

ILLINOIS VALLEY COMMUNITY COLLEGE



COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 1240 Power Trans & Manual Transmissions

Date: Spring 2014

Credit Hours: 3.5

Prerequisite(s): None

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **3 Contact Hours** (2 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 clutches, manual transmissions/transaxles, driveshafts/halfshafts and differentials on front wheel drive and rear wheel drive vehicles. The course will study the operation, service and rebuilding of constant mesh, fully synchronized manual transmissions and transaxles.

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:

NATEF Tasks:

- A. Clutch Diagnosis and Repair -
 1. Diagnose clutch noise, binding, slippage, pulsation, and chatter problems; determine needed repairs.
 2. Inspect, adjust or replace clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs.
 3. Inspect, adjust, repair or replace hydraulic clutch slave and master cylinders, lines and hoses.
 4. Inspect, adjust or replace release (throw-out) bearing, lever, and pivot.
 5. Inspect and replace clutch pressure plate assembly and clutch disc.
 6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).
 7. Inspect, repair, and service or replace flywheel and ring gear.
 8. Inspect engine block, clutch (bell) housing, and transmission case mating surfaces; determine needed repairs.
 9. Measure flywheel-to-block runout and crankshaft end play; determine needed repairs.
 10. Measure clutch (bell) housing bore-to-crankshaft runout and face squareness; determine needed service.
- B. Transmission Diagnosis and Repair -
 1. Diagnose transmission noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.
 2. Inspect, adjust, and replace transmission shift linkages, brackets, bushings, cables, pivots, and levers.
 3. Inspect, replace, and align power train mounts.
 4. Inspect and replace transmission gaskets, seals, and sealants; inspect sealing surfaces.

5. Remove and reinstall transmission.
 6. Disassemble, clean, and reassemble transmission components.
 7. Inspect, adjust, and reinstall transmission shift cover, forks, grommets, levers, shafts, sleeves, detent mechanisms, interlocks, and springs.
 8. Inspect and reinstall input (clutch) shaft and bearings.
 9. Inspect and reinstall main shaft, gears, thrust washers, bearings, and retainers.
 10. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.
 11. Inspect and reinstall counter (cluster) gear, shaft, bearings, thrust washers, and retainers; check endplay; adjust as needed.
 12. Inspect and reinstall reverse idler gear, shaft, bearings, thrust washers, and retainers; check endplay; adjust as needed.
 13. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers.
 14. Inspect, repair, and replace extension housing and transmission case mating surfaces, bores, bushings, and vents.
 15. Inspect lubrication devices (oil pump or slingers).
- C. Transaxle Diagnosis and Repair -
1. Diagnose transaxle noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.
 2. Inspect, adjust, and reinstall transaxle shift linkages, brackets, bushings, cables, pivots, and levers.
 3. Inspect and reinstall power train mounts.
 4. Remove and reinstall transaxle.
 5. Inspect and replace transaxle gaskets, seals, and sealants; inspect sealing surfaces.
 6. Remove and replace transaxle final drive.
 7. Disassemble and clean transaxle final drive.
 8. Inspect, adjust, and reinstall transaxle shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.
 9. Inspect and reinstall input (clutch) shaft and bearings.
 10. Inspect and reinstall output shaft, gears, thrust washers, bearings, and retainers.
 11. Measure endplay or preload (shim or spacer selection procedure) on transaxle shafts; adjust as needed.
 12. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.
 13. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers.
 14. Inspect and reinstall idler gear, shaft, bearings, thrust washers, and retainers.
 15. Diagnose differential assembly noise and vibration problems; determine needed repairs.
 17. Remove, inspect, measure, adjust, and reinstall differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.
 18. Inspect lubrication devices (oil pump or slingers).

