**Course Description:**

Students will inspect, diagnose, and repair diesel truck engines. Students will learn the principles of valve train assemblies, lubrication, intake, exhaust and fuel systems. Additionally, skill development in engine testing, inspection and repair of electronic fuel management systems are emphasized. Students will break down and assemble heavy truck engines and supporting systems.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome 1.1. Employability Skills**

Develop career awareness and employability skills (e.g., face‐to‐face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.1. Identify the knowledge, skills and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training,

certification, licensure and experience.

1.1.3. Develop a career plan that reflects career interests, pathways and secondary and

postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations and

organized labor and use networking techniques to develop and maintain professional

relationships.

1.1.5. Develop strategies for self‐promotion in the hiring process (e.g., filling out job applications,

résumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability and responsibility and demonstrate

associated behaviors in fulfilling personal, community and workplace roles.

1.1.7. Apply problem‐solving and critical‐thinking skills to work‐related issues when making decisions

and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior and appearance and manage those to

establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect

for them.

1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits and abusive

behavior.

**Outcome 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.2. Deliver formal and informal presentations.

1.2.3. Identify and use verbal, nonverbal and active listening skills to communicate effectively.

1.2.4. Use negotiation and conflict‐resolution skills to reach solutions.

1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an

intended audience and purpose.

1.2.6. Use proper grammar and expression in all aspects of communication.

1.2.7. Use problem‐solving and consensus‐building techniques to draw conclusions and determine

next steps.

1.2.8. Identify the strengths, weaknesses and characteristics of leadership styles that influence

internal and external workplace relationships.

1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications

(e.g., common content for large audience, control of tone, speed, cost, lack of non‐verbal

cues, potential for forwarding information, longevity).

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration and work in a

team.

1.2.11. Write professional correspondence, documents, job applications and resumés.

1.2.12. Use technical writing skills to complete forms and create reports.

1.2.13. Identify stakeholders and solicit their opinions.

1.2.14. Use motivational strategies to accomplish goals.

**Outcome 1.3. Business Ethics and Law**

Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance affects business operations and organizational

performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe and healthy work

environment.

1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal

integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety

data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental

Protection Agency [EPA], United States Occupational Safety and Health Administration

[OSHA]) that contribute to the continuous improvement of the organization.

1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door‐to‐door sales,

deceptive service estimates, fraudulent misrepresentations) and their overall impact on

organizational performance.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act [ADA], Fair Labor Standards Acts [FLSA], Equal Employment Opportunity Commission [EEOC]).

1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal,

organizational and professional ethical standards.

**Outcome 1.4. Knowledge Management and Information Technology**

Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner,

public address systems).

1.4.2. Select and use software applications to locate, record, analyze and present information (e.g.,

word processing, e‐mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations and codes (e.g., property, privacy, access,

accuracy issues, client and patient record confidentiality) pertaining to technology specific to

the industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure and monitor business records.

1.4.6. Use an electronic database to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned

tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

**Outcome 1.5. Global Environment**

Evaluate how beliefs, values, attitudes and behaviors influence organizational strategies and goals.

**Competencies**

1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.

1.5.4. Recognize barriers in cross‐cultural relationships and implement behavioral adjustments.

1.5.5. Recognize the ways in which bias and discrimination may influence productivity and

profitability.

1.5.7. Use intercultural communication skills to exchange ideas and create meaning.

**Outcome 1.6. Business Literacy**

Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.

**Competencies**

1.6.1. Identify business opportunities.

1.6.2. Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk versus reward, reasons for success and failure).

1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments and interdepartmental interactions.

1.6.8. Identify the features and benefits that make an organization’s product or service competitive.

1.6.9. Explain how the performance of an employee, a department and an organization is assessed.

1.6.12. Describe classifications of employee benefits, rights, deductions and compensations.

**Outcome 1.7. Entrepreneurship/Entrepreneurs**

Analyze the environment in which a business operates and the economic factors and opportunities associated with self-employment.

**Competencies**

1.7.10. Describe techniques for obtaining experience (e.g., apprenticeship, co-operative [co-op] education, work placement, internship, job shadowing) related to an entrepreneurial objective.

**Outcome 1.8. Operations Management**

Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.

**Competencies**

1.8.4. Identify alternative actions to take when goals are not met (e.g., changing goals, changing strategies, efficiencies).

