## COURSE OUTLINE

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<th>Course Number</th>
<th>Course Title</th>
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<td>AUT 225</td>
<td>Automatic Transmission Service</td>
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**Hours:**
- Lecture: 2
- Lab: 3

**Co- or Pre-requisite:**
- AUT 110, AUT 111 and AUT 224

**Implementation:**
- Spring 2019

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**Catalog description (2018-2019 Catalog):**
Principles of operation and proper diagnostic and repair procedures for current automatic transmissions and transaxles, including electronic computer-controlled designs. Covers basic hydraulic theory with emphasis on the use of test equipment for diagnosis and in-car service. Each student is required to disassemble, overhaul and assemble several automatic transmissions and transaxles.

**Is course New, Revised, or Modified?** Revised


**Revision date:** January 2019

**Course coordinator:** Jason Evans, ext. 3776, evansj@mccc.edu

**Information resources:**
- DealerConnect web-site
- Chrysler Academy Training Reference Books
- Subaru of America resources
- Service Manuals
- On-line Self-study Courses
- AllData Online Service Information Database

**Other learning resources:**
- ASE Study Guides
- Automotive Related Articles Obtained From Magazines and Journals
Course Competencies/Goals: [List the most important 5-8 overall student learning outcomes for your course. Course-level student learning outcomes (or Course Competencies/Goals) are statements that describe the specific, measurable knowledge, skills, and/or values that the student is expected to demonstrate, perform or exhibit after completion of the course. Student learning outcomes should focus on what the students will learn (rather than what the instructor will teach) and must include verbs (explain…., demonstrate…. analyze…) that reflect lower-order and higher-order learning goals.]

The student will be able to:
1. using the computers found in the automotive facility obtain service repair information procedures from the appropriate online service information database.
2. research service procedures to repair program transmissions using the vehicle service manuals found in the shop facility.
3. completely disassemble, inspect and reassemble a RWD automatic transmission following the researched service information.
4. completely disassemble, inspect and reassemble a FWD electronic automatic transaxle following the service information.
5. perform a series of transmission diagnostic pressure tests to determine the cause of poor shift quality.
6. as demonstrated in class, perform a transmission fluid cooler flush to remove harmful debris after a rebuild.

Course-specific General Education Knowledge Goals and Core Skills. [To an extent consistent with its primary purposes, each course in every program is expected to reflect the college’s commitment to general education, as affirmed in the 2005 General Education Policy. A General Education Course is one whose primary purposes and overall design coincide strongly with one or more of the approved general education goals and objectives. For any approved (or proposed) General Education Course, the General Education Goals and Objectives form (the form identified as the "Gen Ed Attachment") should be completed and attached to the course outline. Below is a complete list of Mercer’s General Education Knowledge Goals and Core Skills. Retain on this course outline the Goals and Skills that pertain to your course and delete those that are not a central part of the course.]

**General Education Knowledge Goals**
Goal 1. Communication. Students will communicate effectively in both speech and writing.
Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Goal 5. Social Science. Students will use social science theories and concepts to analyze human behavior and social and political institutions and to act as responsible citizens.
Goal 8. Diversity. Students will understand the importance of a global perspective and culturally diverse peoples.

**MCCC Core Skills**
Goal A. Written and Oral Communication in English. Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.
Goal B. Critical Thinking and Problem-solving. Students will use critical thinking and problem solving skills in analyzing information.
Goal C. Ethical Decision-Making. Students will recognize, analyze and assess ethical issues and situations.
Goal D. Information Literacy. Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.
Goal E. Computer Literacy. Students will use computers to access, analyze or present information, solve problems, and communicate with others.
Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.
Goal G. Intra-Cultural and Inter-Cultural Responsibility. Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.
Units of study in detail.

Unit I: TRANSMISSION/TRANSAXLE IDENTIFICATION

Learning Objectives
The student will be able to...
- identify the program transmissions by using one or more of the six possible methods of identification.
- identify and measure the transmission fluid level following available service information.

