

## Agricultural Power and Technology Detailed Course Outline

### Unit 1 Introduction to Agricultural Power and Technology

#### Lesson 1.1 Mechanical World

1. Organization and record keeping are important to success in agricultural mechanics.
  - Develop and keep an Agriscience Notebook to record and store information.
2. The agricultural industry uses power and technology to produce food, fiber, and fuel that are essential for everyday life.
  - Research systems in power and technology and explain how they are applied in agriculture.
3. Power and technology increase the efficiency of agriculture, food, and natural resource production.
  - Calculate and compare the efficiency of different tools.
4. People in agricultural power and technology use the engineering design process to increase agricultural productivity and solve problems.
  - Identify how an entrepreneur in agricultural mechanics used the engineering process to improve production of food, fiber, and fuel.
  - Design a prototype using the engineering design process to solve a problem.

#### Lesson 1.2 Mechanical Basics

1. Many forms of potential and kinetic energy are used in agriculture to complete tasks or work.
  - Identify types of energy used and managed in agriculture.
2. Machines in agriculture are designed to harness energy to perform work.
  - Make a windmill to convert wind energy into mechanical energy.
3. Work and power calculations are used to determine efficiencies in agricultural systems.
  - Calculate the work completed by a machine.
  - Calculate and compare power in English and SI units
4. Communication and writing skills complement the operation of mechanical equipment used in agricultural power and technology careers.
  - Develop a technical manual for machines that use different forms of energy.

### Unit 2 Safety and Measurement

#### Lesson 2.1 Safety Setting

1. Site-specific safety policies and procedures are in place for agricultural mechanic shops and labs.
  - Identify workplace hazards and the causes for accidents.
  - Develop a standard set of safety requirements for an agricultural shop.
2. Safety must be planned and systematic for effective identification and management in a laboratory or shop.
  - Assess a shop to determine if safety standards are being met and make recommendations for changes.
3. Personal protective equipment is the last line of defense against injury.
  - Identify types of PPE and their uses in the shop.

4. The purpose of first aid is to treat injuries or accidents in order to sustain life until professional medical attention can be received.
  - Prepare an emergency first aid booklet.

### **Lesson 2.2 Tool Operation**

1. Tools are designed for specific applications.
  - Select correct hand tools for a specific job.
2. The function of tools and machines will affect how they are operated.
  - Identify the components of a power tool and determine any hazards present by using a safety evaluation form.
3. Operating procedures for machines and tools keep the operator safe and the machine or tool in good working order.
  - Write an operating procedure for using a power tool safely.

### **Lesson 2.3 Tools of Measurement**

1. Precise and accurate measurements are important for fabrication of materials.
  - Compare precise and accurate measurements using a combination square and caliper.
2. Measurements are expressed in different forms and units.
  - Measure the size of materials and convert the measurements to fractions or decimals.
3. Estimation is used for completing a project or activity.
  - Use pacing to estimate the distance between two points.
4. The Pythagorean Theorem can be used to determine if a corner is square.
  - Use the Pythagorean Theorem to determine if an area is square and square a corner using a 3-4-5 triangle.
5. Areas are calculated using mathematical formulas.
  - Use mathematical formulas to measure an area of land.

## **Unit 3 Material Properties**

### **Lesson 3.1 Heavy Metal**

1. Metals used in agriculture can be identified using physical properties.
  - Identify metals based upon their physical properties.
2. Chemical properties of metal will determine how it reacts with other metals in the environment.
  - Explain how metals chemically react in certain environmental conditions.
  - Explain how metals react with each other.
3. Mechanical properties of metal will determine its service life and applications.
  - Compare and contrast tensile strength, ductility, brittleness, and hardness of common metals used in agriculture.
4. Metals will physically change based upon environmental factors.
  - Measure the thermal conductivity and thermal expansion of different metals.
  - Treat metal with heat and compare the physical changes.