- D. Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair -
1. Diagnose constant-velocity (CV) joint noise and vibration problems; determine needed repairs.
 2. Diagnose universal joint noise and vibration problems; determine needed repairs.
 3. Diagnose front wheel drive (FWD) front wheel bearing noise and vibration problems; determine needed repairs.
 4. Inspect, service, and replace shafts, yokes, boots, and universal/CV joints.
 5. Inspect, service, and replace shaft center support bearings.
 6. Check and correct shaft balance; measure shaft runout; measure and adjust driveline angles.
- E. Rear Axle Diagnosis and Repair -
1. Ring and Pinion Gears and Differential Case Assembly
 1. Diagnose noise and vibration problems; determine needed repairs.
 2. Diagnose fluid leakage problems; determine needed repairs.
 3. Inspect and replace companion flange and pinion seal; measure companion flange runout.
 4. Inspect ring gear and measure runout; determine needed repairs.
 5. Remove and inspect drive pinion gear, spacers, sleeves, and bearings.
 6. Measure and adjust drive pinion depth.
 7. Measure and adjust drive pinion bearing preload.
 8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup and shim types).
 9. Check ring and pinion tooth contact patterns; adjust as needed.
 10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearing, thrust washers, and case.
 11. Reassemble and reinstall differential case assembly; measure runout; determine needed repairs.
 2. Limited Slip Differential
 1. Diagnose noise, slippage, and chatter problems; determine needed repairs.
 2. Inspect and flush differential housing; refill with correct lubricant.
 3. Inspect and reinstall clutch (cone or plate) components.
 4. Measure rotating torque; determine needed repairs.
 3. Axle Shaft
 1. Diagnose rear axle shafts, bearings, and seals for noise, vibration, and fluid leakage problems; determine needed repairs.
 2. Inspect and replace rear axle shaft wheel studs.
 3. Remove and replace rear axle shafts.
 4. Inspect and replace rear axle shaft seals, bearings, and retainers.
 5. Measure rear axle flange runout and shaft end play; determine needed repairs.
- F. Four-Wheel Drive / All-Wheel Drive Component Diagnosis and Repair -
1. Diagnose noise, vibration, and unusual steering problems; determine needed repairs.

2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.
3. Remove and reinstall transfer case.
4. Disassemble, service, and reassemble transfer case and components.
5. Inspect, service, and replace front-wheel bearings and locking hubs.
6. Check drive assembly seals and vents; check lube level.
7. Inspect viscous coupling assembly.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Clutches

A. Clutch Assembly

1. Flywheel
 - a) Stepped Flywheel
 - b) Machining
2. Pressure plate
 - a) Diaphragm type
 - b) Coil spring type
 - c) Semi-centrifugal type
3. Clutch disc
 - a) Construction
 - b) Cushion springs
 - c) Dampening springs (torsional)
4. Release bearing
 - a) Ball bearing type
 - b) Roller bearing type
5. Pilot bearing
 - a) Ball bearing type
 - b) Roller bearing type
 - c) Bronze bushing

B. Clutch Operation

1. Mechanical
 - a) Linkage and leverage action
 - b) Adjustment and maintenance
2. Hydraulic
 - a) Component operation
 - b) Bleeding and maintenance
3. Cable
 - a) Component operation
 - b) Adjustment and maintenance
 - c) Self-adjusting mechanism

C. Operation of Clutch Components

1. Flywheel function
2. Pressure plate
 - a) Release levers operation
 - b) Coil springs
3. Disc
 - a) Cushioning springs
 - b) Hub and torsional spring
4. Release bearing

- a) Types
 - b) Adjustment and maintenance
 - 5. Pilot bearing
 - a) Purpose
 - b) Inspection for wear
 - c) Removal and replacement
 - D. Clutch Problems and Diagnosis
 - 1. Test Drive
 - 2. Chatter
 - 3. Pedal pulsation
 - 4. Slippage
 - 5. Grinding
 - 6. Clutch will not release
 - 7. Chronic clutch disc wear
 - 8. Binding linkage
 - 9. Damaged release bearing
 - 10. Clutch grabs
 - 11. Pilot bearing noise
 - 12. Throw-out bearing noise
 - 13. Transmission input bearing noise
- II. Manual Transmission
- A. Gear Design
 - 1. Helical
 - 2. Spur
 - 3. Internal Gears
 - 4. External gears
 - 5. Thrust
 - B. Gear Ratios
 - 1. First through fifth and reverse gear ratios
 - 2. Calculation of gear ratios
 - 3. Speed and torque multiplication relationship
 - C. Synchronizers
 - 1. Operation
 - 2. Blocker ring type
 - 3. Inspection
 - 4. Reasons for replacement
 - D. Three, Four, and Five Speed Transmission
 - 1. Construction
 - 2. Power flow
 - 3. Disassembly / assembly procedures
 - 4. End-play adjustments
 - E. Overdrive
 - 1. Operation
 - 2. Planetary gear type
 - 3. Manually shift type
 - 4. Hydraulic shift type
 - 5. Electrical shift type
 - F. Manual Transaxle
 - 1. Transverse engine

