

AGRICULTURAL POWER SYSTEMS

Curriculum Content Frameworks

Please note: All assessment questions will be taken from the knowledge portion of these frameworks.

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Curriculum Content Frameworks

Agricultural Power Systems

Grade Levels: 10, 11, 12
Course Code: 491120

Prerequisite: Agricultural Mechanics

Course Description: This course covers the principles of agricultural power systems including the maintenance and repair of internal combustion engines and systems, maintenance and repair of equipment, career opportunities, and safety.

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Unit 1: Introduction to Agricultural Power Systems

Hours: 6

Terminology: Agricultural machinery, Agricultural mechanics, Agricultural power, Application equipment, Harvesting equipment, Mechanization, Planting equipment, Self-propelled machinery, Tillage equipment, Tractor

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
1.1 Define terminology	1.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
1.2 Examine the importance of agricultural power systems	1.2.1 List uses of agricultural power in the production of agronomic crops, including ground maintenance	Foundation	Reading	Applies information to job performance [1.3.4] Determines what information is needed [1.3.10]	
	1.2.2 List uses of power systems in horticultural, including ground maintenance	Personal Management	Organizational Effectiveness	Develops self-confidence by creating a resume' which promotes personal strengths/abilities [3.5.5]	
	1.2.3 List uses of power systems in forestry and natural resources applications, including soil and water management as well as harvesting	Thinking	Creative Thinking	Makes connections between seemingly unrelated ideas [4.1.6]	
	1.2.4 List kinds of agricultural machinery based on function				
	1.2.5 List kinds of tractors based on wheels, fuel, design, and hitch				

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
1.3 Discuss major historical events in the emergence of modern agricultural power systems	1.3.1 List major agricultural mechanization inventions, including planting machine, cotton gin, reaper, steel moldboard plow, and internal combustion engine	Foundation	Reading	Uses standard occupational resource materials [1.3.22] Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]	
	1.3.2 Research an inventor of agricultural power and/or machinery and prepare a short report for class		Writing	Organizes sentences into paragraphs [1.6.11] Produces neat, legible document from typewriter or computer [1.6.15]	
		Personal Management	Career Awareness, Development, and Mobility	Explores career opportunities [3.1.6] Identifies continuing changes in male/female roles at home and work [3.1.7] Identifies education and training needed to achieve goals [3.1.8]	
		Thinking	Knowing How to Learn	Uses available resources to acquire new skills or improve skills [4.3.4] Processes new information as related to workplace [4.3.5]	
1.4 Identify appropriate FFA activities and supervised experiences in agricultural power systems	1.4.1 List FFA activities available in agricultural power systems	Foundation	Listening	Evaluates oral information/presentation [1.2.2] Receives and interprets verbal messages [1.2.8]	
	1.4.2 Participate in appropriate FFA career and personal development experiences	Personal Management	Career Awareness, Development, and Mobility	Sets well-defined and realistic personal/career goals (short-term and long-term) [3.1.11]	
	1.4.3 Plan and/or expand supervised experiences in agricultural power systems	Thinking	Knowing How to Learn	Uses available resources to acquire new skills or improve skills [4.3.4]	
	1.4.4 Keep records of FFA and supervised experience participation			Uses available resources to apply new skills [4.3.6]	

Unit 2: Safety Considerations in Agricultural Power

Hours: 5

Terminology: Accident interaction triangle, Decibel, First aid, Hazard, Operator's manual, Personal Protective Equipment (PPE), Risk, Safety, Slow-moving vehicle emblem

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 Define terminology	2.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
2.2 Discuss the meaning and importance of safety in agricultural power work	2.2.1 Explain the meaning and importance of safety	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]	
	2.2.2 Draw and explain the accident interaction triangle	Personal Management	Organizational Effectiveness	Determines what information is needed [1.3.10]	
	2.2.3 Identify hazards associated with agricultural power			Comprehends the organization's modes of operation [3.3.5]	
	2.2.4 Demonstrate power use of appropriate Personal Protective Equipment (PPE)			Thinking	Creative Thinking
2.3 Describe the use of Personal Protective Equipment (PPE) in agricultural electricity	2.3.1 Identify the safety color coding used in the agricultural mechanics laboratories	Foundation	Listening	Listens to follow directions [1.2.6]	
	2.3.2 Inspect an agricultural mechanics laboratory to determine if proper safety colors are being used	Personal Management	Speaking	Asks questions to clarify information [1.5.3]	
			Organizational Effectiveness	Communicates a thought, idea, or fact in spoken form [1.5.5]	
			Thinking	Creative Thinking	Applies knowledge to implement work-related system or practice [3.3.4]
2.4 Discuss classes of fire and types of extinguishers	2.4.1 List and explain classes of fires	Foundation	Science	Applies life-saving techniques [1.4.4]	
	2.4.2 List the types of fire extinguishers and explain when and how to use each	Thinking	Knowing How to Learn	Applies new knowledge and skills to identifying and using fire extinguishers for safety [4.3.1]	

Unit 3: Agricultural Power Industry and Careers

Hours: 4

Terminology: Agricultural mechanic, Career, Farm equipment dealer, Service technician