A. Transmission Types- RWD
   1. 42 RLE
   2. 45/545 RFE
   3. 46 RH
   4. NAG

B. Transaxle Types- FWD
   1. 31 TH
   2. 41 TE
   3. 42 LE
   4. Constant Velocity Transmission (CVT)

C. Methods of Identification
   1. Serial Number
   2. Vehicle Identification Number
   3. Julian Build Date
   4. Transmission Oil Pan Design
   5. Bell Housing Design
   6. Torque Converter Number

D. Types of Transmission Fluid
   1. ATF Type+4
   2. Dextron III
   3. Mercon
   4. CVT Synthetic

Unit II: FLUID LEAK DIAGNOSIS AND REPAIR

Learning Objectives
The student will be able to...
- identify and diagnose causes of transmission fluid leaks.
- identify sources for fluid leaks.
- using the procedure outlined in the service information, properly repair the leaks.

A. Fluid Leak Identification
   1. Fluid Leak Inspection Tools
   2. Fluid Leak Inspection Methods

B. External Seals
   1. Lip Seal Locations
   2. Case Housing Seals
   3. Directional Seals
   4. Differential Seals

C. Gaskets
   1. Gasket Locations
   2. Reusable Gaskets
   3. Chemical Sealers
      a. Sealer Application

D. Casting Porosity: Pump, Case
Unit III: FUNDAMENTALS OF FLUID COUPLINGS AND TORQUE CONVERTERS

Learning Objectives

The student will be able to…
- identify the components of the torque converter when completing a lab activity sheet.
- explain the operation of the components of a torque converter when answering questions on a test.
- following the correct service procedure, perform a torque converter “stall test” to determine proper operating condition.

A. Principles of Operation
   1. Fundamental Coupling Principle
   2. Components
      a. Impeller
      b. Turbine
      c. Stator
      d. Torque Converter Clutch Assembly

3. Operation of a Torque Converter
   a. Driving Member (Impeller)
   b. Driven Member (Turbine)
   c. Housing Filled with Oil
   d. Oil Flow and Motion in the Housing
      1. Thrown by Centrifugal Force
      2. Strikes Curved Vanes
      3. Torque Multiplication
      4. Types of Fluid Flow: Rotary and Vortex
   e. The Stator Effect
      1. Third Set of Blades to Redirect Fluid
      2. Stall Speed
      3. Over-Running Clutch

4. Converter Operating Characteristics
   a. Acts as an Automatic Clutch
   b. Automatically Adjusts to Torque Output
   c. Acts as a Natural Shock Absorber

5. Converter Capacity and Size
   a. Torque Capacity and Stall Speed
   b. Converter and Engine Must Be Matched
   c. Size Affects Performance

6. Lock-Up Converters
   a. Benefits of Usage
      1. Improved Fuel Economy
      2. Lower Transmission Operating Temperature
      3. Less Engine RPMs at Highway Speeds
   b. Lock-Up Clutch Operation
      1. Eliminates Converter Slippage
      2. Locks Impeller and Turbine Together with Friction Clutch and Piston
      3. TCC Solenoid Sends Fluid Behind Piston Through Input Shaft to Apply
      4. TCC Operating Parameters

7. Checking Stall Speed
a. Precautions
b. Stall Test Oil Flow and Operating Temperature
c. Diagnosis of Test Results

B. Automatic Transmission Fluid Cooler
1. Single-Pass Parallel-Path
   a. Inside Radiator
2. Double-Pass Parallel-Path
   a. Standalone
   b. Combination
3. Cooling System Bypass Valves
   a. Pressure Bypass Systems
   b. Thermal and Pressure Bypass
   c. Torque Converter Drain Back Valve
4. Cooler Flush and Service
   a. Reason for Performing Flush
   b. Demonstration: Flushing the Cooler

LAB ACTIVITY 1: TRANSMISSION DIAGNOSIS AND TESTING
LAB ACTIVITY 2: AUTOMATIC TRANSMISSION COOLER FLUSH

**Unit IV: OIL PUMP ASSEMBLY**

**Learning Objectives**

The student will be able to:
- given questions on a test, describe the operation of the various types of oil pumps.
- Using plasti-gauge, measure the pump body for warpage and damage.
- visually inspect an oil pump body for wear indicators and damage to determine condition.

