

## 2007 Mississippi Curriculum Framework

### Postsecondary Small Engine and Turf Equipment Repair Technology

(Program CIP: 01.0299 Agricultural Mechanization, Other )

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Standards in this document are based on information from the following organizations:

<b>Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs</b>	Industry standards for Small Engine Repair courses were adapted from the publication, <i>Program Assessment Manual: Power Equipment Technology</i> , as published by the Equipment and Engine Training Council. For more information see the Council's Web site at <a href="http://www.eetc.org">www.eetc.org</a>
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## Preface

### Postsecondary Small Engine and Turf Equipment Repair Technology Research Synopsis

Articles, books, Web sites, and other materials listed at the end in each course were considered during the revision process. These references are suggested for use by instructors and students during the study of the topics outlined.

Industry advisory team members and instructors from colleges throughout the state were asked to give input related to changes to be made to the curriculum framework.

### Curriculum

The following national standards were referenced in each course of the curriculum:

- CTB/McGraw-Hill LLC *Tests of Adult Basic Education, Forms 7 and 8 Academic Standards*
- *21<sup>st</sup> Century Skills*
- *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Programs*

Industry and instructor comments, along with current research, were considered by the curriculum revision team during the revision process; changes were made as needed and appropriate. Many of the skills and topics noted in the research were already included in the curriculum framework. Specific changes made to the curriculum at the curriculum revision meeting included:

- Competencies and objectives were reviewed to ensure accuracy and appropriateness.
- The Recommended Tools and Equipment list was updated.

### Assessment

Students will be assessed using the *Postsecondary Small Engine and Turf Equipment Repair Technology MS-CPAS2 Test*.

### Professional Learning

It is suggested that instructors participate in professional learning related to the following concepts:

- Differentiated instruction – To learn more about differentiated instruction, please go to [http://www.paec.org/teacher2teacher/additional\\_subjects.html](http://www.paec.org/teacher2teacher/additional_subjects.html) and click on Differentiated Instruction. Work through this online course and review the additional resources.

## Foreword

As the world economy continues to evolve, businesses and industries must adopt new practices and processes in order to survive. Quality and cost control, work teams and participatory management, and an infusion of technology are transforming the way people work and do business. Employees are now expected to read, write, and communicate effectively; think creatively, solve problems, and make decisions; and interact with each other and the technologies in the workplace. Vocational-technical programs must also adopt these practices in order to provide graduates who can enter and advance in the changing work world.

The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact on local vocational-technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U.S. Department of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.

Referenced throughout the courses of the curriculum are the 21<sup>st</sup> Century Skills, which were developed by the Partnership for 21<sup>st</sup> Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21<sup>st</sup> Century Skills addresses learning skills needed in the 21<sup>st</sup> century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills has been recognized for some time and the 21<sup>st</sup> Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21<sup>st</sup> century involves technology skills, and the International Society for Technology in Education, developers of the National Educational Technology Standards (NETS), were strategic partners in the Partnership for 21<sup>st</sup> Century Skills.

Each postsecondary program of instruction consists of a program description and a suggested sequence of courses which focus on the development of occupational competencies. Each vocational-technical course in this sequence has been written using a common format which includes the following components:

- Course Name – A common name that will be used by all community/junior colleges in reporting students.
- Course Abbreviation – A common abbreviation that will be used by all community/junior colleges in reporting students.
- Classification – Courses may be classified as:
  - Vocational-technical core – A required vocational-technical course for all students.

- Area of concentration (AOC) core – A course required in an area of concentration of a cluster of programs.
  - Vocational-technical elective – An elective vocational-technical course.
  - Related academic course – An academic course which provides academic skills and knowledge directly related to the program area.
  - Academic core – An academic course which is required as part of the requirements for an Associate degree.
- Description – A short narrative which includes the major purpose(s) of the course and the recommended number of hours of lecture and laboratory activities to be conducted each week during a regular semester.
  - Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course.
  - Corequisites – A listing of courses that may be taken while enrolled in the course.
  - Competencies and Suggested Objectives – A listing of the competencies (major concepts and performances) and of the suggested student objectives that will enable students to demonstrate mastery of these competencies.

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75 percent of the time allocated to each course. The remaining 25 percent of each course should be developed at the local district level and may reflect:
  - Additional competencies and objectives within the course related to topics not found in the State framework, including activities related to specific needs of industries in the community college district.
  - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised.
  - Activities which implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational-technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational-technical programs.
  - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area.
- Sequencing of the course within a program is left to the discretion of the local district. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

- Programs that offer an Associate of Applied Science degree must include a minimum 15 semester credit hour academic core. Specific courses to be taken within this core are to be determined by the local district. Minimum academic core courses are as follows:
  - 3 semester credit hours                      Math/Science Elective
  - 3 semester credit hours                      Written Communications Elective
  - 3 semester credit hours                      Oral Communications Elective
  - 3 semester credit hours                      Humanities/Fine Arts Elective
  - 3 semester credit hours                      Social/Behavioral Science Elective

It is recommended that courses in the academic core be spaced out over the entire length of the program, so that students complete some academic and vocational-technical courses each semester. Each community/junior college has the discretion to select the actual courses that are required to meet this academic core requirement.

- In instances where secondary programs are directly related to community and junior college programs, competencies and suggested objectives from the high school programs are listed as Baseline Competencies. These competencies and objectives reflect skills and knowledge that are directly related to the community and junior college vocational-technical program. In adopting the curriculum framework, each community and junior college is asked to give assurances that:
  - Students who can demonstrate mastery of the Baseline Competencies do not receive duplicate instruction, and
  - Students who cannot demonstrate mastery of this content will be given the opportunity to do so.
- The roles of the Baseline Competencies are to:
  - Assist community/junior college personnel in developing articulation agreements with high schools, and
  - Ensure that all community and junior college courses provide a higher level of instruction than their secondary counterparts.
- The Baseline Competencies may be taught as special “Introduction” courses for 3-6 semester hours of institutional credit which will not count toward Associate degree requirements. Community and junior colleges may choose to integrate the Baseline Competencies into ongoing courses in lieu of offering the “Introduction” courses or may offer the competencies through special projects or individualized instruction methods.
- Technical elective courses have been included to allow community colleges and students to customize programs to meet the needs of industries and employers in their area.

In order to provide flexibility within the districts, individual courses within a framework may be customized by:

- Adding new competencies and suggested objectives.
- Revising or extending the suggested objectives for individual competencies.
- Integrating baseline competencies from associated high school programs.

- Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the State Board for Community and Junior Colleges [SBCJC] of the change).

In addition, the curriculum framework as a whole may be customized by:

- Resequencing courses within the suggested course sequence.
- Developing and adding a new course which meets specific needs of industries and other clients in the community or junior college district (with SBCJC approval).
- Utilizing the technical elective options in many of the curricula to customize programs.

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## **Program Description**

Small Engine and Turf Equipment Repair Technology is designed to provide students with entry level skills needed to compete in today's turf equipment industry. Training is provided in the areas of Engine Repair, Diagnostic skills, Cutting Systems, Chassis Repair, Electrical Systems and Shop Management Skills. Students may earn a Technical Certificate in Small Engine and Turf Equipment Repair by completing the 33 hours of required TEM courses and a computer applications course. Students desiring to earn an Associate of Applied Science degree in Small Engine and Turf Equipment Repair must earn an additional 28 hours including required academic courses and approved electives.

Courses in the program have been correlated to standards for turf equipment programs as published by the Equipment and Engine Training Council, a nationally recognized association for the outdoor power equipment industry.

## Suggested Course Sequence\*

### Small Engine and Turf Equipment Repair Technology

#### FIRST YEAR

4 sch Turf Equipment Mechanics I (TEM 1114)	4 sch DC Electrical Systems (TEM 1214)
3 sch Turf Equipment Shop Management (TEM 1123)	4 sch Turf Equipment Mechanics II (TEM 1224)
4 sch Cutting System Maintenance (TEM 1134)	3 sch Chassis Repair and Maintenance (TEM 1243)
3 sch Math/Science Elective	3 sch Social Behavioral Science Elective
14 sch	14 sch

#### SUMMER TERM

3 sch Supervised Work Experience in Small Engine and Turf Equipment Repair Technology (TEM 2923)
3 sch

#### SECOND YEAR

4 sch Turf Equipment Diagnostics I (TEM 1144)	4 sch Turf Equipment Diagnostics II (TEM 1234)
3 sch Written Communications Elective	3 sch Oral Communications Elective
3 sch Humanities/Fine Arts Elective	9 sch Approved Electives***
3 sch Approved Elective***	16 sch
3 sch Computer Technology elective	
16 sch	

\* Students who lack entry level skills in math, English, science, etc. will be provided related studies.

