North Dakota Agriculture Education

POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

1 **Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.** 10.1

1 Identify renewable and nonrenewable energy sources used in AFNR. 10.1.1

2 Compare and contrast the distribution methods for renewable and nonrenewable energy sources in an AFNR enterprise or business. 10.1.2

3 Summarize methods used to benchmark energy use of AFNR structures (e.g., EUIs, Btus, etc.). 10.1.3

4 Assess the environmental impacts of renewable and nonrenewable energy sources used in AFNR. 10.1.4

5 Calculate the costs of using renewable and nonrenewable energy sources in an AFNR enterprise or business. 10.1.5

6 Convert energy utilized in an AFNR structure to an energy utilization index (e.g., convert cubic feet CF, Kilowatt Hours kWh, etc. to British Thermal Units Btu consumption per square foot, etc.). 10.1.6

7 Evaluate the efficiency of renewable and nonrenewable energy sources used in AFNR. 10.1.7

8 Devise a plan to incorporate the use of selected energy sources in an ANFR enterprise or business. 10.1.8

9 Evaluate data to select methods to conserve energy in AFNR structures. 10.1.9

2 **Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.** 10.2

1 Compare and contrast applications of simple machines in AFNR related mechanical systems. 10.2.1

2 Identify the tools, machines, and equipment needed to construct, fabricate, and/or repair projects in AFNR. 10.2.2

3 Identify the types of safety hazards associated with different mechanical systems used in AFNR using appropriate sources (e.g., owner's manuals, Safety Data Sheet (SDS), chemical labels, pesticide labels, safety color codes, etc.). 10.2.3

4 Perform mathematical calculations to determine the mechanical advantage of simple machines in AFNR related mechanical systems. 10.2.4

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5 Calculate the maintenance and purchase cost of tools, machines, and equipment used in AFNR. 10.2.5

6 Demonstrate the proper selection, maintenance, and use of tools (including measuring tape), machines, and equipment. 10.2.6

7 Design a plan to improve the efficiency of operation of AFNR related mechanical systems. 10.2.7

8 Design a process to implement the safe use of AFNR related tools, machinery, and equipment. 10.2.8

9 Develop a safety plan for different AFNR related mechanical systems ensuring compliance with industry standards. 10.2.9

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3 Apply physical science and engineering principles to metal fabrication using a variety of welding and cutting processes and equipment (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.). 10.3

1 Compare and contrast the principles and procedures of different welding and cutting processes and equipment (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.). 10.3.1

2 Compare and contrast the properties of different metals used in AFNR power, structural, and technical systems (e.g., malleability, conductivity, visual properties, chemical composition, etc.). 10.3.2

3 Identify standard welding symbols, specifications, joint configurations, and dimensional callouts used in welding blueprints. 10.3.3

4 Determine the best welding and/or cutting process to be used in metal fabrication. 10.3.4

5 Select the correct consumables (e.g., electrode, welding wire, gas, etc.) and settings (e.g., amperage, wire feed speed, flow rate, etc.) for use in various welding processes. 10.3.5

6 Evaluate and identify weld defects and discontinuities. 10.3.6

7 Evaluate the quality of metal fabrication procedures (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.). 10.3.7

8 Construct and/or repair structures and/or equipment safely using metal fabrication procedures. 10.3.8

9 Recommend solutions to minimize and/or eliminate defects and discontinuities. 10.3.9

Operate and maintain AFNR mechanical equipment and power systems.

4 Perform preventative maintenance and scheduled service to maintain equipment, machinery, and power units used in AFNR settings. 10.4

1 Identify the importance of cleanliness and appearance of equipment, machinery, and power units used in AFNR power, structural and technical systems to ensure proper functionality. 10.4.1

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Identify procedures for servicing mechanical systems and maintaining fluid levels on equipment, machinery, and power units. 10.4.2

3 Perform preventative maintenance for equipment, machinery, and power units used in AFNR power, structural and technical systems. 10.4.3

4 Perform service procedures for mechanical systems on equipment, machinery, and power units in accordance with manufacturer's manuals. 10.4.4

5 Design a plan to communicate processes and procedures (e.g., lockout/tagout (LOTO), safety harnesses, etc.) for, preventative maintenance and service schedule for equipment, machinery, and power units used in AFNR power, structural and technical systems. 10.4.5

6 Assess equipment according to service specifications. (e.g., belts and drives, chains, sprockets, hoses, lines, nozzles, etc.). 10.4.6

5 Operate machinery and equipment while observing all safety precautions in AFNR settings. 10.5

1 Summarize the safe use of equipment, machinery, and power units. 10.5.1

2 Identify safety hazards associated with equipment, machinery and power units used in AFNR power, structural, and technical systems (e.g., caution, warning, danger, etc.). 10.5.2

3 Perform pre-operation inspections, start-up, and shut-down procedures on equipment, machinery and power units as specified in manufacturer's manuals. 10.5.3

4 Operate equipment, machinery, and power units using safety principles and practices. 10.5.4

5 Analyze the efficiency of equipment, machinery, and power units (e.g., theoretical field capacity, actual field capacity, return on investment, etc.). 10.5.5

6 Adjust equipment, machinery, and power units for safe and efficient operation. 10.5.6

Service and repair AFNR mechanical equipment and power systems.