A. General Operation
B. Types of Pumps
   a. Crescent Gear Pumps
   b. Gerotor Pumps
   c. Dual Stage Pumps
   d. Vane Style Oil Pump
C. Inspection of Condition and Wear

**Unit V: PLANETARY GEAR TRAIN**

**Learning Objectives**

The student will be able to:
- given a question on a test, identify the components of the standard planetary gear set.
- given the components of a planetary gear set, explain the operating principles of torque multiplication and overdrive.

A. Components: Planetary Gear Set
   1. Sun Gear
   2. Planet Carrier
      a. Pinion Gears
   3. Annulus Gear or Ring Gear
   4. Front Sun Gear Shell
B. Input and Output Torque Variations
   1. Combinations
   2. One Component Driving, One Held, One Driven
C. Simpson Gear Train
   1. Two Different Simple Gear Sets with Common Sun Gear
2. Gear Ratio Possibilities
3. Combinations
D. Compounded Planetary Gear Set
E. Planetary Gear Set Power Flow
   1. Calculating Gear Ratio
      a. Gear Reduction
      b. Direct Drive
      c. Overdrive
      d. Reverse
F. Parking Systems: Components and Operation

**Unit VI: FRICTIONAL UNITS/ HOLDING DEVICES**

*Learning Objectives*

_The student will be able to:_
- Given a question on a test, explain the operation of a band and servo combination.
- Explain to the instructor the operation of the over-running clutch assembly found in the automatic transmission case.
- Disassemble, inspect and determine condition of each transmission clutch pack for reuse or replacement.

A. Components
   1. Clutch Assemblies
   2. Bands/ Servos/ Accumulators
   3. Over-Running Clutch/ Sprag
   4. Component Functions
B. Clutch Assemblies
   1. Multiple Disc Clutch Assembly
      a. Function
      b. Construction
      c. Clutch Friction Material
      d. Clutch Plate Clearance
      e. Select Fit Snap-Ring
   2. Identifying Clutch Assemblies
      a. Applications
   3. Component Inspection
      a. Wear Patterns
      b. Glazing and Color
      c. Piston Seal Condition
   4. Multiple Disc Clutch Pressure Check
      a. Pressure Check Procedure
      b. Test Results
C. Bands/ Servos/ Accumulators
   1. Function: To Hold Drums or Sun Gear Shell
   2. Friction Material on a Steel Lining
   3. Servo Piston
      a. Moved by Fluid Pressure
      b. Piston Seal
      c. Tightens Band to Hold Planetary Annulus Gear or Clutch Drum
D. Over-Running Clutch Assembly
   1. Construction
      a. Inner Race
      b. Outer Race or Cam
      c. Rollers and Springs
d. Sprag Clutch

2. Over-Running Clutch Operation
   a. Free-Wheeling Condition
   b. Locked Condition

3. Function and Usage
   a. Drive Breakaway (M1)

Unit VII: THE FLOW OF POWER

Learning Objectives
The student will be able to:

• Given a component power flow chart, identify which components are engaged or released in each of the transmission gear ranges.
• Given a component power flow chart, diagnose a shifting problem within the transmission and determine the proper repair.
• Given questions on a test relating to transmission operation, correctly answer the questions and receive a minimum 60% score.