#### \*\*\*APPROVED ELECTIVES

TEM 2913	Special Problem in Small Engine and Repair Technology
ATE 1213	Conversational Spanish
BOT 1433	Business Accounting or ACC 1213 Principles of Accounting
BOT 1313	Applied Business Math or BAD 1313 Business Mathematics
BAD 2413	Legal Environment of Business

HLT 1222	Green Industry Seminar
HLT 1411-1441	Leadership Management
HLT 1614	Landscape Equipment Operation and Maintenance
HLT 2113	Turfgrass Management
PHY 1214	Survey of Physics
WBL 191(1-3)	Work Based Learning

(Other courses may be approved by the instructor when they can be shown to relate to the student's career pathway.)

## Small Engine and Turf Equipment Repair Technology Courses

**Course Name:** Turf Equipment Mechanics I

**Course Abbreviation:** TEM 1114

**Classification:** Vocational-Technical Core

**Description:** Introduces students to the basic principles of engine mechanics and maintenance of two stroke and four stroke engines. Includes instruction on lubrication, fuel, and ignition systems. (3 sch: 2 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>
<p>1. Apply personal and shop safety standards associated with engines.</p> <ul style="list-style-type: none"> <li>a. Describe and apply rules and procedures for personal safety when working on an engine.</li> <li>b. Describe and apply rules and procedures for general shop safety when working on an engine.</li> </ul> <p>(NOTE: Personal safety will be stressed and monitored on a continuous basis throughout all courses in the program.)</p>
<p>2. Describe and discuss basic principles of engine operation.</p> <ul style="list-style-type: none"> <li>a. Identify the major systems of an engine and their function or purpose.</li> <li>b. Discuss the sequence of events in a typical four-stroke cycle engine.</li> <li>c. Discuss the sequence of events in a typical two-stroke cycle engine.</li> <li>d. Differentiate between two-stroke cycle and four-stroke cycle engines and their components.</li> <li>e. Disassemble, inspect/test components (replace as necessary) and reassemble a single cylinder two-stroke cycle and a single cylinder four-stroke cycle engine.</li> </ul>
<p>3. Describe the components of the basic engine assembly.</p> <ul style="list-style-type: none"> <li>a. Identify components of the engine block and the reciprocating assembly.</li> <li>b. Identify components of the valve train.</li> </ul>
<p>4. Describe the components of the lubrication system.</p> <ul style="list-style-type: none"> <li>a. Identify and differentiate among the different types of lubrication systems commonly found on small engines.</li> <li>b. Select lubricants by grade and viscosity.</li> <li>c. Inspect and service the components of a crankcase ventilation system.</li> </ul>
<p>5. Describe components of the gasoline fuel system.</p> <ul style="list-style-type: none"> <li>a. Describe the selection and storage of different fuels for two-stroke and four-stroke cycle engines.</li> <li>b. Identify different classifications of two-cycle mixing oils.</li> <li>c. Prepare premixed fuel and oil solutions for a given two-stroke cycle engine.</li> <li>d. Test a fuel mixture for alcohol contamination.</li> <li>e. Identify components of a carburetor-type fuel system and their functions.</li> <li>f. Remove, disassemble, service, and reassemble carburetors.</li> </ul>

- |  |
|--|
| <ul style="list-style-type: none"> <li>g. Service the fuel supply system (fuel tank, pump, lines, and filters).</li> <li>h. Service electronic fuel injection systems.</li> <li>i. Service air filtering systems including foam-type, pleated paper, oil bath, and canister systems.</li> </ul>  |
| <ul style="list-style-type: none"> <li>6. Describe and service the engine ignition system. <ul style="list-style-type: none"> <li>a. Identify and describe the components of common ignition systems used in small engines including magneto, battery, and electronic systems.</li> <li>b. Test and service ignition systems, including sparkplugs, switches, conductors, and magnetos.</li> </ul> </li> </ul> |

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

#### Category 1: Two and Four Stroke Gasoline Engines

##### Subcategory 100: Small Engine Fundamentals

102: Two Stroke Cycle Engine

103: Four Stroke Cycle Engine

104: Engine Components

##### Subcategory 200: Maintenance

201: Lubrication Fundamentals

202: Lubrication – Engine Maintenance

##### Subcategory 300: 2-Stroke Cycle Gasoline Engine

301: Test a 2-Stroke

##### Subcategory 400: 2-Stroke Cycle Gasoline Engine Overhaul

##### Subcategory 600: 4-Stroke Gasoline Engine Service

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)

- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)
- L1 Usage (pronoun, tense, subject/verb agreement, adjective, adverb)
- L2 Sentence Formation (fragments, run-on, clarity)
- L3 Paragraph Development (topic sentence, supporting sentence, sequence)
- L4 Capitalization (proper noun, titles)
- L5 Punctuation (comma, semicolon)
- L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)

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### *21<sup>st</sup> Century Skills*

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- CS Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

### **SUGGESTED REFERENCES**

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**Course Name:** Turf Equipment Shop Management

**Course Abbreviation:** TEM 1123

**Classification:** Vocational-Technical Elective

**Description:** Provides students with skills and knowledge related to management and operation of a small engine repair shop. Includes instruction in shop safety and OSHA regulations, shop tools and equipment, shop design, overall shop maintenance, and inventory control. (3 sch: 2 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>	
1.	<p>Apply personal safety practices and protective devices.</p> <ul style="list-style-type: none"> <li>a. Identify and describe practices for safe lifting and transport of materials.</li> <li>b. Identify and describe the safe and proper use of personal safety equipment including ear, eye, and skin protection, personal clothing and accessories.</li> <li>c. Apply precautions to prevent carbon monoxide poisoning.</li> <li>d. Describe and apply procedures for lock out and tag out operations.</li> <li>e. Associate the colors of the safety color code with hazardous conditions.</li> <li>f. Identify and apply fire safety procedures including selection of containment methods for different classes of fire and evacuation procedures.</li> <li>g. Describe and apply housekeeping practices to maintain a safe and orderly workplace.</li> <li>h. Interpret hazardous materials safety data sheets (MSDS) to include type of hazard, precautions to follow in using the material, procedures for spills or leakage, and disposal.</li> <li>i. Identify and describe the functions of different agencies associated with safety and environmental concerns including OSHA, EPA, Mississippi Department of Environmental Quality, and local authorities.</li> <li>j. Perform supervisory duties associated with small engine repair shops including job assignment, supervision of other workers, work schedules, etc.</li> </ul>
2.	<p>Apply practices associated with repair shop operations.</p> <ul style="list-style-type: none"> <li>a. Maintain an accurate parts inventory.</li> <li>b. Complete a work order.</li> <li>c. Locate and interpret engine identification numbers.</li> <li>d. Use labor and time guides to determine the cost of a job.</li> <li>e. Identify and order specific parts using Internet, microfiche, and manuals.</li> <li>f. Locate and interpret OEM specifications.</li> <li>g. Complete warranty registration and documentation.</li> <li>h. Define industry specific terms related to small engines.</li> <li>i. Apply and practice effective customer communication skills.</li> <li>j. Explain basic operation and safety precautions/devices on equipment to customers.</li> </ul>

3. Demonstrate the safe and proper use of hand and small power tools and equipment.
  - a. Identify safety precautions and procedures to follow in cleaning equipment using steam, water pressure, and solvents.
  - b. Identify and use general hand tools (wrenches, screwdrivers, sockets, etc.) properly to include cleaning and storing.
  - c. Identify and use special tools associated with small engine component specific operations such as fly wheel pullers, seal drivers, torque wrenches, etc.)
  - d. Use electrical tools and equipment such as drills, drill presses, drivers, and heat guns, safely, and properly.
  - e. Use hydraulic presses, vises, and lifting/hoisting devices safely and properly.
4. Describe career opportunities in small engine and turf equipment repair.
  - a. Describe career pathways in small engine and turf equipment technology.
  - b. Identify professional certification programs for small engine and turf equipment technicians.
  - c. Identify opportunities for continuing education and training in small engine and turf equipment technology.
  - d. Discuss the role of professional and industry associations in small engine and turf equipment repair.