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
3.1 Define terminology	3.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
3.2 Discuss employment opportunities in agricultural power	3.2.1 List examples of occupations in agricultural power	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
	3.2.2 List jobs and employers in agricultural power in the local area	Interpersonal	Coaching	Helps others learn new skills [2.1.3]	
	3.2.3 Observe (job shadow) an agricultural power mechanic or technician at work and prepare a report on your observations	Personal Management	Career Awareness, Development, and Mobility	Develops skills to locate, evaluate, and interpret career information [3.1.4]	
3.3 Describe education and experience preparation for agricultural power careers	3.3.1 List education and skill preparation needed for entering and advancing in an agricultural power career	Foundation	Listening	Listens for content [1.2.3]	
	3.3.2 Identify personal attributes for success in agricultural power careers	Personal Management	Integrity/Honesty/Work Ethic	Describes/Explains significance of integrity, honesty, and work ethics [3.2.4]	

Unit 4: Tools, Equipment, and Fasteners Used in Agricultural Power

Hours: 7

Terminology: Box-end wrench, Center punch, Compression gauge, Cylinder compression gauge, Diagnostic instrument, Drift punch, Dynamometer, Engine analyzer, Fastener, Feeler gauge, Flywheel holder, Gear puller, Hoist, Impact driver, Impact wrench (air), Machinists vise, Micro-depth gauge, Nozzle tester, Open-end wrench, Pin punch, Prick punch, Radiator tester, Retaining ring pliers, Ring compressor, Sparkplug tester, Standard micrometer, Tachometer, Timing light, Torque wrench, Value spring compressor, Vernier caliper, Vernier micrometer

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	
4.1 Define terminology	4.1.1 Prepare a list of terms with definitions	Foundation	Reading Writing	Comprehends written information for main ideas [1.3.7] Applies/Uses technical words and concepts [1.6.4]	
4.2 Discuss tool and equipment needs for agricultural power	4.2.1 List and identify common tools and equipment used in agricultural power work 4.2.2 Demonstrate proper use of common tools and equipment used in agricultural power work	Foundation Personal Management	Reading Organizational Effectiveness	Applies information and concepts derived from printed materials [1.3.3] Applies information to job performance [1.3.4] Identifies relevant details, facts and specifications [1.3.16] Applies knowledge to implement work-related system or practice [3.3.4]	
4.3 Describe tool and equipment care	4.3.1 List practices that help maintain good tool condition 4.3.2 Demonstrate proper tool and equipment storage	Foundation Personal Management Thinking	Reading Integrity/Honesty/Work Ethic Problem Solving	Applies information to job performance [1.3.4] Complies with safety and health rules in a given work environment [3.2.2] Demonstrates logical reasoning in reaching a conclusion [4.4.2]	
4.4 Discuss fasteners used in agricultural power work	4.4.1 List and identify common fasteners used in agricultural power work, including thread-based and non-thread fasteners 4.4.2 Demonstrate proper use of fasteners in agricultural power work	Foundation Personal Management Thinking	Listening Science Integrity/Honesty/Work Ethic Problem Solving	Listens for content [1.2.3] Applies knowledge to complete a practical task [1.4.3] Complies with safety and health rules in a given work environment [3.2.2] Demonstrates logical reasoning in reaching a conclusion [4.4.2]	

Unit 5: Principles of Power and Engine Operation

Hours: 12

Terminology: Bore, Chemical energy, Combustion, Compound machine, Compression ratio, Energy, Force, Friction, Fuel, Horsepower, Internal combustion engine, Machine, Mechanical advantage, Piston displacement, Power, Reciprocating motion, Resistance, Rotary motion, Simple machine, Stroke, Torque, Vacuum, Work

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
5.1 Define terminology	5.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
5.2 Discuss the meaning and importance of appropriate physical science concepts	5.2.1 Demonstrate the calculations of important concepts associated with engine efficiency, including work, torque, power, and horsepower	Foundation	Arithmetic/ Mathematics	Converts different units of measurement [1.1.17]	
	5.2.2 List and explain the power ratings of an engine including indicated power, brake power, PTO power and drawbar power	Thinking	Writing	Performs basic computations [1.1.31]	
5.3 Discuss the role of internal combustion engines in converting chemical energy into mechanical energy	5.3.1 Explain the meaning of energy, chemical energy, and mechanical energy	Foundation	Science	Uses technical words and symbols [1.6.20]	
	5.3.2 List the major internal combustion engine components and the functions of each, including cylinder block, cylinder, piston, cylinder head, connecting rod, and crankshaft	Interpersonal	Problem Solving	Demonstrates logical reasoning in reaching a conclusion [4.4.2]	
	5.3.3 Classify internal combustion engines on the basis of fuel and distinguish between the types	Thinking	Seeing Things in the Mind's Eye	Applies scientific principles related to chemical and mechanical energy [1.4.5]	
			Speaking	Communicates a thought, idea, or fact in spoken form [1.5.5]	
			Coaching	Helps others learn new skills [2.1.3]	
				Visualizes a system's operation from schematics [4.6.3]	

