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PROGRAM CONCENTRATION: Architecture, Construction,
Communication, Transportation
CAREER PATHWAY: Marine Engine Technology
COURSE TITLE: Marine Engine Drive System (MED)

This course introduces students to marine engines, drive units, and fluid power systems. Mastery of these standards through project-based learning and leadership development activities of Skills USA will help prepare students with a competitive edge for the transportation logistics marketplace.

Four Stroke Engine Fundamentals

ACCT-MED-1. Students will understand theory of operation as well as evaluate problems and repair a basic marine diesel or gas four stroke Internal combustion engine. Students will:

- a. Explain the basic principles of operation for marine diesel and gas four-stroke internal combustion engines.
- b. Identify types of four-stroke internal combustion diesel and gas engines.
- c. Check engine oil level; check engine for oil, coolant, and fuel leaks (Engine Off).
- d. Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm.
- e. Check engine for oil, coolant, air, and fuel leaks (Engine Running).
- f. Conduct test of four-stroke engine power head operation.
- g. Diagnose, inspect, and service cylinder head and valve train problems.
- h. Execute four cycle engine valve timing procedures.
- i. Diagnose, inspect, and service camshafts, lifters, timing chain, sprockets and gears.
- j. Explain block repair methods including honing, boring, and sleeving.
- k. Communicate procedures for basic block salvaging.

Academic Standards:

SPS7 Students will relate transformations and flow of energy within a system.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*

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Two Stroke Engine Fundamentals

ACCT-MED-2. Students will understand theory of operation as well as assess and repair a basic marine two stroke engine. Students will:

- a. Explain the basic principles of operation for marine two-stroke internal combustion engines.
- b. Analyze types of two-stroke internal combustion engines.
- c. Perform and test two-stroke engine power head operation.
- d. Diagnose and identify power head failure and their causes, including pre-ignition and detonation.
- e. Diagnose, inspect, repair, and remove & replace cylinder and crank case assemblies, crank shafts, rod and piston assemblies, cylinder heads, and bearings and seals.
- f. Examine two stroke engine power head operation.
- g. Explain block repair methods including honing, boring, and sleeving.
- h. Explain and apply basic power head salvaging procedures and repair damaged threads and install thread repair inserts.

Academic Standards:

ELA12LSV2 Students will formulate reasoned judgments about written and oral communication in various media genres. The student delivers focused, coherent, and polished presentations that convey a clear and distinct perspective, demonstrate solid reasoning, and combine traditional rhetorical strategies of narration, exposition, persuasion, and description.

MM1-4P1 Students will solve problems using appropriate technology. Students will:

- a. Solve problems that arise in mathematics and in other contexts.*
- b. Apply and adapt a variety of appropriate strategies to solve problems*

SPS7 Students will relate transformations and flow of energy within a system.

- a. Identify energy transformations within a system (e.g. lighting of a match).*

Marine Drive Systems

ACCT-MED-3. Students will understand theory of operation of inboard and outboard drive systems, transom bracket servicing and repair of the upper and lower gear case. Students will:

- a. Discuss the inboard drive system
- b. Diagnose, inspect, and service prop shaft systems
- c. Inspect and service prop shaft bearings, seals and mountings.
- d. Describe power transmission for inboard diesel engines.

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- e. Discuss the basic principles of the transom assembly.
- f. Diagnose, inspect, and repair the transom assembly.
- g. Explain the upper gear case assembly, theory, and operation.
- h. Disassemble, inspect, and reassemble upper gear and lower gear case assemblies.
- i. Describe and perform shimming procedures and gear lash inspection.
- j. Perform pressure and vacuum leak test.

Academic Standards:

SPS7 Students will relate transformations and flow of energy within a system.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- a. *Develop and use systematic procedures for recording and organizing information.*
- b. *Use technology to produce tables and graphs.*
- c. *Use technology to develop, test, and revise experimental or mathematical models.*

Marine Fluid Power Systems

ACCT-MED-4. Students will understand theory of operation of the outboard midsection. Students will:

- a. Communicate and demonstrate service procedures on midsection, replace motor mounts and shock absorbers, replace reverse lock mechanisms.
- b. Describe, diagnose, and assess the hydraulic trim and tilt system operating principles and component operations and verify their proper function through setup and the use of hydraulic testers.
- c. Set up and use hydraulic testers to troubleshoot outboard and stern drive tilt and trim systems.