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

- Category 1: Two and Four Stroke Gasoline Engines  
 Subcategory 100: Small Engine Fundamentals  
     101: Engine Identification  
     104: Engine Components

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
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- M5 Decimals (addition, subtraction, multiplication, division)

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- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)
- L1 Usage (pronoun, tense, subject/verb agreement, adjective, adverb)
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- L3 Paragraph Development (topic sentence, supporting sentence, sequence)
- L4 Capitalization (proper noun, titles)
- L5 Punctuation (comma, semicolon)
- L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
- S1 Vowel (short, long)
- S2 Consonant (variant spelling, silent letter)
- S3 Structural Unit (root, suffix)

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### *21<sup>st</sup> Century Skills*

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- CS2 Financial, Economic, and Business Literacy
- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

## **SUGGESTED REFERENCES**

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- AAVIM. (2004). *Developing safety skills for the shop and home*. Winterville, GA: AAVIM.
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**Course Name:** Cutting System Maintenance

**Course Abbreviation:** TEM 1134

**Classification:** Vocational-Technical Elective

**Description:** A course to develop skills and knowledge related to the maintenance and repair of cutting equipment used in landscape and turf operations including mowers, trimmers, edgers, and saws. Includes instruction in drive systems, blade sharpening and height adjustment, reel grinding and adjustment, and chain saw chain sharpening and adjustment. (4 sch: 3 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>
1. Compare features and uses of cutting devices used in landscape and turf maintenance. <ol style="list-style-type: none"> <li>Compare and contrast the features and applications of rotary and reel mowers.</li> <li>Compare and contrast the different types of edgers.</li> <li>Identify and apply safety precautions in operating and repairing cutting equipment including personal protection.</li> </ol>
2. Inspect and repair rotary mowers. <ol style="list-style-type: none"> <li>Identify the types of rotary mowers.</li> <li>Identify, inspect, and adjust/repair a rotary mower deck including pulleys and shafts, belts, mounts and brackets, leveling devices, and blade.</li> <li>Sharpen and balance a rotary mower blade using a side grinder, a bench grinder, and a commercial blade grinder.</li> </ol>
3. Inspect and repair reel mower assemblies. <ol style="list-style-type: none"> <li>Identify the types of reel mowers and their applications.</li> <li>Identify, inspect, and adjust/repair the components of a reel mower assembly including reel, bed knife, supports, rollers, mounting hardware, bearings, reel and bed knife adjustments, and height of cut adjustments.</li> <li>Describe the procedure for grinding a reel.</li> <li>Demonstrate the procedure for backlapping a reel.</li> </ol>
4. Inspect and repair trimmers and edgers. <ol style="list-style-type: none"> <li>Identify the types of trimmers and edgers and their attachments and applications.</li> <li>Discuss selection of cutting string diameter and its effects.</li> <li>Inspect and replace if needs a clutch.</li> <li>Change a string trimmer head.</li> <li>Rewind a string trimmer head cartridge.</li> <li>Replace an edger blade.</li> </ol>

5. Inspect and repair/sharpen a chain saw bar and chain assembly.
  - a. Identify the components of a chain and bar assembly.
  - b. Identify the different types of chains by pitch, cutter, and gauge and their effect on the saw operation.
  - c. Inspect a chain and bar assembly to include sharpening or replacing the chain, inspecting the bar and drive sprocket, reinstalling the bar and sprocket, and tensioning the chain.

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

- Subcategory 200: Maintenance
  - 201: Lubrication Fundamentals
- Subcategory 700: Failure Analysis
- Category 2: Drivelines/Hydraulics/Hydrostatic
  - Subcategory 400: Drivelines
    - 401: Driveline Fundamentals

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)

- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)
- L1 Usage (pronoun, tense, subject/verb agreement, adjective, adverb)
- L2 Sentence Formation (fragments, run-on, clarity)
- L3 Paragraph Development (topic sentence, supporting sentence, sequence)
- L4 Capitalization (proper noun, titles)
- L5 Punctuation (comma, semicolon)
- L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)

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### *21<sup>st</sup> Century Skills*

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- CS2 Financial, Economic, and Business Literacy
- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

## **SUGGESTED REFERENCES**

### Books

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- MAVCC. (1999). *Power product: Lawn and garden equipment*. Stillwater, OK: Author.
- Oregon Distribution. (2004). *Maintenance and safety manual for saw chain, guide bars, and drive sprockets*. Guelph, OR: Author.
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### Videos:

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### Web sites

Shindaiwa, Inc. (2006). *Shindaiwa outdoor power equipment*. Retrieved July 20, 2006, from <http://www.shindaiwa.com/>

**Course Name:** DC Electrical Systems

**Course Abbreviation:** TEM 1214

**Classification:** Vocational-Technical Elective

**Description:** A course to develop skills and knowledge related to the operating principles of direct current circuits. Includes instruction on basic electrical principles, safety procedures, batteries, conductors, and switches. (4 sch: 3 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>	
1.	Apply basic terms and principles of DC electricity. <ol style="list-style-type: none"> <li>Define electrical terms such as amps, volts, resistance, ohms, and watts.</li> <li>Describe the relationship of magnetism and electricity.</li> <li>Identify and describe the common sources of electricity in small engines.</li> <li>Compare and contrast 12 volt direct current to 120 volt alternating current.</li> <li>Trace the flow of electricity in a circuit diagram.</li> <li>Identify common components of electrical circuits in small engines.</li> <li>Measure voltage, amperage, and resistance in a circuit using both analog and digital meters.</li> </ol>
2.	Inspect and service a battery. <ol style="list-style-type: none"> <li>Describe the design and operation of lead-acid storage batteries and their construction.</li> <li>Identify batteries by type, rating, and voltage.</li> <li>Test specific gravity of a battery.</li> <li>Test a battery under load.</li> <li>Clean and service a battery.</li> <li>Charge a battery.</li> <li>Remove and replace a battery.</li> <li>Demonstrate procedure for safe and proper jump starting of an engine.</li> </ol>
3.	Demonstrate basic skills and knowledge related to electrical circuits in small engines. <ol style="list-style-type: none"> <li>Trace the flow of current in series, parallel, and series-parallel circuits.</li> <li>Draw circuits using symbols.</li> <li>Identify and describe the use of circuit protection devices including fuses, fusible links, and circuit breakers.</li> <li>Apply circuit testing procedures to detect opens, shorts, and grounds.</li> <li>Repair or replace circuit wiring to including selecting proper wire size and connection device or method.</li> <li>Identify the normal position of switches in a circuit.</li> </ol>
4.	Demonstrate basic skills related to starting and charging circuits. <ol style="list-style-type: none"> <li>Identify and describe the functions and operation of an electric starting circuit.</li> <li>Inspect, test, and repair charging circuits as needed.</li> <li>Identify and describe the functions and operation of an electric charging circuit.</li> <li>Inspect, test, and repair starting circuits.</li> </ol>

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

#### Category 3: Electrical

##### Subcategory 100: Electrical Systems

##### 101 Electrical Theory

#### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)

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#### *21<sup>st</sup> Century Skills*

- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

**SUGGESTED REFERENCES**

John Deere Publishing. (2004). *Compact equipment: Electrical systems*. Moline, IL: Author.

Radcliff, R. & Roark, D. (2003). *Small engines* (2<sup>nd</sup> ed.). Homewood, IL: American Technical.

Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (text). Tinley Park, IL: Goodheart-Willcox.

Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (workbook). Tinley Park, IL: Goodheart-Willcox.

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Schuster, W. (2001). *Outdoor Power Equipment Electrical Systems*. Ann Arbor, MI: Tech Horizons.

Journals and Magazines

*Compact Equipment*. Peninsula, OH: Benjamin Media.

*Landscape Management*. Newton, MA.: Questex Media.

*Lawn and Landscape*. Cleveland, OH: G.I.E. Media.

