**Power Trains**

Subject Code: 010230

Course & Unit Descriptions

**Course Description:**

Students will learn the physical principles of power trains, the components that transfer and control power, and how power trains are designed to function. Topics include hydraulic theory, bearings and seals along with belts, chains, and gear drives included in power trains. Students will learn how to adjust and maintain transmissions along with diagnosing power take-off devices and clutches. Throughout the course, site and personal safety procedures along with business principles are emphasized.

**Unit: Safety**

Students will demonstrate their knowledge of safety rules and regulations. Students will identify safety signs and signals. Students will describe health and safety practices along with demonstrating appropriate responses for major types of hazardous materials disasters.

Outcome 1.12

Site and Personal Safety Procedures: Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

Competency:

1.12.1 Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.

1.12.2 Interpret safety signs and symbols.

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

1.12.4 Describe how working under the influence of drugs and alcohol increases the risk of accident, lowers productivity, raises insurance costs and reduces profits.

1.12.5 Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits.

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

1.12.7 Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.

1.12.8 Identify safety hazards and take corrective measures.

1.12.9 Identify, inspect and use safety equipment appropriate for the task.

1.12.10 Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

1.12.11 Set up for ergonomic workflow.

1.12.12 Apply inspection, rejection criteria, hitch configurations and load handling practices to slings and rigging hardware.

1.12.13 Demonstrate the proper use of American National Standards Institute (ANSI) hand signals.

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

**Unit: Hydraulic Theory**

Students learn the components and functions of hydraulic and pneumatic systems. Topics include standard symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching and control devices.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.2 Describe the physical and mechanical principles of mechanical, hydraulic, pneumatic and electrical power transfer.

4.7.3 Describe the features, benefits and applications of mechanical, hydraulic, pneumatic and electrical transmission.

4.7.4 Perform calculations involving speed, torque and power relationships.

4.7.5 Test and diagnose hydrostatic transmissions.

4.7.10 Test and diagnose pneumatics.

4.7.13 Select and replace drivetrain fluids and filters.

**Unit: Component Identification**

Learners are taught the operating principles and service procedures for power train components. These include clutches, multi-speed transmissions, propeller shafts, and rear axles.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.11 Test and diagnose auxiliary drives.

4.7.12 Replace damaged and non-functioning power train components.

Outcome 4.10

Drive Axle Universal and Differential: Identify, inspect and replace drive axle and differential components.

Competency:

4.10.1 Identify and inspect drive axle and differential assemblies for noise, vibration and fluid leakage concerns.

**Unit: Service and Preventative Maintenance**

Students learn the fundamentals of power train, service, theory of operation, repair procedures, preventive maintenance, troubleshooting, and power flow from engine to final drive. Students will learn the methods of power transmission, types of gears and bearings, lubrication, and maintenance.

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

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

4.1.4 Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.

4.1.7 Clean, lubricate and adjust machinery and equipment.

4.1.9 Inspect and maintain fluid conveyance and storage components (e.g., hoses and lines, valves,

nozzles).

Outcome 4.2

Equipment Operations: Operate and maintain mechanical equipment and power systems.

Competency:

4.2.1 Follow manufacturer’s recommended operating procedures and adjustment specifications.

4.2.3 Perform pre- and post-operation inspections and adjustments and report malfunctions.

4.2.4 Perform appropriate start-up, operating and shut-down procedures.

**Unit: Belts, Chains and Gear Drives**

Students learn how to maintain and repair lubrication; bearings; belt, gear, and chain drive systems along with couplings and brakes.

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

4.1.7 Clean, lubricate and adjust machinery and equipment.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.2 Describe the physical and mechanical principles of mechanical, hydraulic, pneumatic and electrical power transfer.

4.7.3 Describe the features, benefits and applications of mechanical, hydraulic, pneumatic and electrical transmission.

4.7.6 Test and diagnose differentials and final drives.

4.7.7 Test and diagnose clutches and brakes.

4.7.8 Test and diagnose gear-type transmissions, including power shift, synchronized and sliding gear.

4.7.9 Test and diagnose electronic power train control systems and programmable parameters.

4.7.10 Test and diagnose pneumatics.

4.7.11 Test and diagnose auxiliary drives.

4.7.12 Replace damaged and non-functioning power train components.

4.7.13 Select and replace drivetrain fluids and filters.

Outcome 4.10

Drive Axle Universal and Differential: Identify, inspect and replace drive axle and differential components.