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
5.4 Discuss efficiency of internal combustion engines	5.4.1 Explain the concept of efficiency as related to internal combustion engines	Foundation	Arithmetic/ Mathematics	Applies mathematical principles related to engine efficiency [1.1.4]	
	5.4.2 Identify factors or conditions associated with engine efficiency, including mechanical efficiency		Listening	Listens for long-term contexts [1.2.7]	
		Thinking	Science	Applies knowledge to complete a practical task [1.4.3]	
			Problem Solving	Comprehends ideas and concepts related to engine efficiency [4.4.1]	
5.5 Explain the role of systems in engine operation	5.5.1 List engine systems	Foundation	Science	Chooses appropriately from a variety of scientific methods and techniques to complete a task [1.4.8]	
				Constructs hypothesis [1.4.10]	
		Thinking	Creative Thinking	Finds new ways of dealing with existing problems/situations [4.1.5]	
			Problem Solving	Identifies possible reasons for problem [4.4.6]	

Unit 6: Small Engines

Hours: 14

Terminology: Air-cooled engine, Armature gap, Camshaft, Crankcase, Crankcase breather, Crankshaft, Crosshatch, Flywheel magnet, Four-stroke cycle engine, Governor, Horizontal crankshaft, Liquid coolant; Liquid cooled engine, Model number, Oil sump, Piston ring, Preventive maintenance, Tappet, Top Dead Center (TDC), Two-stroke cycle engine, Valve guides, Vertical crankshaft

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	
6.1 Define terminology	6.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
6.2 Identify features and uses of small engines	6.2.1 Explain the meaning and sizes of small engines	Foundation	Listening	Comprehends ideas and concepts related to small engines [1.2.1]	
	6.2.2 List and distinguish between small engines based on stroke cycle		Reading	Comprehends written information for main ideas [1.3.7]	
	6.2.3 Distinguish between small engines based on crankshaft placement		Science	Describes/Explains scientific principles related to the operation of small engines [1.4.13]	
	6.2.4 Distinguish between small engines based on the kinds of cooling systems	Thinking	Knowing How to Learn	Applies new knowledge and skills to small engines [4.3.1]	
	6.2.5 Locate the nameplate on a small engine and interpret the information provided				
	6.2.6 List uses of small engines in agriculture, horticulture, forestry, and other agricultural applications				
6.3 Discuss small engine components, systems, and functions	6.3.1 List and identify major components of small engines	Foundation	Reading	Comprehends written information and applies it to a task [1.3.8]	
	6.3.2 Identify the systems on small engines, including air, fuel, lubrication, and ignition	Thinking	Decision Making	Follows written directions [1.3.13]	
	6.3.3 Explain the functions of the components and systems of small engines			Comprehends ideas and concepts related to small engines [4.2.2]	

CAREER and TECHNICAL SKILLS			ACADEMIC and WORKPLACE SKILLS		
What the Student Should be Able to Do			What the Instruction Should Reinforce		
Knowledge	Application		Skill Group	Skill	Description
6.4 Describe preventive maintenance service for small engines	6.4.1	Explain the meaning and importance of proper preventive maintenance	Foundation	Listening	Listens to follow directions [1.2.6]
	6.4.2	Refer to the operator's or service manual for scheduled preventive maintenance servicing on a small engine		Reading	Comprehends written information and applies it to a task [1.3.8]
	6.4.3	Perform selected preventive maintenance jobs on small engines, including servicing the air, fuel, lubrication, and ignition systems		Science	Applies scientific principles related to small engine preventive maintenance [1.4.5]
			Interpersonal	Customer Service	Works with customers to satisfy their expectations [2.3.9]
			Thinking	Problem Solving	Recognizes/Defines problem [4.4.8]
6.5 Discuss the use of troubleshooting to diagnose small engine problems	6.5.1	Explain the meaning and importance of troubleshooting	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
	6.5.2	Use troubleshooting to identify a problem with a small engine		Writing	Follows written directions [1.3.13] Applies/Uses technical words and concepts [1.6.4] Completes form accurately [1.6.7]
			Personal Management	Responsibility	Exerts a high level of effort and perseverance towards goal attainment [3.4.4]

Unit 7: Fuel Systems

Hours: 20

Terminology: Carburetor, Diesel, Fuel-air mixture, Fuel filter, Fuel pump, Fuel tank, Gasoline, Injection nozzle, Liquid Petroleum Gas (LPG), Natural gas, Sediment, Trash

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
7.1 Define terminology	7.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
7.2 Describe the function and components of fuel systems	7.2.1 List the functions of fuel systems for gasoline and diesel engines	Foundation	Listening	Listens to follow directions [1.2.6]	
	7.2.2 Identify the components of fuel systems for gasoline and diesel engines	Personal Management	Speaking	Asks questions to clarify information [1.5.3]	
	7.2.3 Explain the functions of the components of fuel systems		Organizational Effectiveness	Communicates a thought, idea, or fact in spoken form [1.5.5]	
	7.2.4 Draw a diagram showing major fuel system components of gasoline and diesel engines and indicate the direction of fuel movement in the system	Thinking	Creative Thinking	Applies knowledge to implement work-related system or practice [3.3.4]	
7.3 Discuss the operation of fuel systems	7.3.1 Distinguish between gravity feed and force-feed fuel systems	Foundation	Writing	Records data [1.6.16]	
	7.3.2 Identify the major parts and functions in a carburetor	Thinking		Writes appropriate entries [1.6.22]	
	7.3.3 Demonstrate the proper adjustment of a carburetor, including idle speed, idle fuel, and full-loaded fuel adjustment		Decision Making	Writes/Prints legibly [1.6.24]	
			Reasoning	Evaluates information/data to make best decision [4.2.5]	
				Determines which conclusions are correct when given a set of facts and a set of conclusions [4.5.3]	

