DESIGN APPLICATIONS IN ENGINEERING AND TECHNOLOGY EDUCATION II

Curriculum Content Frameworks

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DESIGN APPLICATIONS II

Grade Levels: 8-9

Prerequisites: Prerequisites: Introduction and Fundamentals of Engineering and Technology Education and Design Applications I

Course Code:

Course Description: Course Description: This 18 week course is designed to provide 8th and 9th grade students with a more in-depth look at the application of engineering and technology in the fields of energy, power, and transportation and manufacturing technologues. Students will also further their understanding of technology and the use of the engineering design loop to solve technological problems. Emphasis will be placed on the further exploration and application of engineering and technology through experiments and design projects.

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Unit 1: Design Applications of Energy, Power, and Transportation Technologies
Hours: 45

Terminology: alternating current, direct current, electromagnet, magnetism, electron flow, conductor, insulator, solder, resistor, voltage, generator, motor, distribution system, circuit, wiring schematic, multimeter.

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
1.1 Undertstand basic alternating curreent (AC) and direct current (DC) electric principles, concepts, and systems	1.1.1 Participate in readings and discussions of basic electrical and electronic principles, systems, and concepts.	Foundation	Listening	Comprehends ideas and concepts related to energy and power technologies [1.2.1]
			Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
	1.1.2 Diagram how electricity is generated, transmitted, and delivered to the electrical circuit in their home.	Thinking Skills	Reasoning	Comprehends ideas and concepts related to energy and power [4.5.2]
3.2 Understand how AC and DC electricity is generated, distributed, and consumed through circuitry.	3.2.1 Use basic hand tools to wire and solder simple AC and DC wiring circuits	Foundation	Listening	Comprehends ideas and concepts related to the planning process in energy and power technologies [1.2.1]
	3.2.2 Demonstrate the use of a multimeter and various other electrical measuring devices.	Thinking Skills	Reasoning	Comprehends ideas and concepts related to the planning process in energy and power technologies [4.5.2]
3.3 Understand how basic circuitry is represented on paper.	3.3.1 Create a pictoral sketch, a schematic drawing, and a materials list for a DC electric motor.	Foundation	Math	Draws to scale [1.1.20]
			Science	Determines quantities/measurements in English and metric units [1.4.14]
		Thinking	Seeing Things in the Mind's Eye	Visualizes a finished product [4.6.4]
				Applies rules and principles to a new situation [4.5.1]
3.4 Understand how DC motors and generators are constructed and how they operate.	3.3.1 Design, construct, and test a DC electric motor that is capable of transferring mechnical power for a given task	Foundation	Math	Draws to scale [1.1.20]
			Science	Reads measurements from common measuring devices [1.4.20]
				Constructs model to depict basic concept of energy and powersystems [1.4.11]
		Thinking Skills	Creative Thinking	Creates new design by applying specified criteria [4.1.3]

Unit 2: Design Applications of Manufacturing Technologies
Hours: 45

Terminology: assembly line, quality control, jigs, fixtures, engineering design process, decision matrix, constraints, tolerances, CAD, coordinate systems, pictorial drawings, bill of materials

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
2.1 Understand the components of modern manufacturing systems	2.1.1 Participate in discussions and readings concerning modern manufacturing systems	Foundation	Listening	Comprehends ideas and concepts related to the components of modern manufacturing systems[1.2.1]
	2.1.2 Recognize how technologies can be broken into systems in order to effectively understand their purpose, operation, and maintenance	Thinking Skills	Reasoning	Comprehends ideas and concepts related to systems thinking [4.5.2]
2.2 Describe the need for mass production of goods in a global society	2.2.1 Identify the origin and lifecycle of daily household goods	Foundation	Listening	Comprehends ideas and concepts related to product life cycle [1.2.1]
	2.2.2 Research ways that quality goods are manufactured at low prices	Thinking Skills	Reasoning	
	2.2.3 Create and analyze how sequential instructions can be used to make an everyday process or task more efficient			
2.3 Recognize the importance of planning and communication during the process of product design	2.3.1 Create pictorial sketches of geometric shapes	Foundation	Math	Constructs geometric figures [1.1.15] Uses basic geometric symbols, terms, principles, and formulas [1.1.34]
	2.3.2 Apply concepts of measurement to product design	Thinking Skills	Seeing Things in the Mind's Eye	Visualizes a finished product [4.6.4}
	2.3.3 Use the concepts of the engineering design process to innovate an everyday product			
2.4 Identify the need for criteria and constraints within the designed world	2.4.1 Identify the constraints and limitations of an engineering design problem	Foundation	Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
	2.4.2 Analyze and solve an engineering design problem through systematic analysis	Thinking Skills	Reasoning	Uses logic to draw conclusions from available information [4.5.6]

