



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2260 Advanced Drivelines

Date: Spring 2022

Credit Hours: 3

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): ATO 1240, ATO 2230

Enrollment by assessment or other measure? Yes No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor: Yes No

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **2 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended
 VCM

Offered: **Fall** **Spring** **Summer**

CATALOG DESCRIPTION and IAI NUMBER (if applicable):

This course includes information relative to four wheel drive transfer cases, front axles, all wheel drive systems, and computer controlled transmissions and transaxles. The theory, diagnosis and repair of electronically controlled transmissions and transaxles will be covered. Some of the topics covered include: the computer, sensors, shift solenoids, force motors, pulse width modulation, torque converter clutches, PM generators and all other related electronics that allow the computer to control the shift pattern and shift

quality. The student is required to rebuild a minimum of two electronically controlled transmissions in this course.

ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Transfer Cases

A. Purpose

B. Types

1. Part-time 4WD
2. Full-time 4WD
3. Automatic/Active 4WD
4. All Wheel Drive (AWD)

C. Designs

1. Drive chains
2. Planetary gear designs
3. Inter-axle differentials
4. Viscous couplings
5. Electronic control

II. Four Wheel Drive Axles

A. Parts and Operation

1. Universal joints
2. Knuckle
3. Wheel bearings
4. Hubs
5. Spindle
6. Noise diagnosis
7. Diagnosis and repair

B. Four Wheel Drive Front Hub Operation

1. Manual locking hubs
2. Automatic locking hubs
3. Vavuum locking hubs
4. Diagnosis and repair

C. Front Drive Axle Electronic Disconnect

1. Front axle solenoid
2. Front axle switch
3. Synchronizer coil
4. Testing the electrical circuit
5. Testing the front axle solenoid
6. Noise diagnosis
7. No front axle engagement diagnosis

D. Front Drive Axle Cable/Vacuum Disconnect

1. Transfer case vacuum switch
2. Vacuum-control actuator
3. Push-pull cable
4. Single front-axle clutching unit
5. Testing vacuum related components
6. Noise diagnosis
7. No front axle engagement diagnosis

III. Electronic Shift Four Wheel Drive

A. Transfer Case Control Module Inputs

1. Transfer case selector
2. Neutral start switch
3. Clutch safety switch
4. Digital ratio adaptor controller
5. Encoder motor/switch
6. Diagnostic's
7. Testing sensors and switch

B. Transfer Case Control Module Outputs

1. Electronic shift motor
2. Selector switch status lamps
3. Diagnostic's
 - a. Reading trouble codes
 - b. Clearing trouble codes
 - c. Functional test

IV. Electronic Controlled Transmission Operation

A. Inputs

1. Coolant sensor
2. Throttle position sensor
3. Vehicle speed sensor
4. PRNDL switch
5. Brake switch
6. Cruise control switch
7. Manifold absolute pressure sensor
8. Low gear pressure switch
9. 4th gear pressure switch
10. Transmission temperature sensor
11. Transmission input speed sensor (TISS)
12. Transmission output speed sensor (TOSS)
13. Pressure switch manifold
14. Engine RPM

B. Outputs

1. Shift solenoids
2. Torque converter clutch solenoid
3. Viscous converter clutch solenoid
4. Pulse-width modulated solenoid
5. Electronic Pressure Control Solenoid
6. Adaptive learning

7. Torque management
- C. Testing
 1. Reading trouble codes
 2. Erasing troubles codes
 3. Using a "Scan Tool" to access data stream
 - a. Sensor information
 - b. Output status
 - c. Road test mode
 - d. Using the snap shot feature
 - e. Energizing outputs (functional/output tests)
 - f. Shifting transmission/transaxle
 4. Input sensor testing
 - a. Resistance testing
 - b. Reference voltage
 - c. Circuit voltage drops
 - d. Checking continuity
 5. Solenoid diagnosis
 - a. Reference voltage tests
 - b. Testing current flow on solenoids
 - c. Resistance tests
 6. Force motor diagnosis
 - a. Resistance tests
 - b. Current flow tests
 7. Torque converter clutch diagnosis
 - a. Using scan tool
 - b. Testing pressure switches
 - c. Voltage tests
 8. Using the Digital Storage Scope
 - a. testing shift solenoids (voltage and current)
 - b. testing PWM solenoids (voltage and current)
 - c. testing input and input shaft speed sensors
 9. Diagnostic strategy

INSTRUCTIONAL METHODS:

1. Lecture
2. Power Point Presentations
3. ATSG Online Training Videos
5. Demonstrations
6. Lab Practice (hands on)
7. Quizzes and Exams

EVALUATION OF STUDENT ACHIEVEMENT:

1. Complete all lab objectives (ASE Education Foundation tasks)
2. Pass written exams and quizzes (60% minimum)
3. Safety
4. Attendance
5. Class participation

INSTRUCTIONAL MATERIALS:

Textbooks

Chris Johnson and James E. Duffy. Manual Drive Trains and Axles. 4th Edition, Goodheart-Wilcox Company, 2021.

Chris Johnson and James E. Duffy, Automatic Transmissions and Transaxles, Fifth Edition, Goodheart-Willcox, 2021.

Resources

1. Pro-Demand – Information System
2. All Data Pro - Information System

LEARNING OUTCOMES AND GOALS:

Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify automatic transmission and transaxle components and configurations.
7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.
11. Perform lock-up converter system tests; determine needed action.
12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action.
13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.
14. Diagnose noise and vibration concerns; determine needed action.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

B. In-Vehicle Transmission/Transaxle

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
3. Perform relearn procedures.
6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT).
2. Describe the operational characteristics of a hybrid vehicle drive train.

III. MANUAL DRIVE TRAIN AND AXLES

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify manual drive train and axles components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
5. Diagnose drive train concerns; determine needed action.

III. MANUAL DRIVE TRAIN AND AXLES

F. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios.
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.
3. Inspect axle locking mechanisms; determine needed action(s).
4. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
5. Diagnose noise, vibration, and unusual steering concerns; determine needed action.
6. Diagnose, test, adjust, and/or replace electrical/electronic components of four-wheel drive/all-wheel drive systems.
7. Disassemble, service, and reassemble transfer case and components.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems.
11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.
12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.

13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action.

VIII. ENGINE PERFORMANCE

B. Computerized Controls

1. Identify computerized control system components and configurations.
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.
3. Perform active tests of actuators using a scan tool; determine needed action.
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM), digital storage oscilloscope (DSO), and/or scan tool; determine needed action.
6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM).
7. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.
8. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action.
9. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, HVAC, automatic transmissions, non-OEM installed accessories, or similar systems); determine needed action.

FOUNDATIONAL TASKS – 2022

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.

15. Locate and demonstrate knowledge of safety data sheets (SDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper).
6. Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert.

Preparing for Vehicle Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

Personal Standards

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.

6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.