2. Operation
 3. Overhaul
 4. Removal and installation
- G. Manual Transmission Problems and Diagnosis
1. Worn detent parts
 2. Synchronizer failure
 3. Damage pilot bearing
 4. Bent shift fork
 5. Gears clash during shifting
 6. Transmission oil leaks
 7. Hard shifting into gear
 8. Transmission jumps out of gear
 9. Linkage adjustments
 10. Front wheel drive shaft noises
- III. Drive Line and Axles
- A. Drive Shafts
1. Design
 - a) Torque tube drive
 - b) Hotchkiss drive
 2. Slip yoke
 3. Universal joint
 - a) Cross and roller
 - b) Constant velocity
 4. Tube construction
 5. Phasing
 6. Balancing
 7. Law of canceling angles
- B. Axles
1. Design
 - a) Semi-floating
 - b) Full-floating
 - c) Front wheel drive
- C. Bearings
1. Types
 2. Service
- IV. Differentials
- A. Operation
1. Driving wheels turn at different speeds
 2. Straight ahead operation
 3. Torque multiplication
 4. One wheel held stationary
- B. Differential Parts
1. Side gears
 2. Differential pinions
 3. Ring gear
 4. Pinion gear
 5. Bearings
 6. Shims
 7. Oil Seal Case

- 8. Thrust washers
- C. Gear Design
 - 1. Hypoid
 - 2. Spur bevel
- D. Gear Ratios
 - 1. Calculations
 - 2. Hunting, non hunting, and partial non hunting
- E. Limited-Slip Differential
 - 1. Types
 - a) Clutch plates
 - b) Clutch cones
 - 2. Operation
 - 3. Testing
 - 4. Service
- F. Disassembly/Assembly Procedures
 - 1. Ring gear backlash
 - 2. Ring gear run-out
 - 3. Carrier bearing pre-load
 - 4. Drive pinion bearing pre-load
 - 5. Drive pinion depth
 - 6. Gear tooth patterns
 - a) Interpretation
 - b) Adjustment
 - 7. Lubrication
- G. Differential Problems and Diagnosis
 - 1. Noise on turns
 - 2. Vibration
 - 3. Noise produced with car in neutral
 - 4. Noise is the same in drive or coast
 - 5. Clunk on acceleration or deceleration
 - 6. Chatter on turns
- V. Transfer Case
 - A. Purpose
 - B. Types
 - 1. Part-time transfer case
 - 2. Full-time transfer case
 - C. Four Wheel Drive Front Hubs
 - 1. Locked hub
 - 2. Free-running clutch hub
 - D. Adjustments and Maintenance

INSTRUCTIONAL METHODS:

Lecture
 Demonstration
 Video tapes
 Quizzes
 Exams
 Handouts
 Transparencies

INSTRUCTIONAL MATERIALS:

Text
Power Point Presentations
Videos
Transparencies

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

1. Complete all lab objectives (NATEF Tasks)
2. Pass written exams and quizzes.
3. Safety Practices
4. Attitude
5. Attendance.
6. Class participation.

OTHER REFERENCES

Course Competency/Assessment Methods Matrix

ATO 1240; Power Trans & Manual Transmissions	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	I	I	I	I	D	D								
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
A.1 Clutch Diagnosis and Repair - Diagnose clutch noise, binding, slippage, pulsation, and chatter problems; determine needed repairs.				X			X																										
A.2 Clutch Diagnosis and Repair - Inspect, adjust or replace clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs.				X																													
A.3 Clutch Diagnosis and Repair - Inspect, adjust, repair or replace hydraulic clutch slave and master cylinders, lines and hoses.				X																													
A.4 Clutch Diagnosis and Repair - Inspect, adjust or replace release (throw-out) bearing, lever, and pivot.				X																													
A.5 Clutch Diagnosis and Repair - Inspect and replace clutch pressure plate assembly and clutch disc.				X																													
A.6 Clutch Diagnosis and Repair - Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).				X																													

B.8 Transmission Diagnosis and Repair - Inspect and reinstall input (clutch) shaft and bearings.				X																								
B.9 Transmission Diagnosis and Repair - Inspect and reinstall main shaft, gears, thrust washers, bearings, and retainers.				X																								
B.10 Transmission Diagnosis and Repair - Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.				X																								
B.11 Transmission Diagnosis and Repair - Inspect and reinstall counter (cluster) gear, shaft, bearings, thrust washers, and retainers; check endplay; adjust as needed.				X																								
B.12 Transmission Diagnosis and Repair - Inspect and reinstall reverse idler gear, shaft, bearings, thrust washers, and retainers; check endplay; adjust as needed.				X																								
B.13 Transmission Diagnosis and Repair - Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers.				X																								
B.14 Transmission Diagnosis and Repair - Inspect, repair, and replace extension housing and transmission case mating surfaces, bores, bushings, and vents.				X																								
B.15 Transmission Diagnosis and Repair - Inspect lubrication devices (oil pump or slingers).				X																								
C.1 Transaxle Diagnosis and Repair - Diagnose transaxle noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.				X		X																						
C.2 Transaxle Diagnosis and Repair - Inspect, adjust, and reinstall transaxle shift linkages, brackets, bushings, cables, pivots, and levers.				X																								