6 Troubleshoot, service, and repair components of internal combustion engines using manufacturers' guidelines. 10.6

1 Identify components of internal combustion engines. 10.6.1

2 Describe the characteristics of internal combustion engines. 10.6.2

3 Demonstrate how the components of internal combustion engines work together during operation. 10.6.3

4 Determine service and repair needs of internal combustion engines using technical manuals and diagnostic tools. 10.6.4

5 Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.). 10.6.5

6 Repair internal combustion engines. 10.6.6

7 Service electrical systems and components of mechanical equipment and power ystems using a variety of troubleshooting and/or diagnostic methods. 10.7

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1 Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm's Law, Power Law, etc.). 10.7.1

2 Contrast the characteristics of electronic components (e.g., battery, resistor, diode, transistor, capacitor, etc.). 10.7.2

3 Classify the uses of electrical sensors and controls. 10.7.3

4 Perform the measurements of the basic units of electrical circuits (e.g., motors, controls, lighting, etc.) with the appropriate tools. 10.7.4

5 Utilize electrical systems, symbols, and diagrams. 10.7.5

6 Select materials and tools used in electrical control circuit installation. 10.7.6

7 Design electrical circuits using knowledge of the basic units of electricity and code. 10.7.7

8 Evaluate malfunctioning electrical components and systems using testing procedures and equipment service/technical manuals. 10.7.8

9 Build electrical control circuits to ensure proper operation. 10.7.9

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8 Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems (e.g., hydraulic, pneumatic, transmission, steering, powertrain, suspension, etc.). 10.8

1 Summarize the applications of common types of hydraulic and pneumatic systems. 10.8.1

2 Compare and contrast operation principles and features of mechanical transmission systems (e.g., belts, chains, gears, bearings, seals, universals, drive shafts, etc.). 10.8.2

3 Identify the components of suspension, braking, and steering systems. 10.8.3

4 Distinguish between different hydraulic and pneumatic system symbols and diagrams. 10.8.4

5 Calculate efficiency in power transmission systems using speed, torque, and power measurements. 10.8.5

6 Analyze vehicle and machinery performance related to suspension, braking, and steering systems. 10.8.6

7 Recommend repairs to hydraulic and pneumatic system components. 10.8.7

8 Recommend repairs to the components of power transmission systems. 10.8.8

9 Recommend repairs to vehicle suspension, braking, and steering systems. 10.8.9

Plan, build and maintain AFNR structures.

9 Create plans for AFNR structures. 10.9

1 Explain the meaning of symbols used in plans and designs of agricultural structures. 10.9.1

Interpret the parts and/or views of plans for agricultural structures. 10.9.2

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3 Apply scale measurement and dimension to develop plans of agricultural structures. 10.9.3

4 Construct plans for agricultural structures using current technology (e.g., drafting software, computer-aided design, etc.). 10.9.4

5 Create designs, plans, and related bill of materials for an agricultural structure using the design process. 10.9.5

6 Design functional and efficient facilities. 10.9.6

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10 Determine structural requirements, specifications, customer needs, and estimate costs for AFNR structures. 10.10

1 Summarize the information needed to complete a bill of materials for an AFNR structure. 10.10.1

2 Identify sources of construction and materials standards and their importance (e.g., American National Standards Institute, ANSI, Underwriters' Laboratories, UL, etc.). 10.10.2

3 Analyze a project plan to prepare a bill of materials. 10.10.3

4 Examine and use building code requirements for agriculture structures and those tasked with enforcing them. 10.10.4

5 Create a project cost estimate, including materials and labor for an AFNR structure. 10.10.5

6 Conduct a building functionality and safety assessment on an agricultural structure using knowledge of industry standards and local code. 10.10.6

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11 Apply best practices and safety guidelines for use of hand and power tools associated with constructing and maintaining AFNR structures. 10.11

1 Identify tools and equipment necessary for site preparation, surveying, and site layout. 10.11.1

2 Identify tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs. 10.11.2

3 Select appropriate tools and equipment necessary for site preparation, surveying, and site layout. 10.11.3

4 Select appropriate tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs. 10.11.4

5 Utilize tools and equipment necessary for site preparation, surveying, and site layout. 10.11.5

6 Utilize tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs. 10.11.6

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12 Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, surveying, electrical, plumbing, concrete/masonry, etc.). 10.12

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1 Examine the criteria in selecting materials for constructing, maintaining, and/or repairing AFNR structures. 10.12.1