A. Components Operation
1. Front Clutch Hub/Rear Clutch Retainer Assembly
   a) Multiple-Disc Clutch Assemblies: Two Sets
   b) Front Clutch/Rear Clutch
2. Output Shaft
   a) Rear-Wheel Drive
   b) Front-Wheel Drive
   c) Lubrication and Cooling

B. Power Flow: Drive Positions
1. Neutral
   a) Torque Converter Develops Torque (Power)
   b) No Bands or Clutches Applied
   c) Disc and Output Shaft are Stationary

C. Drive Breakaway/Manual Low
1. Shift Lever in “D” position
2. Rear Clutch Applies
3. Planetary Carrier Rotation
4. Low/Reverse Drum
5. Over-Running Clutch Operation
6. Manual Low
   a. Rear Clutch Applied w/ Low Reverse Band
   b. Engine Deceleration and Gear Reduction

D. Second Gear (Drive)
1. Application of Band/Servo
   a) Holds Front Clutch retainer
   b) Holds Sun Gear Stationary
2. Over-Running Clutch – 1 to 2 Shift
   a) Free-Wheeling

E. Third Gear (Drive/Direct)
1. Band/Servo Released/Front Clutch Applied
   a) Rear Clutch Still Applied
2. Both Clutch Assemblies Locked Up
a) Rotate in same direction
3. Engine to Output Shaft Ratio = 1.0:1
4. Front and Rear Planet Pinions Not Rotating
5. All Connected Parts: One Common Unit

F. Four Gear/Overdrive
   1. Overdrive Clutch Assembly
   2. Overdrive Solenoid

G. Reverse Gear
   1. Front Clutch Applies With Low-Reverse Band
   2. Sun Gear Rotation
      a. Planet Pinions Rotation
      1. Opposite Engine Direction

Unit VIII: HYDRAULIC SYSTEM

Learning Objectives
The student will be able to…
• perform a series of transmission diagnostic pressure tests to determine the cause of poor shift quality.
• as demonstrated in class, perform a transmission fluid cooler flush to remove harmful debris after a rebuild.
• Disassemble the transmission valvebody

A. System Basics
   1. The Hydraulic Lever: Pascal’s Law
      a. “Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas.”
   2. Force and Pressure Relationships
      a. Force of Gravity
      b. Frictional Force
      c. Pressure
         1. Force (lbs.) divided by area (IN² or FT²)
   3. Pressure on a Confined Fluid
      a. Resistance to Flow
      b. Pressure in Fluid Same Everywhere
   4. Force Multiplication
      a. Difference of Area to Create Difference in Pressure to Move Object
   5. Piston Travel
      a. Mechanical Lever: Weight-to-Distance Output

B. Transmission Hydraulic System
   1. Components
      a. Fluid (ATF)
      b. Oil Pan or Sump
      c. Oil Pump
      d. Bands and Clutches
      e. Valve Body
   2. Fluid (ATF)
a. Performance Tasks
b. Properties
c. Operating Temperatures
d. Methods of Fluid Cooling
e. Contamination

3. Fluid Source: Oil Pan
   a. Filter Locations
   b. Fluid Level Over Full

4. Oil Pump Assembly
   a. Parts and Construction
   b. Failure Diagnosis

5. Hydraulic Operating Units
   a. Front Clutch Assembly
   b. Rear Clutch Assembly
   c. Low-Reverse Band/Servo
   d. Band/Servo
   e. Unit Components
   f. Lube Oil Loss

6. Clutch Pack Assembly
   a. Driving Discs/Driven Plates
   b. Steel Plates
   c. Clutch Frictional Material

7. Clutch Assembly Operation
   a. Compressing Clutch Pack
   b. Clutch Application
   c. Results of Slippage
   d. Vent and Ball Check Valve – Eliminates Possibility of Plate Drag

8. Rear Clutch Assembly
   a. Belleville Spring Washer – Multiplies Hydraulic Apply Force
   b. Fiber Thrust Washer

9. Low-Reverse Servo
   a. Piston/Piston Plug Movement
   b. Reduced Band Loading-Cushions Shift

C. Control System-Valve Body
1. Pressure Regulation and Flow Control Valves
   a. Ball Check Valves
   b. Circuits
   c. Orifices

2. Pressure Relief: Ball Check Valve
   a. Operation
   b. Adjustment

3. Transmission Ball Check Valves

4. The Spool Valve
   a. Operation
   b. Spring Forces
c. Compensating or Regulating Valve

5. Manual Valve
   a. Relay-Type Valve
   b. Directs Fluid to Different Circuits
   c. Differences Between Front and Rear-Wheel Drive

