguish between temperature and absolute temperature.
- I can calculate values in a pneumatic system utilizing the perfect gas laws.
- I can calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.

**English Language Arts Standards**

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- I can calculate values in a pneumatic system utilizing the perfect gas laws.
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**Standard 4:** Students adjust their use of spoken, written, and visual language (e.g. conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

**Standard 5:** Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate.

**Standard 8:** Students use a variety of technological and information resources (e.g. libraries, data bases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**Standard 12:** Students use spoken, written and visual language to accomplish their own purposes.

**Standards for Technology Literacy**

**Standard 1:** Students will develop an understanding of the characteristics and scope of technology. (J, L)

**Standard 2:** Students will develop an understanding of the core concepts of technology. (W, X, Y, Z, AA, BB, CC, AF)

**Standard 3:** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study (G)

**Standard 4:** Students will develop an understanding of the cultural, social, economic, and political effects of technology. (I, J)

**Standard 8:** Students will develop an understanding of the attributes of design. (H, J, K)

**Unit 3.3 – Design Problem – Control Systems – 15 Days**

- I can brainstorm and sketch possible solutions to an existing design problem.
- I can create a decision-making matrix for their design problem.
- I can select an approach that meets or satisfies the constraints provided in a design brief.
- I can create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team’s decision matrix.
- I can present a workable solution to the design problem.
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<tr>
<th>Standard 9: Students will develop an understanding of engineering design. (I, J, K, L)</th>
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<tr>
<td><strong>Standard 10:</strong> Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. (J)</td>
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<td><strong>Standard 11:</strong> Students will develop the abilities to apply the design process. (M, N, O, P, Q, R)</td>
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<td><strong>Standard 12:</strong> Students will develop the abilities to use and maintain technological products and systems. (L, M, N, O, P)</td>
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<td><strong>Standard 17:</strong> Students will develop an understanding of and be able to select and use information and communication technologies. (L, M, P, Q)</td>
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