# Small Power Systems Course No. 18410 Credit: 1.0

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| --- | --- | --- | --- |
| **Student name:**  |  | **Graduation Date:** |  |

Pathways and CIP Codes:Agricultural Technology and Mechanical Systems (01.0201); Diversified Agricultural Science (01.0000)

Course Description: Courses provide students with the opportunity to learn how to service & recondition small engines, typically emphasizing two and four-cycle engines. Courses provide student with opportunities to troubleshoot and repair speed controls, lubrication, ignition, fuel, power transfer, cooling, exhaust, and starting systems; use hand, power, and overhaul tools; and read and interpret service manuals and parts’ catalogs. Applications may include lawn mowers, tractors, tillers, power tools

Special Note: The AFNR College and Career Ready Skills are to be taught throughout the course utilizing FFA and SAE programming found at the Kansas Ag Ed website. Specific activities may be found in the SAE for All Teachers Guide and at National FFA.org. The AFNR College and Career Ready Skills competencies can be found at Kansas Ag Ed.

Opportunities in Agriculture Education & FFA:Classroom and laboratory instruction integrates and/or is supplemented by experiential, project, and leadership and personal development through FFA .Students should be introduced to FFA through leadership activities and College and Career Ready Skills. Specific FFA information and activities may be found in the “National FFA Student Handbook, 16thedition”. Student activities, scoring rubrics, grading examples, and teacher lessons are all found in the “FFA Student Handbook Teachers Guide”. Additional information can be found at [www.ffa.org](http://www.ffa.org/).

Workplace Skills, Supervised Agricultural Experience and Record Keeping: Classroom and laboratory instruction integratesand/or is supplemented by experiential, project, and work based learning through SAE. Specific SAE activities that support the College and Career Ready Skills may be found in the “SAE for All Guide”. Students should be introduced to Foundational SAE’s and the AET student portfolio system. Student activities, scoring rubrics, grading examples, and teacher lessons are all found in the “SAE for All Teachers Guide”. Additional information is found in the SAE Individual Learning Guides and Teacher Editions and in the AFNR College and Career Ready Competency Profile found at *Kansas Ag* *Ed.*

Directions:The following competencies are required for full approval of this course. Check the appropriate number to indicate the level of competency reached for learner evaluation.

**RATING SCALE:**

4. Exemplary Achievement: Student possesses outstanding knowledge, skills or professional attitude.

3. Proficient Achievement:Student demonstrates good knowledge, skills or professional attitude. Requires limited supervision.

2. Limited Achievement:Student demonstrates fragmented knowledge, skills or professional attitude. Requires close supervision.

1. Inadequate Achievement:Student lacks knowledge, skills or professional attitude.

0. No Instruction/Training:Student has not received instruction or training in this area.

## Benchmark 1: Career Options in Small Gas Engines

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 1.1 | Identify and contact career opportunities in the small power systems field.  |  |
| 1.2 | List the qualities that are essential for anyone pursuing a career in small engines.  |  |
| 1.3 | List the advantages and disadvantages of entrepreneurship.  |  |
| 1.4 | Identify the benefits of outdoor power equipment certification.  |  |
| 1.5 | Complete a Resume. |  |

## Benchmark 2: SAFETY IN THE SMALL GAS ENGINE SHOP

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 2.1 | Explain why a clean, well organized shop is extremely important.  |  |
| 2.2 | Identify workplace hazards and the root cause of accidents. |  |
| 2.3 | Explain the importance of maintaining and using tools properly.  |  |
| 2.4 | Identify the safety hazards found in the internal motions of equipment. |  |
| 2.5 | Explain the functions of OSHA.  |  |
| 2.6 | Complete a Shop Safety Contract / Release form. |  |
| 2.7 | Demonstrate knowledge of basic shop safety by satisfactorily completing Safety Exam.  |  |
| 2.8 | Identify types of PPE and their uses in the shop. |  |

## Benchmark 3: TOOLS AND MEASURING INSTRUMENTS

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 3.1 | Explain why quality tools and measuring instruments should be used when servicing small gas engines. |  |
| 3.2 | Use common hand tools properly. |  |
| 3.3 | Demonstrate the ability to use precision measuring techniques with a dial caliper, micrometer, feeler gauge, and a dial indicator to within .002” accuracy.  |  |
| 3.4 | Use a digital multimeter to check continuity, voltage and resistance. |  |