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do				ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge		**Application**		**Skill Group**	**Skill**	**Description**
2.5	Define the materials and processes used in the manufacturing enterprise	2.5.1	Identify and categorize resources into people, materials, tools, processes, engergy, and information	Foundation	Writing	Organizes information into an appropriate format [1.6.10]
					Speaking	Communicates a thought, idea, or fact in spoken form [1.5.5]
		2.5.2	Apply the appropriate materials and processes to the design of a product	Thinking Skills	Creative Thinking	Combines ideas or information in a new way [4.1.2]
2.6	Identify, design, and produce a product to serve a need in the community	2.6.1	Identify a need for a product within the community	Foundation	Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
					Science	Records data related to global information systems [1.4.21]
		2.6.2	Design, produce, and market a manufacturing project	Thinking Skills	Reasoning	Uses logic to draw conclusions from available information [4.5.6]

Unit 3: Design Applications: Safety
Hours: As needed

Terminology: Safety procedure, OSHA, ergonomics, first aid, hazard avoidance, protective clothing, personal protection equipment, accident prevention, safety tests, materials safety

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
3.1 Describe the need for safe work environments in the Engineering and Technology Educational classroom and laboratory	3.1.1 Maintain personal safety, workplace safety, hazard avoidance, safety information systems, protective clothing, fall protection, first aid, ergonomics, and environmental safety 3.1.2 Explore implemented safety procedures and discuss classroom and laboratory safety	Thinking Personal Management	Seeing Things in the Mind's Eye Knowing how to Learn Creative Thinking Responsibility	Imagines the flow of work activities from narrative descriptions [4.6.1] Applies new knowledge and skills to safety [4.3.1] Makes connections between seemingly unrelated ideas [4.1.6] Pays close attention to details [3.4.8]
3.2 Describe specific procedures such as reporting illness, injuries, safety violations, etc.	3.2.1 Demonstrate understanding of specific work procedures such as reporting illness, injuries, safety violations, etc.	Foundation	Listening	Listens and follows directions [1.2.6]
3.3 Use appropriate and required personal protection equipment (eye protection, ear protection, etc.)	3.3.1 Practice using appropriate and required personal protection equipment (eye protection, ear protection, etc.)	Thinking	Problem Solving	Devises and implements a plan of action to resolve a problem [4.4.3]
3.4 Describe machine and tool safety practices and procedures	3.4.1 Demonstrate the ability to safely use common tools and machines found in given industrial settings 3.4.2 Demonstrate the ability to pass given safety tests that show evidence of personal safety competence on given tools and machinery 3.4.3 Participate in a discussion concerning securing machinery, securing guards and safety devices, slipping hazards, eye and ear protection, adequate space around machinery, machine vibration, hand feeding and retrieval tools, power transmission parts, blade and cutter safety, worker position safety, safe	Thinking Skills Foundation Skills	Decision Making Reading Science Speaking	Demonstrates decision-making skills [4.2.4] Comprehends written specifications and applies them to a task [1.3.9] Reads and follows instructions to operate technical equipment [1.3.19] Uses standard occupational resource materials [1.3.22] Follows safety guidelines [1.4.15] Participates in conversation, discussion, and group presentations [1.5.8]

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
	procedures for adjusting or repairing machinery, shear points, falling objects, flying objects, rotating parts, moving surfaces, etc.	Thinking Skills	Problem Solving	Comprehends ideas and concepts related to machine and tool safety [4.4.1]
	3.4.4 Design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc			
	3.4.5 Operate tools and equipment in a safe and hazard free manner to the satisfaction of the course instructor			

Glossary
Unit 1: Design Applications of Energy, Power, and Transportation Technologies

1. Alternating current: or AC, the movement of electric charge periodically reverses direction. In direct current (DC, also dc), the flow of electric charge is only in one direction. AC is the form in which electric power is delivered to businesses and residences

2. Direct current: or DC, is the unidirectional flow of electric charge. Direct current is produced by sources such as batteries, thermocouples, solar cells, and commutator-type electric machines of the dynamo type. The electric charge flows in a constant direction, distinguishing it from alternating current (AC)

