

# ILLINOIS VALLEY COMMUNITY COLLEGE



## COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2260: Advanced Drivelines

Date: Spring 2014

Credit Hours: 3

Prerequisite(s): ATO 1240, ATO 2230 or consent of instructor.

Delivery Method:

<input checked="" type="checkbox"/> Lecture	2 Contact Hours (1 contact = 1 credit hour)
<input type="checkbox"/> Seminar	0 Contact Hours (1 contact = 1 credit hour)
<input checked="" type="checkbox"/> Lab	2 Contact Hours (2 contact = 1 credit hour)
<input type="checkbox"/> Clinical	0 Contact Hours (3 contact = 1 credit hour)
<input type="checkbox"/> Online	
<input type="checkbox"/> Blended	

Offered:  Fall  Spring  Summer

IAI Equivalent –**Only for Transfer Courses**–go to <http://www.itransfer.org>.

### CATALOG DESCRIPTION:

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.

## GENERAL EDUCATION GOALS ADDRESSED

*[See the last page of this form for more information.]*

### Upon completion of the course, the student will be able:

[Choose those goals that apply to this course.]

- To apply analytical and problem solving skills to personal, social and professional issues and situations.
- To communicate orally and in writing, socially and interpersonally.
- To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
- To understand and use contemporary technology effectively and to understand its impact on the individual and society.
- To work and study effectively both individually and in collaboration with others.
- To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
- To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
- To appreciate the ongoing values of learning, self-improvement, and career planning.

### EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

*[Outcomes related to course specific goals.]*

#### Upon completion of the course, the student will be able to:

- II. Automatic Transmission/Transaxle Tasks: (NATEF Tasks)
  - A. General Transmissions and Transaxle Diagnosis
    - II.A.1 Interpret and interpret transmission/transaxle concern; assure proper engine operation; determine necessary action.
    - II.A.2 Research applicable vehicle and service information, such as transmission/transaxle system operation, vehicle service history, service precautions, and technical service bulletins.
    - II.A.3 Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals)
    - II.A.7 Perform lock-up converter system tests; determine necessary action.
    - II.A.8 Diagnose electronic, mechanical, hydraulic and vacuum control systems concerns; determine necessary action.
  - C. In-Vehicle Transmission and Transaxle Repair
    - II.C.6 Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.
    - II.C.7 Diagnose electronic transmission control systems using a scan tool; perform necessary action.
  - D. Off-Vehicle Transmission and Transaxle Repair
    - 1. Removal, Disassembly, and Reinstallation

- II.D.1.3 Disassemble, clean, and inspect transmission/transaxle.
- II.D.1.4 Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens spacers and gaskets).
- II.D.1.5 Inspect servo bore, piston, seals, pin, spring, and retainers; perform necessary action.
- II.D.1.6 Inspect accumulator bore, piston, seals, spring, and retainer; perform necessary action.
- II.D.1.7 Assemble transmission/transaxle

## 2. Oil Pump and Converter

- II.D.2.2 Measure torque converter end play and check for interference; check stator clutch.
- II.D.2.3 Inspect, measure, and replace oil pump assembly and components.

## 3. Gear Train, Shafts, Bushings, and Case

- II.D.3.1 Measure endplay or preload; perform necessary action.
- II.D.3.2 Inspect, measure, and replace thrust washers and bearings.
- II.D.3.3 Inspect oil delivery seal rings, ring grooves, and sealing surface areas.
- II.D.3.4 Inspect bushings; perform necessary action.
- II.D.3.5 Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); perform necessary action.
- II.D.3.6 Inspect cases, bores, passages, bushings, vents, and mating surfaces; perform necessary action.
- II.D.3.7 Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.
- II.D.3.8 Inspect, measure, repair, adjust or replace transaxle final drive components.
- II.D.3.9 Inspect and reinstall parking pawl, shaft, spring, and retainer; perform necessary action.

## 4. Friction and Reaction Units

- II.D.4.1 Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; perform necessary action.
- II.D.4.2 Measure clutch pack clearance; perform necessary action.
- II.D.4.3 Air test operation of clutch and servo assemblies.
- II.D.4.4 Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; perform necessary action.
- II.D.4.5 Inspect bands and drums; perform necessary action.

## III. Manual Drive Trains and Axles Tasks - (NATEF Tasks):

### F. Four Wheel Drive/All Wheel Drive Component Diagnosis & Repair

- II.F.1 Diagnose noise, vibration and unusual steering concerns; Determine necessary action.

- II.F.2 Inspect, adjust and repair shift controls (mechanical, electrical, and vacuum), bushings, mounts, levers and brackets.
- II.F.3 Remove and install transfer case.
- II.F.4 Disassemble, service, and reassemble transfer case and components.
- II.F.5 Inspect front-wheel bearings and locking hubs; perform necessary action.
- II.F.6 Check drive assembly seals and vents; check lube level.
- II.F.7 Diagnose, test, adjust and replace electrical/electronic components of four-wheel drive systems.