1.8.5. Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN).

1.8.6. Identify the advantages and disadvantages of carrying cost and Just-in-Time [JIT] productions systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability.

1.8.8. Identify routine activities for maintaining business facilities and equipment.

1.8.10. Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability.

**Outcome 1.10. Sales and Marketing**

Manage pricing, place, promotion, packaging, positioning and public relations to improve quality customer service.

**Competencies**

1.10.2. Determine the customer’s needs and identify solutions.

1.10.3. Communicate features, benefits and warranties of a product or service to the customer.

1.10.4. Identify the company policies and procedures for initiating product and service improvements.

1.10.5. Monitor customer expectations and determine product/services satisfaction by using measurement tools.

1.10.10. Demonstrate sales techniques.

**Strand 2. Safety, Tools and Maintenance**

Learners apply principles of safety and use of tools to maintain equipment and the environment to prevent accidents and mitigate hazards.

**Outcome 2.1. Facility Safety**

Handle materials, prevent accidents and mitigate hazards.

**Competencies**

2.1.1. Use Occupational Safety and Health Administration (OSHA)-defined procedures for identifying employer and employee responsibilities, situations that require working in confined spaces and safety labeling.

2.1.2. Identify and communicate hazards associated with slippery surfaces and lighting.

2.1.6. Identify and eliminate workplace clutter and maintain clearance and boundaries.

2.1.8. Identify procedures for handling, storage and disposal of hazardous materials.

2.1.9. Identify locations and describe use of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits.

2.1.11. Select and operate fire extinguishers based on the class of fire.

2.1.12. Conduct safety inspection of a workspace.

2.1.13. Identify the types of ergonomic workflow and the need for them.

2.1.14. Inspect air and exhaust systems, intake filters, fans and other mechanical components.

**Outcome 2.2. Personal Safety**

Practice personal safety.

**Competencies**

2.2.1. Interpret personal safety rights according to the employee Right-to-Know plan.

2.2.2. Describe the risk factors associated with working under the influence of drugs, alcohol and stimulants and how it increases the risk of accident, lowers productivity, raises insurance costs and reduces profits.

2.2.3. Select, use, maintain and dispose of Personal Protective Equipment (PPE) appropriate to job tasks, conditions and materials.

2.2.4. Identify workplace risk factors associated with repetitive motion and lifting, operating and moving heavy objects.

2.2.5. Demonstrate appropriate body mechanics in lifting and moving heavy objects.

**Outcome 2.3. Tool and Equipment Preventative Maintenance**

Identify, use, clean, maintain and perform planned preventative maintenance on tools and equipment.

**Competencies**

2.3.1. Identify the types of hand tools, power tools and stationary equipment and describe their function.

2.3.2. Identify potential hazards and limitations related to the use of hand tools, power tools and stationary equipment.

2.3.3. Operate power tools and stationary equipment in accordance with established procedures and safety standards.

2.3.4. Ensure the presence and functionality of safety systems and hardware.

2.3.5. Clean, lubricate and adjust power tools and stationary equipment.

2.3.6. Identify, select and maintain fluids and filters.

**Outcome 2.4. General Maintenance**

Provide general maintenance to mechanical systems.

**Competencies**

2.4.1. Inspect for leakage at seals, gaskets and bushings.

2.4.2. Inspect fluid levels and fluid conditions on all mechanical systems.

2.4.3. Select engine, powertrain, power steering and brake system fluids based on characteristics and applications.

2.4.4. Describe characteristics of engine fuels and fuel additives.

2.4.5. Perform engine oil and filter change.

2.4.6. Replace fuel filters.

2.4.7. Flush and fill the engine cooling system.

2.4.8. Inspect, service, or replace air filters, filter housings and intake ductwork.

2.4.9. Drain and replace drivetrain fluids and filters.

2.4.10. Flush, fill and bleed the power steering system and replace filters.

2.4.11. Flush, fill and bleed the brake system.

2.4.12. Store mechanical systems fluids and waste products

2.4.13. Inspect and replace drive belts.

2.4.15. Inspect and service the battery and battery cables, connectors, clamps and hold downs.

2.4.22. Inspect, repair or replace fasteners.

**Strand 3. Engine Adjustments and Repair**

Learners apply principles of computerized engine controls, two- and four-stroke cycle combustion, emission controls, cooling systems, cylinder head and block assemblies and lubrication systems to diagnose and repair malfunctions in recreational vehicles, automobiles and medium and heavy equipment.