### **Lesson 3.2 Woods and Plastics**

1. Wood is selected based upon their physical and mechanical properties.
  - Determine the relationship between density and tensile strength of species of wood.

2. Environmental factors determine the type of wood used for a project.
  - Test the effect moisture has on the dimensional stability of different wood species.
3. Plastics used in agriculture are designed for a specific purpose.
  - Identify different types of plastics and their uses.
4. The chemical makeup of plastics will determine their mechanical properties.
  - Make plastics with varying mechanical properties.

### **Lesson 3.3 Fluid Material**

1. Fluids cool and lubricate agricultural machines and equipment.
  - Determine how lubrication can reduce the friction produced in a machine.
2. Solutions need to be mixed with the correct proportions to function correctly.
  - Prepare solutions of water and antifreeze and compare their physical properties.
3. Temperature can change the physical properties of fluids.
  - Calculate the viscosity of different oils at varying temperatures.
4. Machines use gases, such as air, to produce power.
  - Observe and demonstrate the relationship between airflow and air pressure.
  - Construct a windmill using Bernoulli's Principle as a basis for design.

### **Lesson 3.4 Material Management**

1. Water and land are material that are mechanically managed and conserved.
  - Measure the relationship between slope and velocity of water and observe management techniques to control erosion on sloped land.
2. Slope has an impact on the mechanics and design of materials.
  - Calculate the slope of land between two points using surveying equipment.
3. The strength of concrete is dependent upon proper mixing and curing of materials.
  - Mix concrete and observe the chemical and physical changes.
  - Test the compression strength of different mixtures of concrete.
4. Volume calculations and proportions are used for properly mixing concrete.
  - Complete mathematical calculations to mix concrete using proportions and volume calculations.

## **Unit 4 Fabrication**

### **Lesson 4.1 Making a Plan**

1. Accurate plans and scaled drawings are essential for project success.
  - Draw a floor plan of a shop to scale.
  - Draw isometric and orthographic depictions of three-dimensional objects.
2. A bill of materials accounts for all items needed to complete a project and assists in determining the budget.
  - Complete a bill of materials for the construction of a plant stand.

### **Lesson 4.2 Making the Cut**

1. A variety of tools are used to process bulk materials into useable parts.
  - Identify different types of cutting tools and blades.
  - Fabricate a nut and bolt with a tap and die.
2. Proper measurements and efficient use of materials are essential when manufacturing useable parts.

- Demonstrate how the kerf must be considered when cutting material.
3. Quality products are produced by following procedural steps.
    - Write a prescribed procedure to cut pieces of metal.

### **Lesson 4.3 Fasten and Fuse**

1. Torque is a factor considered when fastening material together.
  - Observe the effect of torque on fastener performance.
2. Fasteners are selected based upon strength and durability when joining machine and structural parts.
  - Test the strength and durability of different fasteners and determine where they should be used.
3. A variety of welding processes are used to fuse metal.
  - Research and present basic techniques for different welding processes.
4. Metals are welded together for a strong fit using a combination of materials.
  - Identify materials used to weld metal together.
  - Design a welding electrode for a specific job.
5. Fabrication involves forming and fastening multiple types of materials together to make a useable product.
  - Fabricate a doorstop using concrete, metal, and wood.

## **Unit 5 Energy**

### **Lesson 5.1 Chemical Energy**

1. Chemical reactions release and absorb thermal energy.
  - Make a hand warmer using elements that chemically react.
2. Electrical energy can be harnessed and transferred through chemical reactions.
  - Design and test a wet cell battery to power an electric motor.
3. Chemical energy can be converted into mechanical movement.
  - Make a steam engine that propels a boat and explain the transfer of energy.
4. Agriculture is a producer of renewable forms of fuel.
  - Make ethanol from agricultural products.
5. Fossil and bio-fuels release energy and chemical bi-products when they combust.
  - Model the combustion of hydrocarbons and ethanol.
6. Many factors influence the choice of an energy source.
  - Compare the advantages and disadvantages of renewable and nonrenewable fuels.
  - Measure the energy output of renewable and nonrenewable fuels.