## VI. Electrical/Electronic System Tasks - (NATEF Tasks):

### A. General Electrical System Diagnosis

(Performed on Electronically Controlled Transmissions/Transaxles)

- VI.A.1 Identify and interpret electrical/electronic system concern: determine necessary action.
- VI.A.2 Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technician service bulletins.
- VI.A.3 Locate and interpret vehicle and major component identification numbers (VIN, certification labels, calibration decals)
- VI.A.5 Use wiring diagrams during diagnosis of electrical circuit problems.
- VI.A.6 Demonstrate the proper use of a digital multi-meter (DMM) during diagnosis of electrical circuit problems.
- VI.A.8 Measure source voltage and perform voltage drop tests in electrical/electronic circuits using a voltmeter; determine necessary action.
- VI.A.9 Measure current flow in electrical/electronic circuits using an ammeter; determine necessary action.
- VI.A.10 Check continuity and measure resistance in electrical/electronic circuits and components using an ohmmeter; determine necessary action.
- VI.A.11 Check electrical circuits using fused jumper wires; determine necessary action.
- VI.A.12 Locate shorts, grounds, opens and resistance problems in electrical/electronic circuits; determine necessary action.
- VI.A.15 Inspect and test switches connectors, relays, solid state devices, and wires of electrical/electronic circuits; determine necessary action.
- VI.A.16 Repair wiring harnesses and connectors.
- VI.A.17 Perform solder repair of electrical wiring.

## VIII. Engine Performance Tasks - (NATEF Tasks)

### B. Computerized Engine Controls Diagnosis & Repair

(Performed on Electronically Controlled Transmissions/Transaxles)

- VIII.B.1 Retrieve and record stored OBD I diagnostic trouble codes; clear codes.
- VIII.B.2 Retrieve and record stored OBD II diagnostic trouble codes; clear codes.
- VIII.B.6 Inspect and test computerized engine control system sensors, powertrain control module (PCM) actuators, and circuits using a graphing multi-meter (GMM)/digital storage oscilloscope (DSO); perform necessary action.
- VIII.B.7 Obtain and interpret scan tool data.

- VIII.B.8 Access and use service information to perform step-by-step diagnosis.
- VIII.B.9 Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems).

## **COURSE TOPICS AND CONTENT REQUIREMENTS:**

- I. Transfer Cases
  - A. Purpose
  - B. Types
    - 1. Part-time transfer case
    - 2. Full-time transfer case
    - 3. Automatic 4WD transfer case
    - 4. All Wheel Drive transfer case
  - 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. 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 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 (OBD I & OBD II Vehicles)
2. Erasing troubles codes (OBD I & OBD II Vehicles)
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 a test light and ALDL
  - b. Using scan tool
  - c. Testing pressure switches
  - d. Voltage tests
8. Using the TranX2000 Transmission Tester
  - a. testing solenoids
  - b. testing switches
  - c. manually shifting the transmission
  - d. monitoring solenoids during road test
9. Diagnostic strategy

### **INSTRUCTIONAL METHODS:**

1. Lecture
2. Power Point Presentations
3. Videotapes/DVD's
4. Transparencies
5. Demonstrations of lab procedures
6. Lab Practice (hands on)
7. Exams

**INSTRUCTIONAL MATERIALS:**

1. Textbooks
2. ATO 2260 - Workbook
3. Videotapes
4. DVD's

**STUDENT REQUIREMENTS AND METHODS OF EVALUATION:**

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

**OTHER REFERENCES**



# Course Competency/Assessment Methods Matrix

ATO 2260: Advanced Drivelines		Assessment Options																															
For each competency/outcome place an "X" below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
Automatic Transmission/Transaxle Tasks: Interpret and interpret transmission/transaxle concern; assure proper engine operation; determine necessary action.					X																												
Automatic Transmission/Transaxle Tasks: Research applicable vehicle and service information, such as transmission/transaxle system operation, vehicle service history, service precautions, and technical service bulletins.			X		X																												
Automatic Transmission/Transaxle Tasks: Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals)					X																												

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Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
Automatic Transmission/Transaxle Tasks: Perform lock-up converter system tests; determine necessary action.				X																													
Automatic Transmission/Transaxle Tasks: Diagnose electronic, mechanical, hydraulic and vacuum control systems concerns; determine necessary action.				X																													
Automatic Transmission/Transaxle Tasks: Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.				X																													
Automatic Transmission/Transaxle Tasks: Diagnose electronic transmission control systems using a scan tool; perform necessary action.				X																													