**Outcome 3.1. Engine Cylinder Head and Block Assemblies**

Remove, disassemble and repair components in engine cylinder head and block assemblies.

**Competencies**

3.1.1. Describe the physical and mechanical principles of engine operation (i.e., motion, friction, thermodynamics).

3.1.2. Calculate displacement and compare and contrast displacement, horsepower and torque.

3.1.4. Describe the features, benefits and application of engine types.

3.1.5. Inspect an engine assembly for fuel, oil, coolant and other leaks and determine potential causes.

3.1.6. Identify engine noises and vibrations and potential causes.

3.1.7. Verify the engine operating temperature.

3.1.8. Describe potential causes of excessive oil consumption and unusual exhaust color and sound.

3.1.9. Perform engine tests for vacuum, power balance, compression and leakage.

**Outcome 3.2. Computerized Engine Controls**

Perform diagnosis and repair of computerized engine controls.

**Competencies**

3.2.1. Retrieve and record stored on-board diagnostics (OBD) trouble codes and clear codes where applicable.

3.2.2. Follow published diagnostic procedures to identify the causes of emissions or drivability concerns resulting from malfunctions in the computerized engine control system with stored diagnostic trouble codes.

3.2.3. Identify module communication errors (e.g., controller area network [CAN], BUS systems).

3.2.4. Inspect and test computerized engine control system sensors, powertrain control modules (PCMs), actuators and circuits.

3.2.5. Diagnose drivability and emissions problems resulting from malfunctions of interrelated systems.

**Outcome 3.3. Ignition System**

Perform ignition system diagnosis and repair.

**Competencies**

3.3.3. Identify potential causes of ignition system problems (i.e., no starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, emissions concerns).

3.3.4. Identify causes of cranks but fails to start, hard starting and starts but does not continue to run problems.

3.3.5. Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration and shutdown problems.

3.3.8. Explain basic compression ignition theory.

**Outcome 3.4. Fuel, Air Induction and Exhaust System**

Perform fuel, air indication and exhaust system inspection and repair.

**Competencies**

3.4.1. Explain principles of exhaust, intake and turbocharger design and operations.

3.4.2. Identify conditions of hot or cold no starting, hard starting, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling and emissions problems.

3.4.3. Check fuel for contaminants and quality.

3.4.4. Test fuel pumps and pump control systems for pressure, regulation and volume.

3.4.5. Inspect and test the coolant temperature sensor or cold enrichment system and components.

3.4.6. Inspect the air induction system, intake manifold and gaskets for vacuum leaks or unmetered air.

3.4.7. Inspect and service governor systems, speed or rev limiters.

3.4.8. Explain fuel injection theory.

3.4.9. Inspect and test fuel injectors.

3.4.10. Inspect the exhaust manifold, exhaust pipes, mufflers, catalytic converters, resonators, tail pipes and heat shields.

3.4.11. Perform exhaust system backpressure test.

3.4.12. Evaluate and repair exhaust gas recirculation and exhaust gas treatment systems.

3.4.13. Identify positive crankcase ventilation systems.

3.4.14. Identify the parts and describe the functions of evaporative emissions controls systems.

3.4.15. Check and refill the diesel exhaust fluid (DEF) and service diesel particulate filter (DPF).

**Outcome 3.5. Lubrication and Cooling Systems**

Inspect lubrication and cooling systems operation.

**Competencies**

3.5.1. Explain principles of engine lubrication and cooling.

3.5.2. Perform lubrication, cooling system and pressure and sensor tests.

3.5.3. Perform oil sampling and consumption tests.

3.5.4. Inspect the oil pump gears or rotors, housing, pressure relief devices and pump drive.

3.5.5. Inspect and test the radiator, pressure cap, coolant recovery tank and hose, cooling and heater system hoses and water pump.

3.5.6. Remove and replace radiator, pressure cap, coolant recovery tank and hose, cooling and heater system hoses.

3.5.7. Inspect, test and replace the thermostat and gasket.

3.5.8. Measure coolant concentration using a refractometer.

3.5.9. Identify types of coolants and their applications.

3.5.10. Test, drain, flush and refill coolant and bleed the cooling system.

3.5.11. Remove and replace the water pump.

3.5.12. Inspect mechanical and electrical fans, fan clutches, fan shrouds and air dams.