6. Pressure Regulator Valve Train
   a. Front-Wheel Drive
   b. Rear-Wheel Drive
      1. Line Pressure Plug

7. Pressure Regulation: Operation
   a. In Park Position
   b. In Drive Position
      1. Torque Converter and Switch Valve Circuit
         2. Range: 50-90 PSI
         3. Throttle Pressure-Line pressure
         4. Throttle Pressure Linkage Adjustment
   c. In Reverse Position
      1. Line Pressure
      2. Causes of High Pressure
      3. FWD: Metered Orifice – Throttle Valve
      4. RWD: Modulated Line Pressure

LAB L-3: FOUR SPEED TRANSMISSION (RWD) OVERHAUL
LAB L-4: FOUR SPEED TRANSAXLE (FWD) OVERHAUL

Unit IX: ELECTRICAL CONTROLS AND DIAGNOSIS

Learning Objectives:
The student will be able to...
- Given questions on a test, identify the different transmission controller types and their communication strategies.
- Given questions on a test, identify control system input signals, signal processing and output signals.

Use diagnostic scan tool equipment to diagnose control system input and output devices and their circuitry and determine the appropriate repair path.

01. Controller Overview
   a. Controller Types
      1. Integrated
      2. Internal
      3. Standalone
   b. Overview of Inputs and Outputs
   c. Controller Power and Ground Circuits
   d. Power Out Control

02. Transmission Control Inputs
   a. Transmission Range Sensor (TRS)
   b. Transmission Temperature Sensor (TTS)
   c. Pressure Switch Signals
   d. Line Pressure Sensor (LPS)
   e. Speed Sensors
   f. Electronic Range Select and Autostick
   g. Indirect Inputs
03. Transmission Control Outputs
   a. Overview
   b. Solenoid Types
   c. Torque Converter Clutch (TCC) Control
   d. Line Pressure Control
   e. Shift Solenoid Architecture and Control
   f. Solenoid Diagnosis
   g. Indirect Outputs

04. Transmission Control Strategies
   a. Clutch Volume Index (CVI)
   b. Quick Learn
   c. Drive Learn
      1. Examples
   d. Shutdown Routines Strategies
   e. Temperature-Based Shift Strategies
   f. Torque Reduction
   g. Economy Mode

LAB L-5: TCM AND ELECTRONIC CONTROL DIAGNOSIS

Unit X: COURSE REVIEW/ FINAL EXAM

Learning Objective:
The student will be able to...
- Given a final exam, achieve a passing grade of 60 percent or higher on a scale of 100%.

Evaluation of student learning: [Describe general guidelines for examinations, required work, course work, assignments, and tests. Explain how assignments evaluate student achievement of course competencies/goals (course-level SLOs). Multiple measures (quizzes, tests, essays, projects, portfolios, practicums, etc.) are recommended.]
- Quizzes/exams 50%
- Lab Work, class assignments 50%

Academic Integrity Statement: A student who knowingly represents the work of others as his/her own, uses or obtains unauthorized assistance in the execution of any academic work, or give fraudulent assistance to another student is guilty of cheating. (See Student Handbook). Any student who violates this policy is subject to receive a failing grade for the assignment and will be reported to the Office of Student Affairs for further disciplinary action. Possible dismissal from the course could result.

Reasonable Accommodations for Students with Documented Disabilities

Mercer County Community College is committed to supporting all students in their academic and co-curricular endeavors. Each semester, a significant number of students document disabilities, which may require learning, sight, hearing, manual, speech, or mobility accommodations to ensure access to academic and co-curricular activities. The college provides services and reasonable accommodations to all students who need and have a legal entitlement to such accommodations.

For more information regarding accommodations, you may visit the Office of Academic Support Services in FA129 or contact them at 609.570.3422 or urbanb@mccc.edu.