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
7.4 Describe how to troubleshoot and service fuel systems	7.4.1 List possible causes of carburetor trouble, including poor performance, poor idling, hard starting, poor acceleration, flooding, and excessive fuel use	Foundation	Reading	Interprets drawings to obtain factual information [1.3.17]	
	7.4.2 List the steps in removing, cleaning, and replacing the carburetor on an engine			Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]	
	7.4.3 List the steps in servicing a fuel filter		Science	Follows safety guidelines [1.4.15]	
	7.4.4 Identify procedures in bleeding the air from diesel fuel systems	Personal Management	Writing	Summarizes written information [1.6.17]	
	7.4.5 List procedures in testing diesel injector nozzles		Integrity/Honesty/Work Ethic	Follows established rules, regulations, and policies [3.2.5]	
	7.4.6 Bleed air from a diesel fuel system		Responsibility	Pays close attention to details [3.4.8]	

Unit 8: Engine Lubrication Systems

Hours: 10

Terminology: Dipstick, Lubrication, Oil filter, Society of Automitove Engineers (SAE), Viscosity

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		
8.1 Define terminology	8.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]		
			Writing	Applies/Uses technical words and concepts [1.6.4]		
8.2 Discuss the meaning and roles of the lubrication system in an engine	8.2.1 Explain lubrication and tell why it is important	Foundation	Reading	Identifies relevant details, facts and specifications [1.3.16]		
	8.2.2 List the roles of lubrication in an engine			Locates pertinent information in documents such as manuals, graphs, and schedules to perform tasks [1.3.18]		
	8.2.3 List the types of lubrication systems used in engines, including circulating splash, internal force feed splash, and full internal force feed	Thinking	Knowing How to Learn	Locates appropriate learning resources to acquire or improve knowledge and skills [4.3.3]		
	8.2.4 Identify the parts and their functions of a lubrication system			Problem Solving	Recognizes/Defines problem [4.4.8]	
	8.2.5 Explain the importance of the oil pressure regulating valves					

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS		
What the Student Should be Able to Do		What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
8.3 Discuss servicing the lubrication system of an engine	8.3.1 List the functions performed when servicing a lubrication system, including changing the oil and replacing the filter	Foundation	Science	Follows safety guidelines [1.4.15]
	8.3.2 Check oil fill level in an engine by properly using a dipstick	Interpersonal	Coaching	Encourages others to develop personal and professional skills [2.1.2]
	8.3.3 Identify different kinds of oil and oil additives	Personal Management	Integrity/Honesty/Work Ethic	Complies with safety and health rules in a given work environment [3.2.2]
	8.3.4 List the steps in changing the oil in an engine			Describes desirable worker characteristics [3.2.3]
	8.3.5 Demonstrate the ability to clean and replace a crankcase breather			
	8.3.6 Locate information on the lubrication system of an engine in the operator's or service manual			
	8.3.7 Properly dispose of used oil, filters, and other wastes			

Unit 9: Cooling Systems

Hours: 10

Terminology: Antifreeze, Cavitation erosion, Coolant, Hydrometer, Permanent antifreeze

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
9.1 Define terminology	9.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
9.2 Discuss the meaning and functions of the cooling system	9.2.1 List the functions of the cooling system	Foundation	Speaking	Asks questions to clarify information [1.5.3]	
	9.2.2 Distinguish between the two types of cooling systems (air and liquid)	Personal Management	Integrity/Honesty/Work Ethic	Pronounces words correctly [1.5.9]	
	9.2.3 Identify the major components of liquid cooling systems			Complies with safety and health rules in a given work environment [3.2.2]	
	9.2.4 Check coolant level in a cooling system			Thinking	Problem Solving
9.3 Discuss servicing liquid cooling systems	9.3.1 List reasons for servicing cooling systems	Foundation	Speaking	Applies/Uses technical terms as appropriate to audience [1.5.2]	
	9.3.2 Identify procedures in servicing a liquid cooling system	Interpersonal	Coaching	Helps others learn new skills [2.1.3]	
	9.3.3 Demonstrate the process of draining and replacing coolant	Personal Management	Responsibility	Exhibits enthusiasm in approaching and completing tasks [3.4.3]	
	9.3.4 Inspect/adjust fan belt tension as needed	Thinking	Knowing How to Learn	Maintains a high level of concentration in completion of a task [3.4.7]	
	9.3.5 Inspect/replace hoses as needed			Pays close attention to details [3.4.8]	
	9.3.6 Test/replace the cooling system thermostat, if needed			Uses available resources to acquire new skills or improve skills [4.3.4]	
	9.3.7 Inspect/clean radiator and cap			Uses available resources to apply new skills [4.3.6]	
	9.3.8 Test radiator pressure with tester				
	9.3.9 Properly dispose of used fluids/wastes				

Unit 10: Electrical Systems

Hours: 10

Terminology: Alternator, Battery, Battery charger, Distributor, Electrolyte, Hydrometer, Ignition, Ignition coil, Spark plug

