ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2230 – Automatic Transmissions

Date: Fall 2016

Credit Hours: 4.5

Prerequisite(s): None

Delivery Method:		
	☒ **Lecture**	**2 Contact Hours (1 contact = 1 credit hour)**
	☐ **Seminar**	**0 Contact Hours (1 contact = 1 credit hour)**
	☒ **Lab**	**5 Contact Hours (2-3 contact = 1 credit hour)**
	☐ **Clinical**	**0 Contact Hours (3 contact = 1 credit hour)**
	☐ **Online**	
	☐ **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 automatic transmissions and transaxles found on the modern day motor vehicle. Classroom topics covered will include: planetary gear operation, application devices, hydraulics, torque converters and diagnosis. The main emphasis in lab will be the diagnosing of transmission problems, service procedures and rebuilding of automatic transmissions/transaxles.

GENERAL EDUCATION GOALS ADDRESSED

[See last page for Course Competency/Assessment Methods Matrix.]

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

[Choose up to three goals that will be formally assessed in this course.]

☒ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☐ To communicate successfully, both orally and in writing, to a variety of audiences.
☐ To construct a critical awareness of and appreciate diversity.
☐ To understand and use 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. See last page for more information.]

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

I. AUTOMATIC TRANSMISSION AND TRANSAXLE (NATEF Tasks)

A. General: Transmission and Transaxle Diagnosis

1. Identify and interpret transmission/transaxle concern, differentiate between engine performance and transmission/transaxle concerns; determine necessary action.
2. Research applicable vehicle and service information fluid type, vehicle service history, service precautions, and technical service bulletins.
3. Diagnose fluid loss and condition concerns; determine necessary action.
4. Check fluid level in a transmission or a transaxle equipped with a dip-stick.
5. Check fluid level in a transmission or a transaxle not equipped with a dip-stick.
6. Perform pressure tests (including transmissions/transaxles equipped with electronic pressure control); determine necessary action.
7. Diagnose noise and vibration concerns; determine necessary action.
8. Perform stall test; determine necessary action.
9. Perform lock-up converter system tests; determine necessary action.
10. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
11. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).

B. In-Vehicle Transmission/Transaxle Maintenance and Repair

1. Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.
2. Inspect for leakage; replace external seals, gaskets, and bushings.
3. Drain and replace fluid and filter(s).
4. Inspect, replace and align powertrain mounts.

C. Off-Vehicle Transmission and Transaxle Repair

1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.
2. Inspect, leak test, and flush or replace transmission/transaxle oil cooler, lines, and fittings.
3. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
4. Disassemble, clean, and inspect transmission/transaxle.
5. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).
6. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine necessary action.
7. Assemble transmission/transaxle.
8. Inspect, measure, and reseal oil pump assembly and components.
9. Measure transmission/transaxle end play or preload; determine necessary action.
10. Inspect, measure, and replace thrust washers and bearings.
11. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.
12. Inspect bushings; determine necessary action.
13. Inspect and measure planetary gear assembly components; determine necessary action.
14. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.
15. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.
16. Inspect, measure, repair, adjust or replace transaxle final drive components.
17. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates, bands and drums; determine necessary action.
18. Measure clutch pack clearance; determine necessary action.
19. Air test operation of clutch and servo assemblies.
20. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, retainers; determine necessary action.

REQUIRED SUPPLEMENTAL TASKS (NATEF)

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. Locate and demonstrate knowledge of material safety data sheets (MSDS).

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 (i.e. micrometer, dial-indicator, dial-caliper).

Preparing Vehicle for Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of fender covers, mats.
3. Demonstrate use of the three C's (concern, cause, and correction).
4. Review vehicle service history.
5. 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.).

<u>Note</u>: NATEF Tasks are completed by students either individually or with a partner.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Gear Types
   A. The shape and location of gear teeth determine a gear's determine a gear's type.
      1. Spur gear teeth cut parallel to axis.
      2. Helical gear teeth cut at angle to axis
      3. External gear teeth cut on outer circumference.
      4. Internal gear teeth cut on inner circumference.
   B. Gear combinations transmit motion in varying ways.
   C. Meshed internal and external gears rotate in same direction.
   D. Meshed external gear rotate in opposite directions.
   E. Both combinations transmit motion along same or parallel axes.
   F. Other gear types can change axis of rotation.
   G. Bevel gears change axis of rotation by 90°.
   H. A large and small bevel is called a ring and pinion.
   I. When pinion centerline is below ring centerline, it's called a hypoid.
   J. Worm gears can change axis of rotation, they are more like a screw.

II. Gear Ratios
   A. The relationships between the speeds of the gears.
   B. When drive gear must rotate more than once to turn driven gear once, set is in gear reduction.
   C. When driven gear turns faster than drive gear, set is in overdrive.