**Course Name:** Turf Equipment Mechanics II

**Course Abbreviation:** TEM 1224

**Classification:** Vocational-Technical Elective

**Description:** A continuation of Turf Mechanics I with emphasis on cooling systems, engine governance, multi-cylinder engines, and diesel fuel systems, (4 sch: 3 hr. lecture, 2 hr. lab)

**Prerequisites:** TEM 1114

<b>Competencies and Suggested Objectives</b>
1. Apply theories and principles related to engine cooling systems. <ol style="list-style-type: none"> <li>a. Identify the components of an air cooled engine cooling system and their functions.</li> <li>b. Inspect, service, and repair as needed an air cooled engine cooling system.</li> <li>c. Identify the components of a liquid coolant system and their functions.</li> <li>d. Inspect, service, and repair a liquid coolant system to include testing coolant, pressure testing the system, and flushing the system.</li> </ol>
2. Apply theories and principles related to engine governing systems. <ol style="list-style-type: none"> <li>a. Identify the different types of governing system and describe how they operate.</li> <li>b. Inspect, service, and repair if necessary a pneumatic governor.</li> <li>c. Inspect, service, and repair if necessary a mechanical governor.</li> </ol>
3. Apply theories and principles related to multi-cylinder engines. <ol style="list-style-type: none"> <li>a. Inspect, test, and repair or replace the fuel intake system.</li> <li>b. Inspect, test, and repair or replace valve train components.</li> <li>c. Inspect, test, and repair or replace cylinder heads.</li> <li>d. Inspect, test, and repair or replace engine block components (pistons, cylinders, crankshaft, connection rods, bearings, seals, etc.)</li> <li>e. Inspect, test, service and repair/replace a pressurized lubrication system.</li> <li>f. Inspect, service and repair/replace exhaust systems components.</li> <li>g. Inspect, service and replace as needed emission control system devices.</li> <li>h. Inspect, service and replace as needed monitoring devices such as oil pressure, coolant temperature, and electrical system gages and sensors.</li> <li>i. Disassemble, inspect, repair or replace components, and reassemble a multi-cylinder engine.</li> </ol>
4. Apply theories and principles related to diesel engine service and repair. <ol style="list-style-type: none"> <li>a. Describe the basic theories of diesel engine operation to include compression ignition, direct fuel injection, engine design, etc.</li> <li>b. Identify the components of a typical diesel fuel injection system and describe their functions and operation.</li> <li>c. Inspect, test, service and/or replace diesel engine starting system aids including glow plugs and fuel heaters.</li> <li>d. Inspect, test, service and/or repair the air induction system.</li> <li>e. Describe the operations and functions of power enhancers such as turbo chargers and super chargers.</li> </ol>

- f. Describe precautions and procedures for safely storing diesel fuels.
- g. Service a diesel engine fuel system to include replacing filters and bleeding the system.
- h. Inspect, test, and replace fuel injectors if necessary.

## STANDARDS

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The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

#### Category 1: Two and Four Stroke Gasoline Engines

##### Subcategory 100: Small Engine Fundamentals

- 101: Engine Identification
- 102: Two Stroke Cycle Engine
- 103: Four Stroke Cycle Engine
- 104: Engine Components

##### Subcategory 200: Maintenance

- 201: Lubrication Fundamentals
- 202: Lubrication – Engine Maintenance

##### Subcategory 300: 2-Stroke Cycle Gasoline Engine

- 301: Test a 2-Stroke

##### Subcategory 400: 2-Stroke Cycle Gasoline Engine Overhaul

##### Subcategory 500: 4-Stroke Gasoline Engine Diagnosis

##### Subcategory 600: 4-Stroke Gasoline Engine Service

##### Subcategory 700: Failure Analysis

#### Category 3: Electrical

##### Subcategory 100: Electrical Systems

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
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- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)

- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)

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### *21<sup>st</sup> Century Skills*

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- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

## **SUGGESTED REFERENCES**

### Books

- Equipment and Engine Training Council. (2004). *Four stroke study guide – power equipment technology*. Hartland, WI: Author.
- Equipment and Engine Training Council. (2001). *Program assessment manual – power equipment technology*. Hartland, WI: Author.
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- Radcliff, R. & Roark, D. (2003). *Small engines* (2<sup>nd</sup> ed.). Homewood, IL: American Technical.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (text). Tinley Park, IL: Goodheart-Willcox.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (workbook). Tinley Park, IL: Goodheart-Willcox.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (instructor guide). Tinley Park, IL: Goodheart-Willcox.
- Schuster. W. (1999). *Small engine technology*. Florence, KY: Thompson Learning.

### Journals and Magazines

*Compact Equipment*. Peninsula, OH: Benjamin Media.

*Landscape Management*. Newton, MA.: Questex Media.

*Lawn and Landscape*. Cleveland, OH: G.I.E. Media.

### Videos

Goodheart-Willcox. (n.d.). *Small gas engines construction and operation* [Videotape]. Tinley Park, IL: Author

Goodheart-Willcox. (n.d.). *Small gas engines disassembly* [Videotape]. Tinley Park, IL: Author

Goodheart-Willcox. (n.d.). *Small gas engines reassembly* [Videotape]. Tinley Park, IL: Author

**Course Name:** Chassis Repair and Maintenance

**Course Abbreviation:** TEM 1243

**Classification:** Vocational-Technical Elective

**Description:** A course to develop skills and knowledge related to small equipment chassis repair and maintenance. Includes instruction in oxyfuel cutting and arc welding as well as painting and other chasis maintenance. (3 sch: 2 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>	
1.	Perform basic oxyfuel cutting operations <ol style="list-style-type: none"> <li>Assemble an oxyfuel cutting torch unit to include attaching regulators and torch tips and checking for leaks and proper operation.</li> <li>Set up, light, and adjust an oxyfuel cutting torch to cut steel.</li> <li>Shut down an oxyfuel cutting torch to include bleeding the system.</li> <li>Use an oxyfuel cutting torch to cut various types of metal in various positions</li> <li>Use an oxyfuel cutting torch to heat metal.</li> </ol>
2.	Perform basic electrical arc welding <ol style="list-style-type: none"> <li>Identify and describe the use of different types of arc welders including type of metal that can be welded by each.</li> <li>Identify the different positions and types of welds.</li> <li>Set up an arc welder for a given welding job.</li> <li>Perform basic arc welding operations using shielded metal arc welding equipment. (SMAW)</li> <li>Perform basic arc welding operations using gas metallic arc welding equipment. (GMAW)</li> </ol>
3.	Recondition and repair chassis. <ol style="list-style-type: none"> <li>Identify areas on a chassis that can be repaired or reconditioned.</li> <li>Prepare chassis for painting.</li> <li>Spot paint a chassis repair.</li> </ol>

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

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Category 2: Drivelines/Hydraulics/Hydrostatic  
 Subcategory 400: Drivelines  
 401: Driveline Fundamentals

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*Related Academic Standards*


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- R1 Interpret Graphic Information (forms, maps, reference sources)
- R3 Recall Information (details, sequence)
- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)

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*21<sup>st</sup> Century Skills*


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- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

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**SUGGESTED REFERENCES**


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Books

- Radcliff, R. & Roark, D. (2003). *Small engines* (2<sup>nd</sup> ed.). Homewood, IL: American Technical.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (text). Tinley Park, IL: Goodheart-Willcox.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (workbook). Tinley Park, IL: Goodheart-Willcox.
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<http://millerwelds.com/education/library.html>

Thermadyne Inc. (2006). *Victor Professional*. Retrieved July 21, 2006, from  
<http://thermadyne.com/victor/>

**Course Name:** Turf Equipment Diagnostics I

**Course Abbreviation:** TEM 1144

**Classification:** Vocational-Technical Elective

**Description:** A course to develop skills and knowledge associated with the basics of equipment diagnostics. Instruction is provided on tools and equipment used in diagnosis, fasteners, fluids, and measurement devices. (3 sch: 2 hr. lecture, 2 hr. lab)