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For each competency/outcome place an "X" below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment			
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D									
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																			
Automatic Transmission/Transaxle Tasks: Disassemble, clean, and inspect transmission/transaxle.					X																														
Automatic Transmission/Transaxle Tasks: Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens spacers and gaskets.					X																														
Automatic Transmission/Transaxle Tasks: Inspect servo bore, piston, seals, pin, spring, and retainers; perform necessary action.					X																														
Automatic Transmission/Transaxle Tasks: Inspect accumulator bore, piston, seals, spring, and retainer; perform necessary action.					X																														

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	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D										
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																				
Automatic Transmission/Transaxle Tasks: Assemble transmission/transaxle					X																															
Automatic Transmission/Transaxle Tasks: Measure torque converter end play and check for interference; check stator clutch.					X																															
Automatic Transmission/Transaxle Tasks: Inspect, measure, and replace oil pump assembly and components.					X																															
Automatic Transmission/Transaxle Tasks: Measure endplay or preload; perform necessary action.					X																															
Automatic Transmission/Transaxle Tasks: Inspect, measure, and replace thrust washers and bearings.					X																															

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	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																		
Automatic Transmission/Transaxle Tasks: Inspect oil delivery seal rings, ring grooves, and sealing surface areas.					X																													
Automatic Transmission/Transaxle Tasks: Inspect bushings; perform necessary action.					X																													
Automatic Transmission/Transaxle Tasks: Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); perform necessary action.					X																													
Automatic Transmission/Transaxle Tasks: Inspect cases, bores, passages, bushings, vents, and mating surfaces; perform necessary action.					X																													

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	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D									
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																			
Automatic Transmission/Transaxle Tasks: Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.					X																														
Automatic Transmission/Transaxle Tasks: Inspect, measure, repair, adjust or replace transaxle final drive components.					X																														
Automatic Transmission/Transaxle Tasks: Inspect and reinstall parking pawl, shaft, spring, and retainer; perform necessary action.					X																														
Automatic Transmission/Transaxle Tasks: Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; perform necessary action.					X																														



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Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
Manual Drive Trains and Axles Tasks - Remove and install transfer case.					X																												
Manual Drive Trains and Axles Tasks - Disassemble, service, and reassemble transfer case and components.					X																												
Manual Drive Trains and Axles Tasks - Inspect front-wheel bearings and locking hubs; perform necessary action.					X																												
Manual Drive Trains and Axles Tasks - Check drive assembly seals and vents; check lube level.					X																												
Manual Drive Trains and Axles Tasks - Diagnose, test, adjust and replace electrical/electronic components of four-wheel drive systems.					X																												



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Electrical/Electronic System Tasks - Identify and interpret electrical/electronic system concern: determine necessary action.					X																															
Electrical/Electronic System Tasks - Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technician service bulletins.					X																															
Electrical/Electronic System Tasks - Locate and interpret vehicle and major component identification numbers (VIN, certification labels, calibration decals)					X																															
Electrical/Electronic System Tasks - Use wiring diagrams during diagnosis of electrical circuit problems.					X				X																											

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	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D									
Electrical/Electronic System Tasks - Demonstrate the proper use of a digital multi-meter (DMM) during diagnosis of electrical circuit problems.					X																														
Electrical/Electronic System Tasks - Measure source voltage and perform voltage drop tests in electrical/electronic circuits using a voltmeter; determine necessary action.					X																														
Electrical/Electronic System Tasks - Measure current flow in electrical/ electronic circuits using an ammeter; determine necessary action.					X																														
Electrical/Electronic System Tasks - Check continuity and measure resistance in electrical/electronic circuits and components using an ohmmeter; determine necessary action.					X																														

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Electrical/Electronic System Tasks - Check electrical circuits using fused jumper wires; determine necessary action.					X																														
Electrical/Electronic System Tasks - Locate shorts, grounds, opens and resistance problems in electrical/ electronic circuits; determine necessary action.					X																														
Electrical/Electronic System Tasks - Inspect and test switches connectors, relays, solid state devices, and wires of electrical/electronic circuits; determine necessary action.					X																														
Electrical/Electronic System Tasks - Repair wiring harnesses and connectors.					X																														

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For each competency/outcome place an "X" below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
Electrical/Electronic System Tasks - Perform solder repair of electrical wiring.					X																												
Engine Performance Tasks - Retrieve and record stored OBD I diagnostic trouble codes; clear codes.					X																												
Engine Performance Tasks - Retrieve and record stored OBD II diagnostic trouble codes; clear codes.					X																												
Engine Performance Tasks - Inspect and test computerized engine control system sensors, powertrain control module (PCM) actuators, and circuits using a graphing multi-meter (GMM)/digital storage oscilloscope (DSO); perform necessary action.					X																												

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For each competency/outcome place an "X" below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
Engine Performance Tasks - Obtain and interpret scan tool data.					X																												
Engine Performance Tasks - Access and use service information to perform step-by-step diagnosis.					X																												
Engine Performance Tasks - Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems.					X																												