III. Torque, Speed, and Power
   A. Torque is twisting force.
   B. Multiply force applied times distance from pivot.
   C. Constant input speed, torque decreases as output speed increases and vice versa.
   D. Torque multiplied or divided by a gearset, depending on ratio.
   E. Gear ratios selection matches engine torque curve.

IV. Planetary Gear Systems
   A. Allows gear ratio changes without meshing and unmeshing.
   B. A simple planetary is made up of:
      1. Central sun gear.
      2. Planet Carrier and pinions.
      3. Internal ring gear
   C. To transmit power through the set.
      1. One member rotated (input).
      2. One member held (reaction).
      3. One member driven (output).

V. Planetary Gear Operations
   A. Gear reduction obtained when carrier is the output
   B. Overdrive obtained when carrier is the input.
   C. Reverse obtained by holding the carrier
   D. Direct drive obtained by turning two members at same input speed.
   E. Simpson gearset is a compound planetary
      1. Two ring gears

2. Two carrier assemblies
3. One common sun gear

F. Ravigneaux gearset is a compound planetary system
1. Two sun gears
2. Two carrier assemblies
3. One common ring gear

VI. Hydraulic Principles
A. Force is amount of push or pull causing motion
B. Pressure is force exerted on a given unit of surface area.
C. Liquid cannot be compressed.
D. It will assume the shape of its container.
E. If areas of input and output pistons are the same, motion and force are equal at input and output.
F. Force equals pressure times area.
G. Pressure equals force divided by area.
H. Changing piston size affects output motion.

VII. Principal Parts of a Hydraulic System
A. Basic Parts
1. Reservoir
2. Input Source
3. Control Valving
4. Output Device
B. Hydrodynamics in study of fluids in motion.
C. Pressure occurs from resistance to flaw.
D. The 1-way overrunning clutch will hold mechanically when rotated in one
E. direction, but unlocks and overruns in the opposite direction.
F. Accumulators act to cushion clutch and servo engagement by slowing the
G. buildup of pressure in an apply circuit.

VIII. Fluids, Seals, and Bearings
A. Jobs done by ATF
1. Provide a fluid coupling between engine and transmission.
2. Move spool valves
3. Transmit hydraulic pressure
4. Operate apply devices
5. Cool and lubricate
B. ATF is a petroleum-based oil.
C. Fiber, paper, or screen filters are used to filter fluid before it enters the pump.
D. Gaskets conform to irregular surfaces to seal parts together.
E. Synthetic rubber seals include o-rings, square cut, a lib seal.
F. Thrust washers, bushing, and bearings control axial motion, radial play, and lubrication.
G. Properties of Dexron IIE the first multi-weight ATF.
H. Selective thrust washer location.

IX. Fluid Couplings and Converters
A. Fluid Coupling

1. Consists of an internally coned turbine and impeller enclosed in a housing.
2. A fluid coupling cannot multiply torque; a torque converter can.

B. Torque Converter
   1. Consists of three elements:
      a. Impeller (drive member)
      b. Turbine (driven member)
      c. Stator (reaction member)
   2. Rotary and vortex flow combine into resultant force.
   3. Lock-up Torque Converters
      a. Hydraulically locked converters
      b. Centrifugally locked converters
      c. Lockup controls
         1. brake switch
         2. low vacuum switch
         3. governor switch
         4. 3rd gear switch
         5. 4th gear switch
         6. TCC solenoid

C. Torque Converter Clutch
   1. Lock-up converters eliminate slippage at cruising speeds and increase fuel economy.
   2. Operation
   3. Types of Clutches
      a. TCC – Torque Converter Clutch
      b. VCC – Viscous Converter Clutch
   4. Types of Lock-up
      a. Partial lock-up
      b. Full lock-up
      c. Gradual unlock
   5. Solenoids
      a. Torque converter solenoid
      b. Force motor
      c. Pulse width modulated solenoid
      d. Testing and diagnosis

X. Computer Controlled Transmission Operation
   A. System operation
   B. Sensors/inputs
      1. PRNDL switch
      2. Neutral switch
      3. Transmission temperature sensor
      4. Turbine speed sensor
      5. Output speed sensor
      6. Brake switch
      7. Throttle position sensor
      8. Vehicle speed sensor
   C. Solenoids/Outputs
      1. Shift solenoids
      2. Solenoid assemblies

3. Torque converter clutch solenoid
4. Modulated converter clutch solenoid (MCCC)
5. Electronic pressure control solenoid
6. Force motor
7. Pulse width modulated solenoid

D. Testing and Diagnosis
1. On-board diagnostics
2. Scan tool
3. Limp-in mode
4. Solenoid testing
5. Common problems

INSTRUCTIONAL METHODS:

1. Lecture
2. Videos
3. Demonstration of lab procedure
4. Lab practice (hands on)
5. Power Point Presentations

INSTRUCTIONAL MATERIALS:

1. Textbooks
2. Power Point Presentations
3. Videos
4. Handouts

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

1. Complete lab objectives (NATEF Tasks)
2. Pass written and practical exams
3. Attendance
4. Safety Practices
6. Attitude

OTHER REFERENCES

1. “Pro-Demand” On-Line Information System – Mitchell (Both shops)
2. “All Data” On-Line Information System (Both Shops)

Course Competency/Assessment Methods Matrix

(Dept/# Course Name)	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
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	D	I	I	I	I	D	D							
2.A.1. Identify and interpret transmission/transaxle concern, differentiate between engine performance and transmission/transaxle concerns; determine necessary action.					X										X																		
2.A.2. Research applicable vehicle and service information fluid type, vehicle service history, service precautions, and technical service bulletins.					X										X																		
2.A.3. Diagnose fluid loss and condition concerns; determine necessary action.					X										X																		
2.A.4. Check fluid level in a transmission or a transaxle equipped with a dip-stick.					X										X																		

2.A.5. Check fluid level in a transmission or a transaxle not equipped with a dip-stick.					X										X																
2.A.6. Perform pressure tests (including transmissions/ transaxles equipped with electronic pressure control); determine necessary action.					X										X																
2.A.7. Diagnose noise and vibration concerns; determine necessary action.					X										X																
2.A.8. Perform stall test; determine necessary action.					X										X																
2.A.9. Perform lock-up converter system tests; determine necessary action.					X										X																
2.A.10. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.					X										X																
2.A.12. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).					X										X																
2.B.1. Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.					X										X																
2.B.2. Inspect for leakage; replace external seals, gaskets, and bushings.					X										X																
2.B.4. Drain and replace fluid and filter(s).					X										X																
2.B.5. Inspect, replace and align powertrain mounts.					X										X																

2.B.1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.					X										X																
2.B.2. Inspect, leak test, and flush or replace transmission/ transaxle oil cooler, lines, and fittings.					X										X																
2.B.3. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.					X										X																
2.B.6. Disassemble, clean, and inspect transmission/ transaxle.					X										X																
2.B.7. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).					X										X																
2.B.8. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine necessary action.					X										X																
2.B.9. Assemble transmission/transaxle.					X										X																
2.B.10. Inspect, measure, and reseal oil pump assembly and components.					X										X																
2.B.11. Measure transmission/transaxle end play or preload; determine necessary action.					X										X																

2.B.12. Inspect, measure, and replace thrust washers and bearings.					X										X																
2.B.13. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.					X										X																
2.B.14. Inspect bushings; determine necessary action.					X										X																
2.B.15. Inspect and measure planetary gear assembly components; determine necessary action.					X										X																
2.B.16. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.					X										X																
2.B.17. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.					X										X																
2.B.18. Inspect, measure, repair, adjust or replace transaxle final drive components.					X										X																
2.B.19. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates, bands and drums; determine necessary action.					X										X																
2.B.20. Measure clutch pack clearance; determine necessary action.					X										X																
2.B.21. Air test operation of clutch and servo assemblies.					X										X																

2.B.22. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, retainers; determine necessary action.					X									X																	
S.1. Identify general shop safety rules and procedures.														X																	X
S.2. Utilize safe procedures for handling of tools and equipment.														X																	X
S.3. Identify and use proper placement of floor jacks and jack stands.														X																	X
S.4. Identify and use proper procedures for safe lift operation.														X																	X
S.5. Utilize proper ventilation procedures for working within the lab/shop area.														X																	X
S.6. Identify marked safety areas.														X																	X
S.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.														X																	X
S.8. Identify the location and use of eye wash stations.														X																	X
S.9. Identify the location of the posted evacuation routes.														X																	X
S.10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.														X																	X
S.11. Identify and wear appropriate clothing for lab/shop activities.														X																	X

S.12. Secure hair and jewelry for lab/shop activities.														X																	X
S.15. Locate and demonstrate knowledge of material safety data sheets (MSDS).														X																	X
T.E.1. Identify tools and their usage in automotive applications.					X									X																	
T.E.2. Identify standard and metric designation.														X																	
T.E.3. Demonstrate safe handling and use of appropriate tools.					X									X																	
T.E.4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.					X									X																	
T.E.5. Demonstrate proper use of precision measuring tools (i.e. micrometer, dial-indicator, dial-caliper).					X									X																	
P.V.S.1. Identify information needed and the service requested on a repair order.					X									X																	
P.V.S.2. Identify purpose and demonstrate proper use of fender covers, mats.					X									X																	
P.V.S.3. Demonstrate use of the three C's (concern, cause, and correction).					X									X																	
P.V.S.4. Review vehicle service history.					X									X																	X
P.V.S.5. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.					X									X																	

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