CAREER and TECHNICAL SKILLS		ACADEMIC and WORKPLACE SKILLS			
What the Student Should be Able to Do		What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
10.1 Define terminology	10.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
10.2 Discuss the meaning and functions of the electrical system of an engine	10.2.1 List the uses of electricity on an engine and a tractor	Foundation	Reading	Interprets drawings to obtain factual information [1.3.17]	
	10.2.2 Identify the major components of an electrical system and the functions of each	Thinking	Problem Solving	Interprets drawings to solve design problems [4.4.7]	
	10.2.3 Describe the basic circuits of an electrical system		Reasoning	Sees relationship between two or more ideas, objects, or situations [4.5.5]	
	10.2.4 Describe the role and function of a battery				
10.3 Describe service practices on electrical systems	10.3.1 Use a diagnostic instrument to electronically check the performance of an electrical system	Foundation	Speaking	Applies/Uses technical terms as appropriate to audience [1.5.2]	
	10.3.2 Check, clean, and otherwise service the battery and connecting terminals of an engine	Personal Management	Writing	Participates in conversation, discussion, and group presentations [1.5.8]	
	10.3.3 Check, clean, adjust, and/or replace the spark plugs in an engine			Writes appropriate entries [1.6.22]	
	10.3.4 Check and service/replace the coil on an engine			Writes/Prints legibly [1.6.24]	
	10.3.5 Check and service/replace the distributor, condenser, and breaker points on an engine	Thinking	Responsibility	Maintains a high level of concentration in completion of a task [3.4.7]	
	10.3.6 Check/service the generator or alternator on an engine			Pays close attention to details [3.4.8]	
			Creative Thinking	Makes connections between seemingly unrelated ideas [4.1.6]	

Unit 11: Transmission Systems

Hours: 10

Terminology: Automatic transmission, Bearing, Clutch, Differential, Final drive, Gear, Gear train, Mechanical transmission, Power Takeoff (PTO), Power train, Seal, Transaxle, Transmission, Transmission housing

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
11.1 Define terminology	11.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]
			Writing	Applies/Uses technical words and concepts [1.6.4]
11.2 Discuss the meaning, components, and functions of a power train	11.2.1 Identify the major components of a power train	Foundation	Listening	Listens for content [1.2.3]
	11.2.2 Explain the functions of the components of a power train		Reading	Comprehends written information for main ideas [1.3.7]
	11.2.3 List common kinds of transmissions		Science	Applies scientific principles related to power [1.4.5]
	11.2.4 Identify the importance of lubrication with power trains	Personal Management	Responsibility	Pays close attention to details [3.4.8]
	11.2.5 Explain the meaning of gear ratio and why it is important			
11.3 Describe service practices with transmissions	11.3.1 List routine transmission service procedures	Foundation	Reading	Comprehends written information and applies it to a task [1.3.8]
	11.3.2 Demonstrate how to check the fluid level			Follows written directions [1.3.13]
	11.3.3 Add and/or replace fluid in a transmission	Personal Management	Writing	Applies/Uses technical words and concepts [1.6.4]
	11.3.4 Use an owner's/service manual to identify and carry out practices with specific manufacturer brands of transmissions		Integrity/Honesty/Work Ethic	Follows established rules, regulations, and policies [3.2.5]
	11.3.5 Explain how to clean and maintain the exterior surfaces of a power train housing		Responsibility	Pays close attention to details [3.4.8]

Unit 12: Troubleshooting

Hours: 10

Terminology: Backfire, Detonation, Flash point, Knock, Miss, Octane rating, Pre-ignition, Troubleshooting, Volatility

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	
12.1 Define terminology	12.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]	
			Writing	Applies/Uses technical words and concepts [1.6.4]	
12.2 Discuss the meaning and importance of troubleshooting	12.2.1 Explain the importance of troubleshooting in identifying engine problems	Foundation	Science	Applies/Uses scientific method [1.4.6] Measures dry and liquid supplies [1.4.16]	
			Speaking	Asks questions to obtain information [1.5.4]	
		Personal Management	Responsibility	Exhibits enthusiasm in approaching and completing tasks [3.4.3]	
		Thinking	Problem Solving	Devises and implements a plan of action to resolve problem [4.4.3]	
12.3 Describe troubleshooting procedures	12.3.1 Identify troubleshooting steps if an engine will not start or is hard to start	Foundation	Reading	Analyzes and applies what has been read to specific task [1.3.2]	
	12.3.2 Identify troubleshooting steps if an engine starts but will not run	Thinking	Science	Applies a scientific principle to solve a problem [1.4.7]	
	12.3.3 Identify troubleshooting steps if an engine misses		Problem Solving	Devises and implements a plan of action to resolve problem [4.4.3]	
	12.3.4 Identify troubleshooting steps if an engine detonates and/or pre-ignites		Identifies possible reasons for problem [4.4.6]		
	12.3.5 Identify troubleshooting steps if an engine backfires and/or knocks		Recognizes/Defines problem [4.4.8]		
	12.3.6 Identify troubleshooting steps if an engine overheats		Revises plan of action indicated by findings [4.4.9]		
	12.3.7 Identify troubleshooting steps if an engine lacks power				
	12.3.8 Identify troubleshooting steps if an engine uses too much oil or has low or high oil pressure				

Unit 13: Machinery Management

Hours: 12

Terminology: Depreciation, Fixed cost, Operating cost, Opportunity cost, Rolling resistance, Straight-line depreciation, Variable cost, Wheel slippage

