# COURSE OUTLINE

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<tr>
<th>Course Number</th>
<th>Course Title</th>
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<td>AUT 224</td>
<td>Manual Transmissions and Drivelines</td>
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- **Hours:**
  - 2 lecture/Lab
  - 3 Other

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

- **Implementation:** Spring 2019

**Catalog description (2018-2019 Catalog):** Study of automotive systems for torque multiplication and speed reduction includes the relationship of engine speed and vehicle speed and its effect on fuel economy. Other topics included clutch service, front and rear wheel drive applications, component replacement, differentials, diagnosis, removal and reinstallation procedures, and transmission overhaul. Involves extensive use of special tools and test equipment.

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


**Revision date:** January 2019

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

**Information resources:** DealerConnect Service web-site, Learning Center Training Reference Books, Service Manuals, Subaru of America resources, Web-based Self-study Courses and the AllData Online Service Information Database.

**Other learning resources:** (Describe any other student learning resources that are specific to this course, including any special tutoring or study group support, learning system software, etc.)
Course Competencies/Goals:

The student will be able to:
1. obtain service repair information and procedures from the shop’s available on-line web-site using the computers found in the automotive facility.
2. research service procedures to repair program vehicles using the vehicle service manuals found in the shop facility.
3. diagnose, remove and replace the clutch assembly found in a manual transmission vehicle as demonstrated in class.
4. completely disassemble and reassemble a RWD 5-speed manual transmission following the service information.
5. completely disassemble and reassemble a FWD 5-speed transaxle following the service information.
6. completely disassemble, inspect, set-up and reassemble a rear differential assembly following the service procedures.

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. History. Students will understand historical events and movements in World, Western, non-Western or American societies and assess their subsequent significance.
Goal 6. Diversity. Students will understand the importance of a global perspective and culturally diverse peoples.
Goal 7. Ethical Reasoning and Action. Students will understand ethical issues and situations.

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.

Units of study in detail.

Unit I: DRIVELINE COMPONENTS: INSPECTION AND SERVICE

Learning Objectives

The student will be able to...
1. given a lab activity, complete an inspection of the manual driveline components on a live
vehicle to determine their condition.

A. Clutch Assembly
   1. Types of Clutch Release Mechanisms
      a. Mechanical (linkage)
      b. Cable
      c. Hydraulic
   2. Inspection
      a. Linkage
      b. Fluid Leaks
   3. Pedal Adjustment
      a. Pedal Travel
      b. Methods of Adjustment

B. Manual Transmission/Transaxle
   1. Fluid Leaks

C. Rear Differential Assembly
   1. Rear Axle Bearings
   2. Gear Wear and Backlash
   3. Housing
   4. Bushing Condition
   5. Universal Joints

Homework: Read pages 51-71
Questions 1-4, 1-10 page 72

LAB ACTIVITY: L-1 DRIVELINE INSPECTION AND ADJUSTMENT

Unit II: CLUTCH ASSEMBLY THEORY

Learning Objectives
The student will be able to...
1. given questions on a test, describe the operation and components of the manual clutch assembly.
2. using a program vehicle, remove and install a manual transmission or transaxle assembly and return it to service.
3. given a quiz or test, answer questions about clutch system malfunctions and problem diagnosis, supporting their answers with service information.
4. using a manual transmission equipped program vehicle, remove, inspect and install the components of the clutch assembly.

A. Principles of Operation
   1. Function of the Clutch
   2. Basic Clutch Operation
      a. Friction Pressure
      b. Types of Clutches
      c. Engagement/ Disengagement
   3. Clutch Assembly Components
      a. Flywheel
      b. Friction Disc or Plate
      c. Pressure Plate
      d. Release Bearing
      e. Release Fork/ Ball Pivot
      f. Pilot Bushing/ Bearing
g. Bellhousing  
h. Dual-Mass Flywheel

**Homework:** Read pages 73-96  
Questions 1-4, 1-10 page 96

**B. Transmission Removal/ Installation Procedures**  
1. Rear Wheel Drive (RWD) Transmission  
   a. Component Removal  
   b. Support Equipment and Special Tools  
   c. Installation  
      1. Fastener Torque  
      2. Shifter Linkage and Adjustments  
2. Front wheel Drive (FWD) Transaxle  
   a. Removal  
   b. Installing the Engine Support Fixture  
   c. Installation