### **Lesson 5.2 Electrical Energy**

1. Electricity must flow in a complete loop from the source and to the source with no breaks for a circuit to operate correctly.
  - Build a complete electrical circuit.
  - Define an open and closed circuit.
2. The relationship between amps, volts, and ohms can be defined using Ohm's Law.
  - Calculate amps, volts, and ohms in a circuit using Ohm's Law.
3. Two types of electrical circuits used in agriculture are series and parallel.
  - Construct a parallel and series circuit.

4. The use of electricity requires a knowledge and understanding of relationships between voltage, current, and resistance.
  - Demonstrate how a resistor affects the electrical current in circuit.
5. Circuits are designed to provide electrical power for a specific job or application.
  - Design, construct, and test an electrical circuit that meets certain specifications.

### **Lesson 5.3 Mechanical Energy**

1. Electromagnetic fields are a source of mechanical energy used to produce rotational movement.
  - Construct an electric motor and identify the parts and their functions.
2. Mechanical energy can be converted into electrical power.
  - Generate electrical energy with a windmill and optimize the power produced.
3. The force produced in a fluid power system is measured using Pascal's Law.
  - Calculate the force of fluids under pressure.
4. Controlled movements of fluids under pressure produce mechanical energy.
  - Construct a hydraulic lift that can perform a specified amount of work.

## **Unit 6 Machines and Structures**

### **Lesson 6.1 Machine Design**

1. Agricultural machines consist of one or more simple machines that produce linear and/or rotational movement.
  - Identify the simple machines and types of motions found in agricultural equipment.
2. Simple machines provide a mechanical advantage.
  - Measure the mechanical advantage of different classes of levers and identify where levers are used in agriculture.
3. The amount of work to operate a machine will be greater than the work done by the machine.
  - Calculate the efficiency of work completed by a pulley system to lift an object.
4. The power and speed of a machine is dependent upon proper design.
  - Use ratios to calculate the speed and torque of multiple systems of gears.

### **Lesson 6.2 Machine Management**

1. Technical reading involves interpreting and applying information from manuals, schematics, diagnostic tools, and measuring tools.
  - Read and interpret an operation manual.
2. Preventive maintenance requires a systematic periodic schedule.
  - Use a technical manual to develop a maintenance schedule for a small engine.
3. Troubleshooting includes identifying the problem, researching solutions, and applying the possible solutions.
  - Develop a flow chart for solving a problem for a machine and use the chart for troubleshooting.
4. Machines are calibrated to perform a specified task.
  - Calibrate a water pump to perform a task at a specific rate.
  - Design a model of a windmill that produces electricity used to pump water at a specified rate.

### **Lesson 6.3 Structural Design**

1. Requirements of a project need to abide by code, laws, or rules governing such project.

- Identify codes and laws for constructing an agricultural structure.
- 2. Structures provide a controlled environment to protect agricultural commodities and equipment.
  - Measure and compare the insulation properties of building materials.
- 3. Agricultural structures contain joints and assemblies that withstand multiple types of forces.
  - Construct and test truss designs for strength.
- 4. Agricultural structures need to be well planned, to meet a specific need or purpose.
  - Develop a plan for constructing an agricultural building.

## **Unit 7 Mechanical Applications**

### **Lesson 7.1 Mechanical Applications**

1. Communication and writing skills complement the operation of mechanical equipment used in agricultural power and technology careers.
  - Complete a final draft of a technical manual for chosen tools and share the operational information about the tools with the class.
2. Careers in agricultural mechanics require the application of technical skill combined with material knowledge.
  - Students will identify technical skills, careers, and knowledge needed in mechanical systems.
3. Agricultural mechanics design and calibrate equipment to produce food, fiber, and fuel.
  - Design a planter that meets the needs of a specific crop.