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
13.1 Define terminology	13.1.1 Prepare a list of terms with definitions	Foundation	Reading	Comprehends written information for main ideas [1.3.7]
			Writing	Applies/Uses technical words and concepts [1.6.4]
13.2 Discuss the meaning and importance of tractor and machinery cost	13.2.1 Identify the costs associated with agricultural machinery	Foundation	Arithmetic/ Mathematics	Computes using a formula [1.1.14]
	13.2.2 Explain depreciation and calculate examples			Converts different units of measurement [1.1.17]
	13.2.3 List factors that affect operating cost		Science	Performs basic computations [1.1.31]
13.3 Discuss the role of tractor and machinery management in cost	13.3.1 Explain the overall goal of tractor and machinery management; i.e., keeping costs low	Foundation	Speaking	Communicates a thought, idea, or fact in spoken form [1.5.5]
	13.3.2 Identify management decisions in keeping costs down, including speed, hitching, engine tuning, rolling resistance and slipping	Interpersonal	Teamwork	Works effectively with others to reach a common goal [2.6.6]
	13.3.3 Explain the role of tractor weight in cost management, including the addition of weight	Personal Management	Responsibility	Maintains a high level of concentration in completion of a task [3.4.7]
	13.3.4 Identify the roles of tractor and machinery storage and maintenance in cost			

Glossary

Unit 1: Introduction to Agricultural Power Systems

1. Agricultural machinery – tractors and equipment used in agricultural production and related areas
2. Agricultural mechanics – the selection, operation, maintenance, service, sale, and use of power units, machinery, equipment, structures, and utilities in agriculture
3. Agricultural power – the use of power to perform agricultural work
4. Application equipment – implements used to apply materials used in plant production, such as fertilizer and herbicide
5. Harvesting equipment – implements that pick, reap, or otherwise gather crop products
6. Mechanization – the efficient use of machines to assist in all areas of production, processing, and marketing
7. Planting equipment – implements used to place seed or other plant materials in soil for growth
8. Self-propelled machinery – implements powered by their own engines rather than pulled by a tractor
9. Tillage equipment – implements that mechanically turn and loosen the soil
10. Tractor – a vehicle with an engine that provides power for other machines

Unit 2: Safety Considerations in Agricultural Power

1. Accident interaction triangle – a depiction of the three factors involved in the safe operation of tractors and equipment: the operator, the machine, and the environment
2. Decibel – standard unit of sound measurement
3. First aid – emergency treatment given before certified medical help can attend an injury
4. Hazard – injury or loss risk possibility; a danger
5. Operator's manual – a publication prepared by a manufacturer that explains how to use and maintain tractors and equipment
6. Personal Protective Equipment (PPE) – devices placed on the human body to protect it from injury
7. Risk – a situation that poses the potential for loss or injury
8. Safety – being free of harm or danger
9. Slow-moving vehicle emblem – a large, brightly colored triangle attached to the rear of an agricultural vehicle to indicate caution

Unit 3: Agricultural Power Industry and Careers

1. Agricultural mechanic – an occupation that deals with the selection, operation, maintenance, servicing, and use of agricultural tractors and equipment
2. Career – the general direction of an individual's life as related to employment
3. Farm equipment dealer – an individual or entity that owns and manages a business where agricultural tractors and equipment are sold and serviced
4. Service technician – an occupation that deals with the repair, maintenance, and service of tractors and equipment

Unit 4: Tools, Equipment, and Fasteners Used in Agricultural Power

1. Box-end wrench – a tool to loosen or tighten a nut or bolt where 90-degree partial or full turn is available
2. Center punch – a steel punch with a hardened steel point to make depressions in metal surfaces before drilling
3. Compression gauge – a test instrument used to test compression in an internal combustion engine
4. Cylinder compression gauge – a device that measures compression in a cylinder to determine the impact of valve and ring wear and carbon buildup
5. Diagnostic instrument – an electronic device used to identify problems with engines and component systems
6. Drift punch – a steel that is tapered and used to align holes in mating parts
7. Dynamometer – engine test equipment that measures engine torque, speed, and power when under load
8. Engine analyzer – an electronic instrument used to test a gasoline ignition system
9. Fastener – a device that holds parts or components together
10. Feeler gauge – a metal strip or blade finished accurately to thickness and used to measure the clearance between two parts
11. Flywheel holder – a tool used to hold the flywheel when torquing the crankshaft nut or clutch
12. Gear puller – a tool used to pull gears and bearing from shaft
13. Hoist – a system of chains and pulleys used to lift engines, transmissions, and other heavy weights
14. Impact driver – a hand tool used to loosen or tighten nuts and bolts by converting the force of a hammer blow to rotary motion
15. Impact wrench (air) – an air powered tool used to loosen or tighten nuts or bolts
16. Machinist's vise – a tool used to hold parts while they are being worked on
17. Micro-depth gauge – a device used to measure depths
18. Nozzle tester – an instrument used to determine the condition of diesel injection systems, including spray pattern, "pop-off" pressure, leak-off, valve and seat in a nozzle, and nozzle valve lift
19. Open-end wrench – a tool used to loosen or tighten a nut or bolt when it is not possible to encompass the bolt head or nut with a box-end wrench or socket
20. Pin punch – a steel punch of various diameters and lengths to drive straight pins, tapered pins, and roll pins in and out of holes
21. Prick punch – a steel punch with a 60 degree hardened point to make a small depression in metal prior to using a center punch