3. Electromagnet: is a type of magnet in which the magnetic field is produced by the flow of electric current. The magnetic field disappears when the current is turned off. Electromagnets are widely used as components of other electrical devices, such as motors, generators, relays, and loudspeakers

4. Magnetism: a property of materials that respond to an applied magnetic field

5. Electron Flow: the flow of electric charge through a medium. This charge is typically carried by moving electrons in a conductor such as wire

6. Conductor: a material or object that permits electrical current to flow through

7. Insulator: a material or object that is a poor conductor of electricity

8. Solder: is a fusible metal alloy used to join together metal workpieces and having a melting point below that of the workpiece(s)

9. Resistor: a component of an electrical circuit that resists the flow of electrical current. A resistor has two terminals across which electricity must pass, and is designed to drop the voltage of the current as it flows from one terminal to the next. A resistor is primarily used to create and maintain a known safe current within an electrical component

10. Voltage: a measurement of the energy contained within an electric circuit

11. Generator: a device that converts mechanical energy to electrical energy

12. Motor: an electromechanical device that converts electrical energy into mechanical energy

13. Distribution system: carries electricity from the transmission system and delivers it to consumers

14. Circuit: a path in which current or voltage can flow

15. Wiring schematic: represents the elements of an electrical system using abstract, graphic symbols rather than realistic pictures

16. Multimeter: A peice of test equipment used for measuring voltage, current, resistance, and possibly other electircal quantities

Unit 2: Design Applications of Manufacturing Technologies

1. Assembly line: a manufacturing process in which parts are added to a product in a specific sequence to create a finished product faster and more efficiently. Sometimes refered to as progressive assembly.

2. Quality control: or QC, is the process in which the quality of all factors within a production line are inspected to uncover defects before being sold into an external market.

3. Jigs: a type of tool used to control the location or motion of another tool. The primary purpose of a jig is to provide repeatability, accuracy, and interchangeability during the manufacturing process.

4. Fixtures: a holding or support device used in manufacturing. The primary purpose of a fixture is to locate or hold a workpiece during a machining operation or industrial process.

5. Engineering design process: a systematic problem-solving strategy, with criteria and constraints, used to develop many possible solutions to solve a problem or satisfy human needs and wants and to narrow down the possible solutions to one final choice

6. Decision matrix: a list of values in rows and columns that allows an analyst to systematically identify, analyze, and rate the performance of relationships between sets of values and information. Elements of a decision matrix show decisions based on certain decision criteria. The matrix is useful for looking at large masses of decision factors and assessing each factor's relative significance.

7. Constraints: a limit to the design process. Examples of constraints are: appearance, funding, space, materials, human capabilities, etc.

9. Tolerances: the permissible limit or limits of variation in the physical properties of a material or manfactured object.

10. CAD: Computer-Aided Drafting and Design (CAD/CADD) - a type of design using computers to create and store technical drawings

11. Coordinate system: an arrangement of lines used to identify points in space. Points are designated by their distance along a horizontal (x) and vertical (y) axis from a reference point, the origin, designated (0, 0). A third dimension is added along a (z) axis.

12. Pictorial drawing: provide a 3D image to help understand the drawing. The 3 most common types of pictorial drawings are oblique, isometric, and perspective.

14. Bill of materials: is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, components, parts and the quantities of each needed to manufacture an end product.

Unit 3: Safety

1. Safety procedures: Proper usage techniques for a given piece of equipment or tool
2. OSHA: Occupational Safety and Health Administration. A division of the Department of Labor that sets and enforces occupational health and safety rules
3. Ergonomics: The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort
4. First Aid: Emergency aid or treatment given to someone injured, suddenly ill, etc., before regular medical services arrive or can be reached
5. Hazard Avoidance: Systems designed to plan ahead and prevent dangerous workplace situation before they occur
6. Protective Clothing: Clothing aimed at protecting the skin from various health hazards that may be encountered in the workplace
7. Personal Protection Equipment: Includes equipment like safety glasses, gloves, hearing protection, etc. designed to protect the worker in hazardous areas
8. Accident Prevention: The practice of developing practices and habits that prevent accidents before the occur
9. Safety Test: A test designed to prove that a student has the appropriate skills and knowledge to safely operate a given tool or machine
10. Materials Safety: The act of using materials and resources in a safe and environmentally friendly manner