**C. Clutch Assembly Service**  
1. Troubleshooting and Diagnosis  
   a. Clutch Slips When Engaged  
   b. Clutch Chatters or Grabs When Engaged  
   c. Clutch Spins or Drags when Disengaged  
   d. Noises with Clutch Engaged  
   e. Noises with Clutch Disengaged  
   f. Clutch Pedal Pulsations  
   g. Rapid Friction Disc Wear  
   h. Hard Pedal Effort  
2. Clutch Service  
   a. Clutch Disassembly  
      1. Marking Flywheel/ Pressure Plate  
      2. Component Removal  
   b. Component Inspection and Service  
      1. Asbestos Caution  
      2. Pilot Bushing/ Bearing  
      3. Flywheel  
      4. Clutch Release Bearing  
      5. Release Fork/ Pivot Ball  
   c. Clutch Reassembly  
      1. Flywheel Torque  
      2. Disc and Pressure Plate Alignment

**Homework:** Read pages 98-130  
Questions 1-4, 1-10 page 131

**LAB ACTIVITY: L-2 CLUTCH ASSEMBLY SERVICE**

**Unit III: MANUAL TRANSMISSIONS/ TRANSAXLE THEORY**  
**Learning Objectives**  
The student will be able to .....  
1. given questions on a test, describe the principles of operation of a current manual transmission.  
2. following the procedures outlined in the service information, completely disassemble, inspect and reassemble a rear-wheel drive manual transmission.  
3. following the procedures outlined in the service information, completely disassemble,
inspect and reassemble a front-wheel drive manual transaxle.

A. Principles of Gearing
1. Need for Gearing
   a. Torque
   b. Leverage
   c. Speed
2. Gear Ratio
   a. Definition
   b. Results on Torque, Leverage and Speed
   c. Combination of Gears
3. Types of Gears in Automotive Use
   a. Spur, Helical, Bevel, Skew, Worm
   b. Planetary Combinations

B. Components of the Basic Transmission
1. Function
2. Principles of Operation
3. Components
   a. Input Shaft
   b. Output Shaft
   c. Countershaft W/Gears
   d. Synchronizer Assembly, Blocking Rings
   e. Bearings, Thrust Washers
   f. Gears
   g. Shift Forks, Linkage

C. Transmission Design: Operation and Power Flow
1. Types of Transmissions Currently Used
   a. Five-Speed Transmission (RWD)
   b. Five-Speed Transaxle (FWD)
2. Five-Speed Transmission (RWD)
   a. Components
   b. Overdrive Operation
   c. Power Flow
3. Transaxle (FWD)
   a. Components
   b. Power Flow
   c. Final Drive Mechanisms

Homework: Read pages 133-162
Questions 1-4, 1-10 pages 162-163
Read pages 164-179
Questions 1-4, 1-10 pages 179-180

D. Inspection, Teardown and Overhaul Procedures
1. Troubleshooting Procedures
   a. Complaints: Transmission
   b. Sticks in Gear
   c. Slips Out of Gear
   d. No Power Through Transmission
   e. Noisy in Neutral
   f. Noisy in Gear
   g. Gear Clash/ Hard Shifting
h. Oil Leaks

2. Teardown Procedures
   a. Use of Special Tools
   b. Component Cleaning

3. Parts Inspection
   a. Transmission Case
   b. Extension Housing
   c. Bearing Assemblies
   d. Input Shaft
   e. Countershaft Assembly
   f. Mainshaft
   g. Gears
   h. Synchronizer Assemblies
   i. Shift Forks/Linkage

4. Overhaul Procedures/ Reassembly
   a. Components Replaced
   b. Pre-lubrication
   c. Special Tool Usage
   d. Checking Shaft Endplay

Homework: Read pages 181-238
Questions 1-4, 1-10 page 239
LAB ACTIVITY: L-3 MANUAL TRANSMISSION/ L-4 TRANSAXLE OVERHAUL

Unit IV: FOUR-WHEEL DRIVE THEORY AND SERVICE

Learning Objectives:
The student will be able to:
1. following the procedures outlined in the service information, completely disassemble, inspect and reassemble a 4WD transfer case.

A. Introduction
   1. Part-time
   2. Full-time
   3. On-demand

B. Power Transfer Units and Transfer Cases
   1. 4WD
   2. AWD
   3. Gear Drive
   4. Chain Drive

C. Couplers
   1. Electromagnetic Clutch Coupler
   2. Electro-hydraulic Coupler

D. Front Drive Axles

Homework: Read pages 390-407
Questions 1-4, 1-10 pages 407-408

E. Problem Diagnosis
F. In-Vehicle Service
   1. Shift Linkage Adjustment
   2. Locking Hub Service
   3. Axle Removal/Replacement
G. Transfer Case/Unit Overhaul
   1. Removal/Replacement
   2. Overhaul Procedures

**Homework**: Read pages 409-427
   Questions 1-4, 1-10 page 4298

LAB ACTIVITY: L-5 TRANSFER CASE OVERHAUL

Unit V: DIFFERENTIAL ASSEMBLY OPERATION AND SERVICE

**Learning Objectives:**
The student will be able to….
1. following the procedures outlined in the service information, completely disassemble,
   inspect, reassemble and adjust a differential axle assembly.