22. Radiator tester – a device used to check radiators and radiator caps for leaks and operating pressure
23. Retaining ring pliers – tools used to remove and install retaining rings on the shafts or in cylindrical holes
24. Ring compressor – a tool used to force the piston rings into their grooves so the piston can be pushed down into the cylinder
25. Sparkplug tester – a device for testing spark plug function
26. Standard micrometer – a precision instrument designed to accurately measure pistons, crankshafts, valve stems, and other small engine components; may be constructed for measuring outside or inside dimensions accurately to .001"
27. Tachometer – a device for measuring and indicating the rotational speed of an engine
28. Timing light – a device used to check ignition timing while the engine is running
29. Torque wrench – a special wrench with a built in indicator to measure the applied turning force
30. Valve spring compressor – a tool used to squeeze valve springs to release the keepers so springs can be removed
31. Vernier caliper – a device used to measure both internal and external measurements
32. Vernier micrometer – a precision measuring instrument accurate to .001"

Unit 5: Principles of Power and Engine Operation

1. Bore – the diameter of a cylinder
2. Chemical energy – the unreleased energy in fuel, such as energy in gasoline released by combustion
3. Combustion – burning of fuel and air (oxygen); rapid oxidation
4. Compound machine – a device comprised of two or more simple machines
5. Compression ratio – in a cylinder, the amount the fuel-air mix is compressed by volume by the piston
6. Energy – usable power; the ability to do work
7. Force – the energy that pushes or pulls on an object to be moved
8. Friction – resistance to movement of an object when two or more objects are touching
9. Fuel – any source of power that is released by burning
10. Horsepower – a unit of measurement equal to the amount of power required to lift or move 550 pounds a distance of 1 foot in the time of 1 minute
11. Internal combustion engine – a compound machine that converts the heat from combustion of fuel inside of an engine into a mechanical power
12. Machine – any device that helps do work
13. Mechanical advantage – the number of times a machine increases or multiplies force
14. Piston displacement – the "swept volume" of a cylinder as the piston makes one stroke
15. Power – rate of doing work
16. Reciprocating motion – back and forth motion, as a piston within a cylinder
17. Resistance – opposition to movement that is overcome if work is done
18. Rotary motion – the turning of a shaft
19. Simple machine – a device with few or no moving parts that does work with one movement
20. Stroke – movement of a piston in a cylinder from top dead center to bottom dead center or vice versa

21. Torque – a rotating force; twisting; turning of a shaft
22. Vacuum – emptiness or decrease in material; suction
23. Work – the process of moving an object over a distance

Unit 6: Small Engines

1. Air-cooled engine – uses air movement around the engine to dissipate heat
2. Armature gap – the space between the legs of the armature and the flywheel magnets
3. Camshaft – a shaft containing lobes or cams that operate engine valves
4. Crankcase – the housing for the crankshaft and other related internal parts
5. Crankcase breather – a reed valve assembly that allows outward airflow only from the crankcase
6. Crankshaft – the part of an engine that converts reciprocating motion into rotary motion; attached to piston by a connecting rod
7. Crosshatch – the correct pattern of marks on the cylinder walls created by the in-and-out motion of a cylinder hone
8. Flywheel magnet – a piece of metal with magnetic properties embedded in the flywheel to establish a magnetic field around the winding of the coil
9. Four-stroke cycle engine – an engine with pistons using two up and down strokes for a cycle
10. Governor – a mechanical, hydraulic, or electrical device that regulates speed
11. Horizontal crankshaft – an engine in which the crankshaft is placed horizontally in the crankcase
12. Liquid coolant – the liquid used in the cooling system of a liquid cooled engine; mixture of water and antifreeze
13. Liquid cooled engine – uses liquid movement around an engine to dissipate heat
14. Model number – a numbering system that describes the basic engine; each is specific to the manufacturer
15. Oil sump – the part of the block in an engine that holds and collects lubricating oil
16. Piston ring – an expanding ring placed in the grooves of the piston to seal it against the passage of fluid or gas
17. Preventive maintenance – service activities on an engine to keep it in good operating condition and promote engine life
18. Tappet – the engine component for transferring motion to cause valves to open and close
19. Top Dead Center (TDC) – the position of a piston in an engine in which it is furthest from the crankshaft; also spelled dead centre
20. Two-stroke cycle engine – an engine needing one up and down stroke for a cycle to be completed
21. Valve guides – bushings or holes in which the valve system is placed; only back-and-forth, two-way motion is allowed
22. Vertical crankshaft – an engine in which the crankshaft is placed vertically, with the pistons moving horizontally

Unit 7: Fuel Systems

1. Carburetor – device on an internal combustion engine that provides fuel and air to the engine in appropriate portions and volumes
2. Diesel – a fuel used in internal combustion engines that is ignited by pressure
3. Fuel-air mixture – the combination of fuel and air that promotes combustion and engine efficiency
4. Fuel filter – a device in the fuel system of an engine that removes trash and other foreign matter from fuel before it reaches the carburetor or injectors
5. Fuel pump – the device that forcibly moves fuel from the storage tank to the engine
6. Fuel tank – the reservoir on an engine or vehicle that stores fuel until it is used by the engine
7. Gasoline – a volatile, flammable liquid refined from crude petroleum manufactured for use in internal combustion engines
8. Injection nozzle – a device that injects fuel directly into the combustion chamber (cylinder); used with diesel engines and some gasoline engines
9. Liquid Petroleum Gas (LPG) – a fuel that is liquid under pressure but otherwise a vapor
10. Natural gas – a fuel that is in vapor form and stored under pressure
11. Sediment – tiny particles of solid materials in fuel that can cause engine malfunctions if not removed by a filter; such particles are heavier than the fuel and will settle to the bottom of a fuel reservoir
12. Trash – small particles of rust, metal, or other materials that may contaminate fuel