C.3 Transaxle Diagnosis and Repair - Inspect and reinstall power train mounts.						X																						
C.4 Transaxle Diagnosis and Repair - Remove and reinstall transaxle.						X																						
C.5 Transaxle Diagnosis and Repair - Inspect and replace transaxle gaskets, seals, and sealants; inspect sealing surfaces.						X																						
C.6 Transaxle Diagnosis and Repair - Remove and replace transaxle final drive.						X																						
C.7 Transaxle Diagnosis and Repair - Disassemble and clean transaxle final drive.						X																						
C.8 Transaxle Diagnosis and Repair - Inspect, adjust, and reinstall transaxle shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.						X																						
C.9 Transaxle Diagnosis and Repair - Inspect and reinstall input (clutch) shaft and bearings.						X																						
C.10 Transaxle Diagnosis and Repair - Inspect and reinstall output shaft, gears, thrust washers, bearings, and retainers.						X																						
C.11 Transaxle Diagnosis and Repair - Measure endplay or preload (shim or spacer selection procedure) on transaxle shafts; adjust as needed.						X		X																				
C.12 Transaxle Diagnosis and Repair - Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.						X																						
C.13 Transaxle Diagnosis and Repair - Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers.						X																						
C.14 Transaxle Diagnosis and Repair - Inspect and reinstall idler gear, shaft, bearings, thrust washers, and retainers.						X																						
C.15 Transaxle Diagnosis and Repair - Diagnose differential assembly noise and vibration problems; determine needed repairs.						X		X																				

C.17 Transaxle Diagnosis and Repair - Remove, inspect, measure, adjust, and reinstall differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.				X																																			
C.18 Transaxle Diagnosis and Repair - Inspect lubrication devices (oil pump or slingers).				X																																			
D.1 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Diagnose constant-velocity (CV) joint noise and vibration problems; determine needed repairs.				X		X																																	
D.2 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Diagnose universal joint noise and vibration problems; determine needed repairs.				X		X																																	
D.3 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Diagnose front wheel drive (FWD) front wheel bearing noise and vibration problems; determine needed repairs.				X		X																																	
D.4 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Inspect, service, and replace shafts, yokes, boots, and universal/CV joints.				X																																			
D.5 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Inspect, service, and replace shaft center support bearings.				X																																			
D.6 Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair - Check and correct shaft balance; measure shaft runout; measure and adjust driveline angles.				X																																			
E.1.1 Rear Axle Diagnosis and Repair - Diagnose noise and vibration problems; determine needed repairs.				X		X																																	

E.1.2 Rear Axle Diagnosis and Repair - Diagnose fluid leakage problems; determine needed repairs.				X																										
E.1.3 Rear Axle Diagnosis and Repair - Inspect and replace companion flange and pinion seal; measure companion flange runout.				X																										
E.1.4 Rear Axle Diagnosis and Repair - Inspect ring gear and measure runout; determine needed repairs.				X		X																								
E.1.5 Rear Axle Diagnosis and Repair - Remove and inspect drive pinion gear, spacers, sleeves, and bearings.				X																										
E.1.6 Rear Axle Diagnosis and Repair - Measure and adjust drive pinion depth.				X		X																								
E.1.7 Rear Axle Diagnosis and Repair - Measure and adjust drive pinion bearing preload.				X		X																								
E.1.8 Rear Axle Diagnosis and Repair - Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup and shim types).				X		X																								
E.1.9 Rear Axle Diagnosis and Repair - Check ring and pinion tooth contact patterns; adjust as needed.				X		X																								
E.1.10 Rear Axle Diagnosis and Repair - Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearing, thrust washers, and case.				X																										
E.1.11 Rear Axle Diagnosis and Repair - Reassemble and reinstall differential case assembly; measure runout; determine needed repairs.				X																										
E.2.1 Rear Axle Diagnosis and Repair - Diagnose noise, slippage, and chatter problems; determine needed repairs.				X		X																								

F.4 Four-Wheel Drive / All-Wheel Drive Component Diagnosis and Repair - Disassemble, service, and reassemble transfer case and components.				X																									
F.5 Four-Wheel Drive / All-Wheel Drive Component Diagnosis and Repair - Inspect, service, and replace front-wheel bearings and locking hubs.				X																									
F.6 Four-Wheel Drive / All-Wheel Drive Component Diagnosis and Repair - Check drive assembly seals and vents; check lube level.				X																									
F.7 Four-Wheel Drive / All-Wheel Drive Component Diagnosis and Repair - Inspect viscous coupling assembly.				X																									