A. Components of the Standard Differential
   1. Purpose of the Differential
      a. Compensation of Wheel Travel on Turns
      b. Increased Axle Speed
      c. Increased Drive Wheel Torque
   2. Types of Differential Assemblies
      a. Open
      b. Limited Slip
   3. Components
      a. Axles
      b. Bearings
      c. Differential Side Gears/ Pinion (spider) Gears
      d. Housing and Carrier
      e. Ring and Pinion Gear Set
      f. Thrust Washers

B. Principles of Operation
   1. Power Flow: Straight Line
      a. Equal Friction to Each Wheel
      b. Equal Applied Torque
   2. Power Flow: Unequal Friction
      a. Spinning Wheel
         1. Side Gear Rotation
         b. Rounding a Curve
         1. Pinion Gear Rotation Ratio
   3. Types of Ring and Pinion Gears
      a. Hunting
      b. Non-hunting
      c. Determining Gear Ratio
   4. Limited Slip
      a. Types
         1. Clutch
         2. Cone
         3. Detroit Locker
         4. Electronic
      b. Clutch Pack
      c. Power Flow
C. Service Diagnosis: Condition/ Correction
   1. Trouble Condition
      a. Rear Wheel/ Axle Noise
      b. Driveshaft/ Universal Joint Noise
      c. Differential Case Breakage
      d. Scoring of Differential Gears
      e. Ring and Pinion Gear Tooth Breakage
      f. Loss of Lubricant
      g. Overheating
   2. Possible Causes/ Corrections for Above Conditions
      a. Use of Service Information

D. Differential Assembly Reconditioning Procedures
   1. Axle Shaft and Bearings
      b. Removal and Disassembly
         1. Installing Bearing
         2. Special Tools
         3. Seal Installation
         4. Axle Installation
   2. Differential Reconditioning
      a. Checking Differential Side Play
      b. Measuring Drive Gear Runout
      c. Checking Ring Gear Flange Runout
      d. Disassembly
      e. Cleaning and Inspection
   3. Differential Assembly
      a. Measuring Pinion Shim Thickness
      b. Installation of the Drive Pinion
         1. Bearing Pre-load
      c. Differential Carrier Installation
         1. Bearing Pre-load Adjustment
         2. Drive Gear Backlash Adjustment
         3. Side Gear Clearance Checks
   4. Types of Lubricants/ Fluid
      a. 75W90 Hypoid
      b. Manual Transmission Fluid
      c. Automatic transmission Fluid

Unit V: COURSE REVIEW/ FINAL EXAM
A. Driveline Components: Inspection and Service
   1. Clutch Assembly
   3. Driveshaft
   4. Differential Assembly

B. Clutch Assembly Theory
   1. Principles of Operation
   2. Transmission Removal and Installation Procedures
   3. Clutch Assembly Service

C. Manual Transmission/ Transaxle Theory
   1. Principles of Gearing
   2. Components
3. Designs, Operation and Power Flow
4. Inspection, Teardown and Overhaul Procedures

D. Four-Wheel Drive Theory and Service
   1. Introduction
   2. Transfer Cases
   3. Problem Diagnosis
   4. In-Vehicle Service
   5. Overhaul Procedures

E. Differential Assembly Operation
   1. Components
   2. Principles of Operation
   3. Service Diagnosis
   4. Differential Assembly Reconditioning

F. Final Examination

**Evaluation of student learning:**
A. Lab Work/class assignments 50%
B. Quizzes/exams 50%

**Policy Statement for Missed Lab and Equipment Demonstrations:**
Due to the technical nature of the Automotive Program and hazards involved with the use of specialty tools and equipment, a student that is absent from lab instruction, where demonstrations are performed by the course instructor, will not be permitted to complete the related lab work upon their return. This includes full-day absences and partial-day absences that result in missing the lab demonstration(s). Enforcement of these policies will be at the discretion of the course instructor.

**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

Mercer County Community College is in compliance with both the ADA and section 504 of the Rehabilitation Act. If you have, or believe you have, a differing ability that is protected under the law, please see Arlene Stinson in LB 216, at 570-3525 or at stinsona@mccc.edu for information regarding support services.