**Prerequisites:** None

<b>Competencies and Suggested Objectives</b>	
1.	Demonstrate the use of special tools, equipment, and supplies used diagnosing and servicing small equipment. <ol style="list-style-type: none"> <li>a. Demonstrate the use of special tools and instruments used in diagnosing engine and equipment problems to include compression testers, leakdown testers, crankcase pressure testers, and tachometers.</li> <li>b. Demonstrate the use of measurement tools and instruments for diagnosis including rulers, micrometers, calipers, dial indicators, bore gages, and feeler gages.</li> <li>c. Identify, describe the use of, and select fasteners including bolts (grade, thread, size, etc.), nuts, washers, wire ties, glues and adhesives, sealants, other specialty fasteners, pins and keys.</li> <li>d. Repair and restore male and female threads.</li> </ol>
2.	Apply principles of failure analysis related to engine performance. <ol style="list-style-type: none"> <li>a. Identify common causes of engine and equipment failure and describe their characteristics.</li> <li>b. Differentiate between normal wear and abnormal wear.</li> </ol>
3.	Apply principles of troubleshooting on small engines and equipment. <ol style="list-style-type: none"> <li>a. List the general steps in proper sequence for troubleshooting equipment.</li> <li>b. Troubleshoot a single cylinder two-cycle engine.</li> <li>c. Troubleshoot a single cylinder four-cycle engine.</li> <li>d. Troubleshoot a multi-cylinder engine.</li> <li>e. Troubleshoot a diesel engine.</li> </ol>
4.	Run diagnosis on steering and suspension system problems. <ol style="list-style-type: none"> <li>a. Identify and describe the functions of the components of a manual steering system.</li> <li>b. Identify and describe the functions of the components of a power assisted steering system.</li> <li>c. Inspect, test, and adjust or replace steering system components.</li> <li>d. Inspect, service, and replace if necessary, suspension system components including tires, wheels, bearings, springs, and shock absorbers.</li> </ol>
5.	Run diagnosis on brake system components. <ol style="list-style-type: none"> <li>a. Identify the components of a brake system to include pedals, lines and rods, shoes, and drums.</li> <li>b. Inspect, service, and repair brake systems.</li> </ol>

## STANDARDS

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#### Category 1: Two and Four Stroke Gasoline Engines

##### Subcategory 100: Small Engine Fundamentals

- 101: Engine Identification
- 102: Two Stroke Cycle Engine
- 103: Four Stroke Cycle Engine
- 104: Engine Components

##### Subcategory 200: Maintenance

- 201: Lubrication Fundamentals
- 202: Lubrication – Engine Maintenance

##### Subcategory 300: 2-Stroke Cycle Gasoline Engine

- 301: Test a 2-Stroke

##### Subcategory 400: 2-Stroke Cycle Gasoline Engine Overhaul

##### Subcategory 500: 4-Stroke Gasoline Engine Diagnosis

##### Subcategory 600: 4-Stroke Gasoline Engine Service

##### Subcategory 700: Failure Analysis

#### Category 2: Drivelines/Hydraulics/Hydrostatic

##### Subcategory 100: Hydraulic Systems

- 101: Hydraulic System Principles
- 102: Hydraulic System Safety

##### Subcategory 200: Hydraulic Component Components

- 201: Hydraulic Component Theory

##### Subcategory 300: Hydraulic System Diagnosis

- 301: Hydraulic System Service Procedures

##### Subcategory 400: Drivelines

- 401: Driveline Fundamentals

#### Category 3: Electrical

##### Subcategory 100: Electrical Systems

- 101 Electrical Theory

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
- M1 Addition of Whole Numbers (no regrouping, regrouping)

- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)
- L1 Usage (pronoun, tense, subject/verb agreement, adjective, adverb)
- L2 Sentence Formation (fragments, run-on, clarity)
- L3 Paragraph Development (topic sentence, supporting sentence, sequence)
- L4 Capitalization (proper noun, titles)
- L5 Punctuation (comma, semicolon)
- L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
- S1 Vowel (short, long)
- S2 Consonant (variant spelling, silent letter)
- S3 Structural Unit (root, suffix)

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### *21<sup>st</sup> Century Skills*

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- CS1 Global Awareness
- CS2 Financial, Economic, and Business Literacy
- CS3 Civic Literacy
- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

### **SUGGESTED REFERENCES**

#### Books

- John Deere Publishing. (2004). *Compact equipment: Electrical systems*. Moline, IL: Author.
- John Deere Publishing. (2004). *Compact equipment: Engines*. Moline, IL: Author.

Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (text). Tinley Park, IL: Goodheart-Willcox.

Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (workbook). Tinley Park, IL: Goodheart-Willcox.

Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (instructor guide). Tinley Park, IL: Goodheart-Willcox.

Webster, J. (2001). *Outdoor power equipment*. Albany, NY: Delmar.

Webster, J. (2001). *Repairing your outdoor power equipment*. Albany, NY: Delmar

### Videos

Goodheart-Willcox. (n.d.). *Small gas engines troubleshooting/tune up* [Videotape]. Tinley Park, IL: Author.

**Course Name:** Turf Equipment Diagnostics II

**Course Abbreviation:** TEM 1234

**Classification:** Vocational-Technical Elective

**Description:** A course to provide skills and knowledge related to the operation and diagnosis of advanced systems on small equipment. Includes instruction on hydraulics and driveline systems. (4 sch: 3 hr. lecture, 2 hr. lab)

**Prerequisites:** Turf Equipment Diagnostics I

<b>Competencies and Suggested Objectives</b>	
1. Diagnose manual transmissions/transaxle and driveline problems.	<ul style="list-style-type: none"> <li>a. Identify different types of drive belts and problems associated with each type.</li> <li>b. Inspect and adjust/replace drive belts and pulleys.</li> <li>c. Identify different types of drive chains and problems associated with each type.</li> <li>d. Inspect and adjust/replace drive chains and sprockets.</li> <li>e. Identify the components of a manual transmission/transaxle and describe each component function.</li> <li>f. Inspect, adjust, and repair/replace manual transmission/transaxles.</li> <li>g. Identify different clutches used in small equipment and problems associated with each type.</li> <li>h. Inspect, adjust, and repair/replace clutches.</li> <li>i. Inspect, adjust, and repair/replace power take off systems.</li> </ul>
2. Diagnose hydraulic system problems.	<ul style="list-style-type: none"> <li>a. Apply personal protection and safety procedures for working on hydraulic systems.</li> <li>b. Describe basic principles of hydraulic system operation.</li> <li>c. Draw a simple hydraulic circuit using common symbols for components.</li> <li>d. Identify the different types of hydraulic systems used on small equipment and problems associated with each type.</li> <li>e. Identify hydraulic system components and describe the function of each.</li> <li>f. Describe the different types of hydraulic fluids by type of fluid, rating, and viscosity.</li> <li>g. Identify and describe the use of fittings on hydraulic systems including thread size, o-rings, flares, and compression.</li> <li>h. Inspect, test, diagnose, and repair/replace hydraulic system components, including pumps, filters, lines and hoses, control valves, cylinders, and motors.</li> </ul>
3. Diagnose hydrostatic transmission/transaxle problems.	<ul style="list-style-type: none"> <li>a. Describe the components of all types of hydrostatic transmissions/transaxles and discuss the function of each.</li> <li>b. Trace the power flow through a hydrostatic transmission/transaxle.</li> <li>c. Inspect, test, service, adjust, and repair/replace a hydrostatic transmission/transaxle.</li> </ul>
4. Perform preventive maintenance.	<ul style="list-style-type: none"> <li>a. Perform preventive maintenance per manufacturer's specifications including chassis and power train service, engine oil and filter service, air cleaner service, fuel system service, cooling system service,</li> </ul>

## STANDARDS

### *Proposed Standards for Mississippi Postsecondary Small Engine and Turf Equipment Repair Technology Programs*

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

#### Category 2: Drivelines/Hydraulics/Hydrostatic

##### Subcategory 100: Hydraulic Systems

101: Hydraulic System Principles

102: Hydraulic System Safety

##### Subcategory 200: Hydraulic Component Components

201: Hydraulic Component Theory

##### Subcategory 300: Hydraulic System Diagnosis

301: Hydraulic System Service Procedures

##### Subcategory 400: Drivelines

401: Driveline Fundamentals

#### Category 3: Electrical

##### Subcategory 100: Electrical Systems

### *Related Academic Standards*

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
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- M9 Algebraic Operations
- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)

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## 21<sup>st</sup> Century Skills

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- CS4 Information and Communication Skills
- CS5 Thinking and Problem-Solving Skills
- CS6 Interpersonal and Self-Directional Skills

## SUGGESTED REFERENCES

### Books

- Industrial Training Zone. (2004). *Basic hydraulics: Fluid power training*. Lindon, UT: Author.
- John Deere Publishing. (2001). *Compact equipment: Power Trains*. Moline, IL: Author.
- John Deere Publishing. (2006). *Fundamentals of service: Hydraulics*. Moline, IL: Author.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (text). Tinley Park, IL: Goodheart-Willcox.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (workbook). Tinley Park, IL: Goodheart-Willcox.
- Roth, A. C. (2004). *Small gas engines: Fundamentals, service, troubleshooting, repair, applications* (instructor guide). Tinley Park, IL: Goodheart-Willcox.
- Webster, J. (2001). *Outdoor power equipment*. Albany, NY: Delmar.
- Webster, J. (2001). *Repairing your outdoor power equipment*. Albany, NY: Delmar
- Vickers, Inc. (1992). *Vickers industrial hydraulics manual* (4<sup>th</sup> ed.). Eden Prairie, MN. Author.