Competency:

4.10.1 Identify and inspect drive axle and differential assemblies for noise, vibration and fluid leakage concerns.

4.10.2 Service and replace the shaft, yokes, boots and joints.

4.10.3 Replace drive axle seals, bearings and retainers.

4.10.4 Inspect, adjust and replace drive belts and chains.

4.10.5 Inspect and replace drive axle housing cover plates, gaskets, sealants, vents, plugs and seals.

**Unit: Bearings and Seals**

Students are taught an understanding of crankshaft, design, parts, lubrication, balance, thrust accommodation, seals, and general inspection. Students will correctly demonstrate bearing removal, inspection, replacement, and reassembly.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Clutches**

Students learn the complete power train system with emphasis on the theory, application, and servicing of clutch systems.

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

4.1.7 Clean, lubricate and adjust machinery and equipment.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.7 Test and diagnose clutches and brakes.

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Manual Transmissions**

Students learn the basic components of manual shift transmissions and their functions as they relate to the operation of various power train systems.

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

4.1.6 Inspect for fluid leakage, fluid levels and the condition of fluids.

4.1.8 Select fluids, maintain fluid levels and replace system filters.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.8 Test and diagnose gear-type transmissions, including power shift, synchronized and sliding gear.

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Power Take-Off**

Students are taught to diagnose, troubleshoot and repair power take-off devices.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.1 Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Differentials**

Students learn the theory of operation, maintenance, diagnosis, and repair of differentials and final drives.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.6 Test and diagnose differentials and final drives.

4.7.10 Test and diagnose pneumatics.

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Hydrostatics**

Learners will demonstrate their knowledge of hydrostatic drives including purpose, design, operating principles, inspection, maintenance and repair procedures.

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

4.1.6 Inspect for fluid leakage, fluid levels and the condition of fluids.

4.1.8 Select fluids, maintain fluid levels and replace system filters.

Outcome 4.7

Transmission of Power: Diagnose and service power train components.

Competency:

4.7.5 Test and diagnose hydrostatic transmissions.

4.7.2 Describe the physical and mechanical principles of mechanical, hydraulic, pneumatic and electrical power transfer.

4.7.12 Replace damaged and non-functioning power train components.

**Unit: Business Operations**

Students will develop business goals and objectives using real-world examples of various organizational and business structures. Students will budget resources, evaluate outcomes, and forecast future budgetary needs according to standard business principles.

Outcome 1.10

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

Competency:

1.10.1 Identify how the roles of sales, advertising and public relations contribute to a company’s brand.

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/service satisfaction by using measurement tools.

1.10.6 Discuss the importance of correct pricing to support a product’s or service’s positioning in the marketing mix.

Outcome 1.6

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

Competency:

1.6.1 Identify business opportunities.

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

1.6.6 Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry.

1.6.7 Identify the effect of supply and demand on products and services.

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.

Outcome 1.8

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

Competency:

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) production 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.

**Unit: Communication & Information Management**

Students will research and conduct presentations using a variety of computer applications including Internet. Students will utilize personal information management to develop recordkeeping and communication skills. Students will organize information accurately and practice workplace communication techniques.

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.

Competency:

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 1.2

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

Competency:

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.

1.2.5 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.

1.2.9 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)

**Unit: Business Leadership, Employability & Interpersonal Skills**

Students will develop critical thinking and problem solving skills through the use of a variety of practical scenarios. Students will demonstrate leadership skills through participation with peer groups, support services, and professional organizations.

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.

Competency:

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, resumé 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.

Competency:

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.

1.2.14 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.

Competency:

1.3.1 Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) 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, Fair Labor Standards Acts, Equal Employment Opportunity Commission [EEOC]).

1.3.8 Verify compliance with computer and intellectual property laws and regulations.

1.3.9 Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational and professional ethical standards.