2 Summarize the characteristics needed for an appropriate building site. 10.12.2

3 Contrast the characteristics of wood, masonry, and/or metal products used in AFNR structures. 10.12.3

4 Compare and contrast the characteristics of materials used in plumbing and water systems (e.g., copper, PVC, PEX, etc.). 10.12.4

5 Contrast the characteristics of fencing materials, including government regulations and applicable installation codes for AFNR structures. 10.12.5

6 Summarize the characteristics of the components found in concrete. 10.12.6

7 Contrast types of insulation materials used in AFNR structures. 10.12.7

8 Analyze samples of materials and/or products for quality and efficiency of workmanship. 10.12.8

9 Complete a building site analysis checklist to select an appropriate building site. 10.12.9

10 Calculate costs associated with the repair and replacement of wood, masonry, and/or metal components of an AFNR structure. 10.12.10

11 Calculate the cost of a water system in an AFNR structure (e.g., copper, PEX, PVC, transportation of materials to jobsite, etc.). 10.12.11

12 Calculate the cost of fencing materials for AFNR structures. 10.12.12

13 Calculate volume for concrete projects. 10.12.13

14 Calculate heat loss (e.g., Btu) in an AFNR structure. 10.12.14

15 Select materials for a project based upon an analysis of the project and the quality of the materials. 10.12.15

16 Demonstrate procedures for assessing site characteristics, identifying adjustments, and preparing a building site. 10.12.16

17 Construct AFNR structures using wood, masonry, and/or metal materials. 10.12.17

18 Install and/or repair pipes and plumbing equipment and fixtures in AFNR structures. 10.12.18

19 Construct and/or repair fencing, including wood, static wire, electrical wire, and other fencing materials for AFNR structures. 10.12.19

20 Construct and/or repair AFNR structures with concrete, brick, stone, or masonry. 10.12.20

21 Install properly selected insulation materials to achieve a given thermal efficiency. 10.12.21

13 Apply electrical wiring principles in AFNR structures. 10.13

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1 Compare and contrast direct and alternating current. 10.13.1

2 Contrast electrical circuits and the components of each. 10.13.2

3 Analyze the electrical requirements of an AFNR structure. 10.13.3

4 Calculate the cost of operating an electrical component or load (e.g., heater, motor, etc.). 10.13.4

5 Install and/or repair loads and control devices following appropriate codes and standards. 10.13.5

6 Install and/or repair electrical circuits (e.g., single pole switch, three-way switch, duplex outlet, etc.). 10.13.6

Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

14 Apply current and/or identify emerging technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems. 10.14

1 List current and emerging technologies used to solve problems and increase efficiency in AFNR systems. 10.14.1

2 Summarize the specific application of technologies used to solve problems and increase the efficiency of AFNR systems (e.g., robotics, UAS, microcontrollers, CNC, etc.). 10.14.2

3 Analyze data using current and emerging technologies. 10.14.3

4 Examine the change in output after using technologies in AFNR systems. 10.14.4

5 Solve problems using current and emerging technologies for AFNR systems. 10.14.5

6 Create recommendations for the use of technology in AFNR systems. 10.14.6

15 Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings. 10.15

1 Identify electrical control system components used in AFNR systems (e.g., transistors, relays, HVAC, logic controllers, etc.). 10.15.1

2 Contrast the purpose of electrical sensors. 10.15.2

3 Summarize the importance of programmable logic controllers (PLC), microcontrollers, and/or other computer- based systems. 10.15.3

4 Analyze schematic drawings for electrical control systems. 10.15.4

5 Select the correct electrical sensor for a given application. 10.15.5

6 Assess the functions of programmable logic controllers (PLC), microcontrollers, and other computer-based systems. 10.15.6

7 Design schematic drawings for electrical control systems. 10.15.7

8 Troubleshoot and install electrical sensors. 10.15.8

9 Develop a plan for using programmable logic controllers (PLC), microcontrollers, and/or other computer-based systems. 10.15.9

16 Apply geospatial principles and technologies to solve problems and increase the efficiency of AFNR systems. 10.16

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1 Identify the various geospatial technologies (i.e., GPS, GIS, remote sensing, telematics, etc.) used in AFNR systems. 10.16.1

2 Describe the components of precision technologies used in AFNR systems. 10.16.2

3 Assess geospatial technology (i.e., GPS, GIS, remote sensing, telematics, etc.) use and applications in AFNR systems. 10.16.3

4 Analyze the economic impact of utilizing precision technologies (e.g., GPS/GIS, remote sensing, etc.) in AFNR systems. 10.16.4

5 Analyze and interpret data from maps utilizing geospatial technologies. 10.16.5

6 Install new and troubleshoot faulty instrumentation and equipment used for precision technologies (i.e., GPS receivers, yield monitors, remote sensors, etc.). 10.16.6