## Benchmark 4: FASTENERS, SEALANTS, AND GASKETS

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 4.1 | Identify fasteners used on small gas engines and implements. |  |
| 4.2 | Remove and install various fasteners correctly. |  |
| 4.3 | Repair or produce internal and external threads.  |  |
| 4.4 | Remove, select, and install gaskets correctly.  |  |

## Benchmark 5: TWO-CYCLE AND FOUR-CYCLE ENGINES

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 5.1 | Describe four-stroke cycle engine operation and explain the purpose of each stroke.  |  |
| 5.2 | Explain the concept of valve timing. |  |
| 5.3 | Compare the lubrication system in a four-cycle engine to the system in a two-cycle engine. |  |
| 5.4 | Describe two-stroke cycle engine operation and explain the principles of two-cycle operation. |  |
| 5.5 | Compare the operation of two-cycle and four-cycle engines. |  |

## Benchmark 6: ENGINE CONSTRUCTION AND PRINCIPLES OF OPERATION

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 6.1 | Explain simple engine operation and the energy flow through each system.  |  |
| 6.2 | List the qualities of gasoline that make it an efficient fuel for small engines.  |  |
| 6.3 | Explain why gasoline is atomized in the small engine.  |  |
| 6.4 | Identify the basic components of a small engine and describe the function of each part.  |  |

## Benchmark 7: MEASURING ENGINE PERFORMANCE

### Competencies

| **#** | **Description** | **RATING** |
| --- | --- | --- |
| 7.1 | Define engine performance. |  |
| 7.2 | Define and compute bore, stroke, displacement, compression ratio, force, work, power, energy, and horsepower.  |  |
| 7.3 | Differentiate between the various types of horsepower. |  |
| 7.4 | Explain the function of a Prony brake and a dynamometer. |  |
| 7.5 | Define and calculate torque. |  |

## Benchmark 8: ENGINE INSPECTION AND DISASSEMBLY

### Competencies

| **#** | **Description** | **RATING** |
| --- | --- | --- |
| 8.1 | Inspect engines for problems.  |  |
| 8.2 | Describe the procedure for removing an engine from an implement. |  |
| 8.3 | Document the steps involved in disassembling an engine using an engine service manual.  |  |
| 8.4 | Measure cylinder conditions such as wear and out-of-roundness.  |  |
| 8.5 | Summarize the reasons for honing a cylinder.  |  |

## Benchmark 9: PISTON AND PISTON RING SERVICE

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 9.1 | Describe piston and piston ring compression.  |  |
| 9.2 | Differentiate between compression rings and oil control rings. |  |
| 9.3 | Explain the purpose of ring end gap. |  |
| 9.4 | Identify common types of piston damage and list possible causes.  |  |
| 9.5 | Explain the purpose of a piston pin. |  |
| 9.6 | Use a leak-down tester to analyze the compression of a small gas engine. |  |
| 9.7 | Demonstrate the ability to remove and replace piston rings. |  |

## Benchmark 10: FUEL AND EMISSION CONTROL SYSTEMS

### Competencies

| **#** | **Description** | **rating** |
| --- | --- | --- |
| 10.1 | Describe the function of the connecting rod and the bearings.  |  |
| 10.2 | Differentiate between friction bearings and antifriction bearings.  |  |
| 10.3 | Summarize the function of the crankshaft. |  |
| 10.4 | Measure and adjust valve clearance to specifications. (OHV engines). |  |
| 10.5 | Explain the operation of ports, reeds, and rotary valves in 2-stroke engines.  |  |
| 10.6 | Describe the purpose of the camshaft. |  |
| 10.7 | Explain the purpose of an automatic compression release.  |  |

## Benchmark 11: FUEL AND EMISSION CONTROL SYSTEMS

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 11.1 | Name various types of fuel that can be used in a small engine and list practical applications for each. |  |
| 11.2 | Explain the importance of proper fuel-oil mixture in a two-cycle engine.  |  |
| 11.3 | Measure the alcohol content of gasoline mixtures. |  |
| 11.4 | Compare the operation of gasoline and diesel fuel systems. |  |
| 11.5 | Describe how renewable resources are used to provide fuel for engines. (Ethanol, biodiesel, etc.). |  |
| 11.6 | Explain fuel pump operation. |  |
| 11.7 | Describe the operation of a pressurized fuel system.  |  |
| 11.8 | Explain the importance of emission control. |  |