Unit 8: Engine Lubrication Systems

1. Dipstick – a graduated rod for indicating depth of oil in a crankcase
2. Lubrication – using oil or grease to reduce friction between moving parts
3. Oil filter – a device that traps and removes tiny particles of metal, carbon, and other solid materials from oil
4. Society of Automotive Engineers (SAE) – develops standards for lubricants and other products; SAE designations are often used with oils
5. Viscosity – flowability of a liquid; a measure of the resistance of a liquid to deform under stress

Unit 9: Cooling Systems

1. Antifreeze – a substance added to water to lower its freezing point
2. Cavitation erosion – eroding action caused by repeated collapsing or bursting of tiny vapor bubbles on the coolant side of the cylinder wall or sleeve
3. Coolant – the substance or material used to cool engines
4. Hydrometer – an instrument for measuring the antifreeze concentration in coolant to determine the temperature of lowest protection against freeze-up
5. Permanent antifreeze – refers only to the type of antifreeze solution that will not boil away at normal engine temperatures; does not mean antifreeze never wears out or does not need changing

Unit 10: Electrical Systems

1. Alternator – the engine component that keeps the battery charged
2. Battery – the electrical storage component of an engine
3. Battery charger – a device that is used to put energy into a rechargeable battery by forcing an electrical current through it
4. Distributor – the device in the ignition system of an internal combustion engine that routes voltage pulses in the correct firing order to the spark plugs
5. Electrolyte – the liquid substance in a battery with free ions that behave as an electrically conductive medium
6. Hydrometer – an instrument for determining the specific gravity of liquids, such as the electrolyte in a battery
7. Ignition – the initiation of combustion in an engine
8. Ignition coil – the device in an ignition system that transforms stored battery voltage into the thousands of volts needed to cause arcing in spark plugs
9. Spark plug – the device in the cylinder head of an internal combustion engine that ignites fuel by means of an electric spark

Unit 11: Transmission Systems

1. Automatic transmission – a type of transmission that changes gears based on speed and torque requirements
2. Bearing – a device that allows rotating shafts to turn freely; most common are ball and roller
3. Clutch – a mechanism for engaging and disengaging the power of an engine or motor to the driven machine
4. Differential – a mechanical device of gears that allows driving wheels to rotate at different speeds with equal torque going to each wheel
5. Final drive – the last stage in the transmission of power from the engine to the drive wheels or PTO
6. Gear – a wheel with teeth around its circumference which are designed to mesh with teeth of another wheel
7. Gear train – a set or system of gears arranged to transfer rotating power from one part to another of a mechanical system
8. Mechanical transmission – a type of transmission in which levers are used to manually shift gears
9. Power Takeoff (PTO) – a rotating shaft from a tractor that is attached to implements to provide power for their operation
10. Power train – the group of components of a tractor or other vehicle that generate power and delivers it to wheels, PTO, or other location
11. Seal – a device that prevents the loss of lubricant from bearings and gears
12. Transaxle – the type of simple transmission found on small tractors and utility vehicles
13. Transmission – a mechanism that controls the rate of release of energy from the driving engine to the source of application
14. Transmission housing – a heavy metal structure that contains components of the transmission of a vehicle; also known as bell housing

Unit 12: Troubleshooting

1. Backfire – a loud noise caused by the improper timing of ignition fuel
2. Detonation – an engine condition in which sharp pinging of the cylinders or erratic firing occur
3. Flash point – the temperature at which vapor from fuel will ignite
4. Knock – an engine sound when moving parts strike each other because of being improperly timed, improperly installed, or other conditions
5. Miss – an engine condition in which the cylinders do not fire properly; the engine does not run smoothly
6. Octane rating – a classification of fuel based on the amount of compression for combustion; higher octain fuels can be more compressed and not combust
7. Pre-ignition – the ignition of fuel mixture before the proper time
8. Troubleshooting – a systematic search to solve an engine or other problem; begin with the simplest and most likely problem first and progress checking each system and component until the problem is solved
9. Volatility – vaporization qualities that promote fuel combustion

Unit 13: Machinery Management

1. Depreciation – the process of a tractor or other property losing value as it ages and is worn; the age of a tractor reflects its value
2. Fixed cost – the cost to purchase a new tractor or implement and own it but not use it
3. Operation cost – costs of fuel, lubricants, labor, repairs and maintenance due to using a tractor or implement
4. Opportunity cost – the cost of investing in tractors or implements associated with giving up returns from other uses of the money
5. Rolling resistance – the resistance of wheels to moving in soft earth
6. Straight-line depreciation – a common method of calculating depreciation
7. Variable cost – costs that vary with operating a tractor or implement
8. Wheel slippage – Failure of drive wheels to "grip" the surface on which they are exerting force to move a vehicle forward