Academic Standards:

MM1-4P3 Students will communicate mathematically. The student:

- b. *Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*

SPS7 Students will relate transformations and flow of energy within a system.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- a. *Develop and use systematic procedures for recording and organizing information.*

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- b. Use technology to produce tables and graphs.*
- c. Use technology to develop, test, and revise experimental or mathematical models.*

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Marine Fuel Systems

ACCT-MED-5. Students will understand diesel and gas engine fuel systems including tank, line, filter, and pump and hose components, and explain their operation. Students will:

- a. Demonstrate the operation of two and four cycle carburetors.
- b. Describe diesel fuel injections systems.
- c. Check fuel tanks, mountings, lines, caps, and vents.
- d. Inspect throttle linkages and return springs.
- e. Describe reed valve operation as used in two cycle engines.
- f. Explain two and four cycle diesel and gas fuel pump operations.
- g. Diagnose and inspect the different types of oil metering systems used in outboard motors.
- h. Conduct a fuel systems pressure and vacuum test to diagnose fuel pump operation and to isolate boat fuel system problems.
- i. Inspect boat fuel system components for leaks, wear, and damage.
- j. Inspect water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system.
- k. Relate electronic fuel injection theory and operation.
- l. Identify the major components of the diesel and gas fuel injection systems and explain their operation in two and four cycle fuel injection systems.
- m. Calibrate components of a diesel and gas fuel injection system in accordance to manufacturer's specifications.
- n. Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks.
- o. Service or replace air filter as needed; check and reset air filter restriction indicator.

Academic Standards:

MM1-4P3 Students will communicate mathematically. The student:

- a. *Organize and consolidate their mathematical thinking through communication.*

SPS7 Students will relate transformations and flow of energy within a system.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*

SCSh3 Students will identify and investigate problems scientifically.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*
- b. *Develop procedures for solving scientific problems.*
- c. *Collect, organize and record appropriate data.*
- d. *Graphically compare and analyze data points and/or summary statistics.*
- e. *Develop reasonable conclusions based on data collected.*
- f. *Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.*

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Marine Cooling Systems

ACCT-MED-6. Students will be able to explain the water cooling system from the intake ports through the water pump and through the cooling passages including the thermostats, manifolds, elbows, and other related cooling items for both two and four stroke diesel and gas engines. Students will:

- a. Track water flow through cooling systems and utilize water flow diagrams.
- b. Describe and diagnose overheating conditions on two and four cycle diesel and gas marine engines, disassemble, inspect, and reassemble inboard and outboard cooling system components, including thermostats, coolant hoses, clamps, bypass valves, water pump assembly and pressure relief components.
- c. Inspect and service heat exchanger
- d. Inspect and service coolant filter/conditioner.
- e. Disassemble, inspect, and reassemble stern drive cooling system components including thermostats, bypass valves, water pump assembly, and pressure relief components.
- f. Check coolant for contamination, supplemental coolant additives (SCA) concentration, and protection level (freeze point).

Academic Standards:

SPS7 Students will relate transformations and flow of energy within a system.

- a. *Identify energy transformations within a system (e.g. lighting of a match).*

SCSh2 Students will use standard safety practices for all classroom laboratories and field investigations.

- a. *Follow correct procedures for use of scientific apparatus.*
- b. *Demonstrate appropriate techniques in all laboratory situations.*
- c. *Follow correct protocol for identifying and reporting safety problems and violations.*

Marine Accessories

ACCT-MED-7. Students will understand how to layout, measure, and install marine accessories. Students will:

- a. Measure and install accessories utilizing hole saws, electrical connectors, and proper soldering procedures.
- b. Apply Ohm's Law in relation to measuring resistance in marine accessory systems.
- c. Set up and program marine accessories to manufacturer's specifications.

Academic Standards:

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MM1-4P1 Students will solve problems using appropriate technology

- a. Solve problems that arise in mathematics and in other contexts*

SPS10 Students will investigate the properties of electricity and magnetism.

- b. Explain the flow of electrons in terms of: alternating and direct current, the relationship among voltage, resistance and current, simple series and parallel circuits.*

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- a. Develop and use systematic procedures for recording and organizing information.*
- b. Use technology to produce tables and graphs.*
- c. Use technology to develop, test, and revise experimental or mathematical models.*

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Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

Students will enhance reading in all curriculum areas by:

- a. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- b. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- c. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.

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- Explore understanding of new words found in subject area texts.
- d. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

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CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

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CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.