## Benchmark 12: CARBURETION

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 12.1 | Explain the parts of a carburetor and their function. |  |
| 12.2 | Identify the three basic types of carburetors. |  |
| 12.3 | Explain float-type carburetor operation.  |  |
| 12.4 | Explain the operation of the diaphragm-type carburetors.  |  |
| 12.5 | Explore the different systems in a carburetor, i.e – idle, choke, high speed, etc.  |  |
| 12.6 | List the basic functions of a governor. |  |
| 12.7 | Describe the purpose of an air cleaner.  |  |

## Benchmark 13: FUEL SYSTEM SERVICE

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 13.1 | Test a fuel pump for proper operation.  |  |
| 13.2 | Summarize basic carburetor adjustments. |  |
| 13.3 | Explain basic procedures for inspecting, overhauling, and adjusting diaphragm and float-type carburetors.  |  |
| 13.4 | Troubleshoot float-type and diaphragm-type carburetors. |  |

## Benchmark 14: IGNITION SYSTEM

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 14.1 | List the primary purposes of the ignition system. |  |
| 14.2 | Identify the components in a typical magneto system and describe the function of each part. |  |
| 14.3 | Describe small engine ignition advance systems.  |  |
| 14.4 | List the advantages of a solid state ignition system. |  |
| 14.5 | Describe the operation of a battery ignition system.  |  |

## Benchmark 15: IGNITION SYSTEM SERVICE

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 15.1 | Examine spark plug deposits for signs of abnormal combustion. |  |
| 15.2 | Clean, gap, and install spark plugs correctly.  |  |
| 15.3 | Explain the basic inspections and tests used to verify proper ignition system operation.  |  |
| 15.4 | Explain basic tests for solid state ignition systems. |  |
| 15.5 | Explain typical service procedures for battery ignition systems. |  |

## Benchmark 16: LUBRICATION SYSTEMS

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 16.1 | Define friction and explain how it affects the internal engine components.  |  |
| 16.2 | List the functions of lubricating oil.  |  |
| 16.3 | Differentiate between the lubrication systems in two-cycle engines and four-cycle engines. |  |
| 16.4 | Explain the operation of ejection pumps, barrel pumps, and positive displacement pumps.  |  |

## Benchmark 17: COOLING SYSTEMS

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 17.1 | Explain how air cooling, exhaust cooling, and water cooling work to lower engine operating temperatures.  |  |
| 17.2 | Define the basic function of a water pump and give examples of several common types. |  |
| 17.3 | Explain the function of a thermostat and a radiator.  |  |

## Benchmark 18: PREVENTIVE MAINTENANCE AND TROUBLESHOOTING

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 18.1 | Change the oil in a four-cycle engine. |  |
| 18.2 | Mix fuel and oil correctly for a two-cycle engine. |  |
| 18.3 | Perform preventive maintenance on various engine systems; including the crankcase breather, air cleaner, and muffler. |  |
| 18.4 | Describe systematic troubleshooting. |  |
| 18.5 | Use manufacturer’s service manuals to determine engine specifications and explain why this information is necessary when servicing a small engine. |  |

## Benchmark 19: ENGINE REASSEMBLY PROCEDURE

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 19.1 | Locate, document, and follow reassembly procedures from an engine service manual. |  |
| 19.2 | Locate part sizes and reject sizes from an engine service manual. |  |
| 19.3 | Look up torque specifications for engine assemblies and parts. |  |
| 19.4 | Assemble engine fasteners and assemblies using the proper torque. |  |
| 19.5 | Start the engine and adjust the top, no-load speed. |  |

## Benchmark 20: ELECTRICAL POWER DRIVE SYSTEMS

### Competencies

| **#** | **Description** | **Rating** |
| --- | --- | --- |
| 20.1 | Discuss electrical power systems for cordless power tools. |  |
| 20.2 | Describe how a battery system works for hybrid electrical vehicles. |  |
| 20.3 | Demonstrate proper safety guidelines for working with electrical battery systems. |  |
| 20.4 | Identify the proper method for disposing of electrical batteries. |  |
| 20.5 | Explain how a hybrid power train works. |  |

I certify that the student has received training in the areas indicated.

Instructor Signature:

For more information, contact:

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