**Course Name:** Special Problem in Small Engine and Turf Equipment Repair Technology

**Course Abbreviation:** TEM 291(1-3)

**Classification:** Vocational-Technical Elective

**Description:** A course designed to provide the student with practical application of skills and knowledge gained in other Small Engine and Turf Equipment Repair Technology courses. The instructor works closely with the student to insure that the selection of a project will enhance the student's learning experience. (1-3 sch: 2-6 hr. lab)

**Prerequisites:** Minimum of 12 sch TEM related courses or consent of instructor

<b>Competencies and Suggested Objectives</b>
1. Develop a written plan which details the activities and projects to be completed. <ol style="list-style-type: none"> <li>a. Use a written plan which details the activities and projects to be completed.</li> <li>b. Perform written occupational objectives in the special problem.</li> </ol>
2. Assess accomplishment of objectives. <ol style="list-style-type: none"> <li>a. Prepare daily written assessments of accomplishment of objectives.</li> <li>b. Present weekly written reports to the instructor of activities performed and objectives accomplished.</li> </ol>
3. Use and follow a set of written guidelines for the special problem. <ol style="list-style-type: none"> <li>a. Develop and follow a set of written guidelines for the special problem.</li> </ol>

## STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

## SUGGESTED REFERENCES

Specific references for use in this course will depend upon the nature of the problem under investigation.

**Course Name:** Supervised Work Experience in Small Engine and Turf Equipment Repair Technology

**Course Abbreviation:** TEM 292(1-6)

**Description:** A course which is a cooperative program between industry and education designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours. (1-6 sch: 3-18 hr. externship)

**Prerequisite:** Consent of instructor and completion of at least one semester of advanced coursework in Program Name.

<b>Competencies and Suggested Objectives</b>
1. Follow a set of instructor-written guidelines for the supervised work experience program.
2. Apply skills needed to be a viable member of the workforce. <ol style="list-style-type: none"> <li>a. Prepare a description of skills to be developed in the supervised work experience program.</li> <li>b. Practice skills needed to be a viable member of the workforce.</li> </ol>
3. Practice human relationship skills in the supervised work experience program.
4. Practice positive work habits, responsibilities, and ethics.
5. Develop written occupational objectives in the supervised work experience program.
6. Assess performance of occupational skills. <ol style="list-style-type: none"> <li>a. Prepare daily written assessments of work performance as specified in the occupational objectives.</li> <li>b. Present weekly written reports to the instructor of activities performed and objectives accomplished.</li> </ol>

## STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

## SUGGESTED REFERENCES

Specific references for use in this course will depend upon the nature of the problem under investigation.

**Course Name:** Work-Based Learning I, II, III, IV, V, and VI

**Course Abbreviation:** WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3)

**Classification:** Free Elective

**Description:** A structured work-site learning experience in which the student, program area teacher, Work-Based Learning Coordinator, and worksite supervisor/mentor develop and implement an educational training agreement. Designed to integrate the student's academic and technical skills into a work environment. May include regular meetings and seminars with school personnel and employers for supplemental instruction and progress reviews. (1-3 sch: 3-9 hours externship)

**Prerequisite:** Concurrent enrollment in vocational-technical program area courses

<b>Competencies and Suggested Objectives</b>	
1.	Apply technical skills and related academic knowledge needed to be a viable member of the workforce. <ol style="list-style-type: none"> <li>a. Demonstrate technical skills necessary to complete job requirements.</li> <li>b. Demonstrate academic skills necessary to complete job requirements.</li> <li>c. Perform tasks detailed in an educational training agreement at the work setting.</li> </ol>
2.	Apply general workplace skills to include positive work habits necessary for successful employment. <ol style="list-style-type: none"> <li>a. Demonstrate appropriate human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service.</li> <li>b. Utilize time, materials, and resource management skills.</li> <li>c. Use critical thinking skills such as problem-solving, decision making, and reasoning.</li> <li>d. Acquire, evaluate, organize, maintain, interpret, and communicate information.</li> </ol>

## STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

## SUGGESTED REFERENCES

Specific references for this course will depend upon the nature of the problem under investigation.

## Recommended Tools and Equipment

### CAPITALIZED ITEMS

1. Basic student tool set (1 per student)
  - 1/4" drive socket set standard and deep 3/16" – 9/16" and metric (5mm – 15mm)
  - 1/4" drive ratchet, universal joint, and extensions
  - 3/8" drive socket set standard 5/16" – 7/8" and metric (10mm – 19mm)
  - 3/8" ratchet with universal joint and extensions
  - 1/2" socket set standard and deep 7/16" – 1 1/4" and metric (10mm – 24mm)
  - 1/4", 3/8" and 1/2" pull handles
  - 1/4", 3/8" and 1/2" torque wrenches
  - Combination wrench set (1/4" to 1 1/4" and 10mm – 24mm)
  - Punch and chisel set
  - Tongue and groove, regular, needle nose and cutting pliers
  - Open end adjustable wrenches (2)
  - Allen wrenches 1.5mm – 10mm and .028" – 3/8"
  - Screwdriver set Standard and Phillips
  - Torx driver set
  - 16 oz. ball pen hammer
  - 1.5 oz brass hammer
  - Soft face hammer
  - 1/2" air impact driver
  - 1/2" Impact socket set socket set standard and deep 7/16" – 1 1/4" and metric (10mm – 24mm)
  - 3/8" cordless electric impact driver
  - 3/8" impact socket set standard 5/16" – 7/8" and metric (10mm – 19mm)
  - Convertible snap ring pliers
  - Digital volt-ohm meter
  - Circuit continuity tester
  - Gasket scrapper
  - Magnetic pickup tool
  - Locking jaw pliers (ViseGrip)
  - Tool chest or cabinet
  - Flashlight
  - Mechanics gloves
  - Rubber safety gloves
  - Battery terminal cleaner
  - Battery terminal pliers
  - Safety glasses
  - Hearing protection
2. Air compressor with regulator and hoses (1)
3. Mechanics benches with vise (1 per 2 students)
4. Oxyfuel cutting torch set
5. Hydraulic floor hoist
6. Hydraulic press with adapters.
7. Parts cleaning tank with gloves

8. Hydraulic pressure testing kit
9. SMAW welder (2)
10. GMAW welder (2)
11. Pressure washer
12. Hydraulic or pneumatic lift table (2)
13. String trimmer (2)
14. Chain saw (2)
15. Reel mower
16. Rotary mower (residential) (2)
17. Zero turn hydrostatic mower
18. Edger (2)
19. Utility vehicle (Gator)
20. Commercial 20" rotary mower
21. Gasoline pole pruner
22. Compact diesel engine
23. Stationary two-stroke engines (4)
24. Stationary four-stroke engines (4)
25. Valve and seat grinder
26. Computer with monitor, printer, and Internet access (1 per 2 students)
27. Flammable material cabinet
28. Engine dynamometer (0-50 hp)

#### NON-CAPITALIZED ITEMS

1. Bench grinder (2)
2. Drill (1/2" variable speed reversible) with drill bits
3. Drill (3/3" variable speed reversible) with drill bits
4. Extension cords (1 per 2 students)
5. Hoists (2)
6. Master puller set
7. Oil filter wrench
8. Remote starter switch
9. Soldering gun
10. Tap and die set (standard and metric)
11. Thread repair kit (standard and metric)
12. Tire pressure gauge (4)
13. Trouble/work light (4)
14. Hose clamp pliers (4)
15. Impact screwdriver set (1)
16. Waste oil receptacle
17. Hack saw (4)
18. Battery charger/starter (2)
19. Battery load tester (2)
20. Battery hydrometer
21. 6" steel ruler (4)
22. Cylinder bore gauge (2)
23. Depth micrometer (2)

24. Inside micrometer set (2)
25. Outside micrometer set (2)
26. Feeler gauge set (4)
27. Dial calipers (metric and standard) (2)
28. Dial indicator with base (2)
29. Engine tachometer (2)
30. Multimeter (4)
31. Belt tension gauge
32. Piston ring expander (2)
33. Piston groove cleaning tool (2)
34. Antifreeze coolant tester (4)
35. Carburetor nozzle tool
36. Ridge reamer
37. Radiator and pressure cap tester
38. Cylinder hone
39. Valve spring compressor
40. Ring compressor
41. Strap wrench
42. Oil filter wrenches (assorted sizes)
43. Ignition wrenches
44. Spanner wrenches
45. Flywheel puller
46. Hand held side grinder (2)
47. Commercial blade grinder
48. Commercial chain saw sharpener
49. Electrical terminal connecting tool
50. Crankcase pressure tester
51. Spark tester
52. Timing light
53. Oil disposal container
54. Mechanics creeper (4)

(NOTE: Additional manufacturer specific tools will be required to work on specific engines.)

#### RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. Microcomputer integrated software package (word processing, spreadsheet and database)
2. LCD video projector
3. VCR/DVD player
4. TV monitor

## ASSESSMENT

### BLUEPRINT

This program is assessed using the MS-CPAS. The following blueprint summary contains the competencies that are measured when assessing this program. Competencies are grouped into *clusters* and a weight is given to each cluster to determine the number of items needed from each cluster. The numbers of C1s and C2s (item difficulty levels) are also indicated on the blueprint.

## Baseline Competencies

The following competencies and suggested objectives are taken from the publication *Mississippi Curriculum Framework for Postsecondary Small Engine and Turf Equipment Repair Technology*. These competencies and objectives represent the baseline which was used to develop the community/junior college Small Engine and Turf Equipment Repair Technology courses. Students enrolled in postsecondary courses should either (1) have documented mastery of these competencies, or (2) be provided with these competencies before studying the advanced competencies in the Small Engine and Turf Equipment Repair Technology program.

Baseline competencies may be integrated into existing courses in the curriculum or taught as special “Introduction” courses. The “Introduction” courses may be taught for up to six semester hours of institutional credit and may be divided into two courses. If the Baseline Competencies are to be taught as “Introduction” courses, each course should be at least 3 credit hours. The following course number(s) and description should be used:

**Course Name(s):** Introduction to Small Engine and Turf Equipment Repair Technology, Introduction to Small Engine and Turf Equipment Repair Technology I, or Introduction to Small Engine and Turf Equipment Repair Technology II

**Course Abbreviation(s):** IRM 100(3-6), IRM 1013, IRM 1023

**Classification:** Vocational-Technical Core

**Description:** These courses contain the baseline competencies and suggested objectives from the high school curriculum which directly relate to the community college program. The courses are designed for students entering the community college who have had no previous training or documented experience in the field. (3-6 semester hours based upon existing skills for each student, may be divided into 2 courses for a maximum total of 6 hours of institutional credit.)

### Competencies and Suggested Objectives:

1. Identify general safety precautions for the work site and laboratory.
  - a. Describe procedures for maintaining a clean and orderly work site.
  - b. Describe personal behavior and personal safety requirements.
  - c. Describe work site and laboratory organization.
2. Apply personal behavior and safety procedures required at the work site.
  - a. Demonstrate appropriate personal manners, cooperation, work attitude, and goal setting.
  - b. Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices.
3. Apply general safety rules pertaining to hand and stationary power tools.
  - a. Demonstrate rules for hand tools including use, danger points, and observer safety.
  - b. Demonstrate rules for power tools including basic operation, safeguards in place, danger points, observer safety, and electrical safety.

4. Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.
  - a. Demonstrate rules of safety with fire prevention, oil and grease, lifting and hoisting, electricity, compressed air equipment, and batteries.
  - b. Demonstrate safe storage, use, and disposal of hazardous waste.
  - c. Demonstrate procedures to clear airway passages, stop bleeding, protect a wound, and prevent shock.
5. Explain concepts of management and maintenance systems.
  - a. Describe concepts of management of agricultural mechanization.
  - b. Describe concepts of maintenance of agricultural mechanics systems.
6. Explore career concepts associated with agricultural mechanization.
  - a. Identify career opportunities in agricultural mechanization.
  - b. Describe educational requirements for participation in careers in agricultural mechanization.
  - c. Identify emerging technology in agricultural mechanization.
7. Develop related workplace skills required in agricultural mechanization.
  - a. Demonstrate human relations skills required for employees in agricultural mechanization.
  - b. Identify concepts of quality assurance related to agricultural mechanization.
8. Demonstrate applications of physical and mechanical technology in agricultural enterprises.
  - a. Identify applications of physical and mechanical technology in the local area.
  - b. Interpret information in operators' manuals in the use of equipment.
9. Apply physical and mechanical technology in operating equipment.
  - a. Identify equipment function controls.
  - b. Demonstrate safe operation of equipment and machinery.
  - c. Select and use materials handling equipment, including augers, conveyors, pumps, and blowers.
10. Identify computer applications related to physical and mechanical technology.
  - a. Discuss the uses of the computer for information management.
  - b. Demonstrate the use of computers in recordkeeping, including inventory, service records, and financial records.
  - c. Demonstrate the use of test instruments that involve computer applications.
11. Acquire technical information.
  - a. Demonstrate how to search a database on CD-ROM.
  - b. Demonstrate how to use the Internet in obtaining information, such as equipment service data.
12. Prepare and send information using electronic technology.
  - a. Use a computer to prepare reports and spreadsheets.
  - b. Use e-mail to send and receive information.
13. Investigate electrical/electronics systems used on tractors and implements and with stationary systems.
  - a. Interpret symbols, schematics, and blueprints.
  - b. Identify components of electrical systems.
14. Identify parts and functions of charging systems on internal combustion engines.
  - a. Operate charging circuit.
  - b. Test charging circuit operation according to specifications.

15. Identify components and functions of starting systems on internal combustion engines.
  - a. Operate a starting system.
  - b. Test and service components of a starting system according to specifications.
16. Describe how hydraulic and pneumatic systems are used in agriculture.
  - a. Compare and contrast the operation of hydraulic and pneumatic systems.
  - b. Identify the components and functions of hydraulic and pneumatic systems.
  - c. Read and interpret flowcharts depicting hydraulic and pneumatic systems.
17. Apply safe practices in servicing and using hydraulic and pneumatic systems.
  - a. Inspect system components and assess and correct unsafe conditions.
  - b. Service hydraulic and pneumatic systems according to operators' manual specifications following safe practices.
  - c. Operate hydraulic and pneumatic systems safely.
18. Describe the importance and uses of internal combustion engines.
  - a. Explain the meaning of "internal combustion engine" and relate its operation to the combustion triangle.
  - b. Explain and distinguish between the kinds of internal combustion engines, including two-cycle and four-cycle gasoline engines and diesel engines.
  - c. List important principles in the safe and efficient operation of internal combustion engines.
19. Identify parts and functions of internal combustion engine systems.
  - a. Demonstrate lubrication system parts and functions and the kinds of lubricants used.
  - b. Demonstrate cooling system parts and functions.
  - c. Demonstrate fuel system components and functions.
  - d. Demonstrate ignition system components and functions.
20. Disassemble and inspect internal combustion systems.
  - a. Disassemble an internal combustion engine.
  - b. Inspect internal combustion engine parts to specifications.
  - c. Identify failed component parts and obtain replacement parts.
21. Assemble, operate, and test an internal combustion engine following safe and approved procedures.
  - a. Assemble an internal combustion engine according to manufacturer's specifications.
  - b. Operate an assembled engine.
  - c. Test an engine for performance according to manufacturer's specifications.
22. Identify the importance of preventive maintenance.
  - a. Explain the meaning of preventive maintenance.
  - b. Describe the use of an operator's manual in identifying needed maintenance.
  - c. List general preventive maintenance practices.
  - d. Describe the meaning and importance of "maintenance intervals."
23. Identify components and systems on small engines requiring preventive maintenance.
  - a. Use manufacturers' manuals to identify preventive maintenance recommendations.
  - b. Explain the importance of routine maintenance based on manufacturer's recommendations.
  - c. Identify safety practices while performing preventive maintenance activities.
24. Perform basic preventive maintenance service on a small engine.
  - a. Service the air filter on an engine.
  - b. Service the fuel system on an engine.

- c. Service the lubrication system on an engine.
  - d. Service the cooling system on an engine.
  - e. Service the exhaust system on an engine.
  - f. Service the starting system on an engine.
  - g. Service the ignition system on an engine.
25. Identify principles of diagnostics.
- a. Explain the meaning and importance of diagnostics.
  - b. Describe the processes used in diagnostics, including equipment.
  - c. Demonstrate how to identify a problem that is preventing proper function of equipment.
  - d. Demonstrate how to identify the system where a problem is occurring.
  - e. Demonstrate how to identify the probable cause of a problem.
26. Apply diagnostic procedures in solving a problem.
- a. Operate the equipment as best possible to assess a problem.
  - b. Explain how to isolate a problem.
  - c. Select and use the proper diagnostic equipment and service data.
  - d. Perform the needed work and repairs according to manufacturer's specifications.
27. Identify common equipment and tools used in welding.
- a. Describe major types of welders including electric arc and metal inert gas (MIG).
  - b. Describe tools used with each type of welding.
28. Apply safety precautions used in welding.
- a. Use eye protection and proper apparel.
  - b. Use ventilation and materials handling procedures.
29. Describe different welding supplies used in welding.
- a. Identify low hydrogen, mild steel, and alloy welding electrodes.
  - b. Identify the different types of gases involved in the shielded arc welding process.
30. Explain the meanings of the numbers in the electrode classification system.
- a. Identify electrodes based upon tensile strength, position, and special characteristics.
  - b. Identify different types of wire and wire sizes (e.g., flux cored wire).
  - c. Describe the function of welding flux.
31. Compare the different types of welds.
- a. Identify bead, groove, and fillet welds.
  - b. Identify the types of weld joints including T, lap, corner, edge, and butt.
32. Perform various welding techniques.
- a. Perform welding techniques including start, stop and re-start, pad construction, flat butt construction, and flat fillet.
  - b. Utilize various welding equipment including electric arc and MIG.
33. Identify parts of the oxyacetylene welding equipment.
- a. Assemble cutting attachment with regulator and gauges.
  - b. Assemble welding attachments with regulators and gauges.
34. Apply safety procedures for using oxyacetylene equipment.
- a. Demonstrate removal of flammable materials.
  - b. Demonstrate lighting, adjustment, and operations.
35. Identify the different types of oxyacetylene flames.
- a. Compare neutral, oxidizing, and carburizing flames.
  - b. Demonstrate proper adjustment of flames.

36. Operate oxyacetylene equipment.
  - a. Set up and adjust oxyacetylene equipment.
  - b. Make a cut in mild steel.

## Appendix A: Proposed Standards for Small Engine and Turf Equipment Repair Technology Programs<sup>1</sup>

The following standards were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's website at [www.eetc.org](http://www.eetc.org).

### Category 1: Two and Four Stroke Gasoline Engines

#### Subcategory 100: Small Engine Fundamentals

- 101: Engine Identification
- 102: Two-Stroke Cycle Engine
- 103: Four-Stroke Cycle Engine
- 104: Engine Components

#### Subcategory 200: Maintenance

- 201: Lubrication Fundamentals
- 202: Lubrication – Engine Maintenance

#### Subcategory 300: 2-Stroke Cycle Gasoline Engine

- 301: Test a 2-Stroke

#### Subcategory 400: 2-Stroke Cycle Gasoline Engine Overhaul

#### Subcategory 500: 4-Stroke Gasoline Engine Diagnosis

#### Subcategory 600: 4-Stroke Gasoline Engine Service

#### Subcategory 700: Failure Analysis

### Category 2: Drivelines/Hydraulics/Hydrostatic

#### Subcategory 100: Hydraulic Systems

- 101: Hydraulic System Principles
- 102: Hydraulic System Safety

#### Subcategory 200: Hydraulic Component Components

- 201: Hydraulic Component Theory

#### Subcategory 300: Hydraulic System Diagnosis

- 301: Hydraulic System Service Procedures

#### Subcategory 400: Drivelines

- 401: Driveline Fundamentals

### Category 3: Electrical

#### Subcategory 100: Electrical Systems

- 101 Electrical Theory

<sup>1</sup> Industry standards for Small Engine Repair courses were adapted from the publication, *Program Assessment Manual: Power Equipment Technology*, as published by the Equipment and Engine Training Council. For more information see the Council's Web site at [www.eetc.org](http://www.eetc.org)

## Appendix B: Related Academic Standards<sup>2</sup>

### Reading

- R1 Interpret Graphic Information (forms, maps, reference sources)
- R2 Words in Context (same and opposite meaning)
- R3 Recall Information (details, sequence)
- R4 Construct Meaning (main idea, summary/paraphrase, compare/contrast, cause/effect)
- R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)

### Mathematics Computation

- M1 Addition of Whole Numbers (no regrouping, regrouping)
- M2 Subtraction of Whole Numbers (no regrouping, regrouping)
- M3 Multiplication of Whole Numbers (no regrouping, regrouping)
- M4 Division of Whole Numbers (no remainder, remainder)
- M5 Decimals (addition, subtraction, multiplication, division)
- M6 Fractions (addition, subtraction, multiplication, division)
- M7 Integers (addition, subtraction, multiplication, division)
- M8 Percents
- M9 Algebraic Operations

### Applied Mathematics

- A1 Numeration (ordering, place value, scientific notation)
- A2 Number Theory (ratio, proportion)
- A3 Data Interpretation (graph, table, chart, diagram)
- A4 Pre-Algebra and Algebra (equations, inequality)
- A5 Measurement (money, time, temperature, length, area, volume)
- A6 Geometry (angles, Pythagorean theory)
- A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
- A8 Estimation (rounding, estimation)

### Language

- L1 Usage (pronoun, tense, subject/verb agreement, adjective, adverb)
- L2 Sentence Formation (fragments, run-on, clarity)
- L3 Paragraph Development (topic sentence, supporting sentence, sequence)
- L4 Capitalization (proper noun, titles)
- L5 Punctuation (comma, semicolon)
- L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)

### Spelling

- S1 Vowel (short, long)
- S2 Consonant (variant spelling, silent letter)
- S3 Structural Unit (root, suffix)

<sup>2</sup> CTB/McGraw-Hill LLC. (1994). *Tests of adult basic education, Forms 7 and 8*. Monterey, CA: Author. Reproduced with permission of CTB/McGraw-Hill LLC. TABE is a registered trademark of The McGraw-Hill Companies, Inc. Copyright © 1994 by CTB/McGraw-Hill LLC. Reproduction of this material is permitted for educational purposes only.

## Appendix C: 21<sup>st</sup> Century Skills<sup>3</sup>

### CS1 Global Awareness

- Using 21<sup>st</sup> century skills to understand and address global issues
- Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
- Promoting the study of non-English language as a tool for understanding other nations and cultures

### CS2 Financial, Economic, and Business Literacy

- Knowing how to make appropriate personal economic choices
- Understanding the role of the economy and the role of business in the economy
- Applying appropriate 21<sup>st</sup> century skills to function as a productive contributor within an organizational setting
- Integrating oneself within and adapting continually to our nation's evolving economic and business environment

### CS3 Civic Literacy

- Being an informed citizen to participate effectively in government
- Exercising the rights and obligations of citizenship at local, state, national, and global levels
- Understanding the local and global implications of civic decisions
- Applying 21<sup>st</sup> century skills to make intelligent choices as a citizen

### CS4 Information and Communication Skills

- Information and media literacy skills: Analyzing, accessing, managing, integrating, evaluating, and creating information in a variety of forms and media; understanding the role of media in society
- Communication skills: Understanding, managing, and creating effective oral, written, and multimedia communication in a variety of forms and contexts

### CS5 Thinking and Problem-Solving Skills

- Critical thinking and systems thinking: Exercising sound reasoning in understanding and making complex choices, understanding the interconnections among systems
- Problem identification, formulation, and solution: Ability to frame, analyze, and solve problems
- Creativity and intellectual curiosity: Developing, implementing, and communicating new ideas to others, staying open and responsive to new and diverse perspectives

### CS6 Interpersonal and Self-Directional Skills

- Interpersonal and collaborative skills: Demonstrating teamwork and leadership, adapting to varied roles and responsibilities, working productively with others, exercising empathy, respecting diverse perspectives
- Self-direction: Monitoring one's own understanding and learning needs, locating appropriate resources, transferring learning from one domain to another
- Accountability and adaptability: Exercising personal responsibility and flexibility in personal, workplace, and community contexts; setting and meeting high standards and goals for one's self and others; tolerating ambiguity

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<sup>3</sup> 21<sup>st</sup> century skills. (n.d.). Washington, DC: Partnership for 21<sup>st</sup> Century Skills.

- Social responsibility: Acting responsibly with the interests of the larger community in mind; demonstrating ethical behavior in personal, workplace, and community contexts