# COURSE OUTLINE

| Course Number | Course Title | Credits |
|---|---|---|
| **AUT 224** | **Manual Transmissions and Drivelines** | **3** |

| Hours: Lecture/Lab/Other | Co- or Pre-requisite | Implementation Semester & Year |
|---|---|---|
| **2/3** | **AUT 110 and AUT 111** | **Spring 2022** |

**Catalog description:**
A study of torque multiplication and speed reduction driveline systems. Examines the relationship between engine and vehicle speed, and effect on performance and economy. Includes diagnosis and overhaul of clutches, transmissions/transaxles, differentials, transfer cases/PTUs. Includes lessons in noise, vibration, and harshness diagnosis and repair. Use of special tools emphasized.

**General Education Category:**
**Not GenEd**

**Course coordinator:**
Jason Evans, 609-570-3776, evansj@mccc.edu

**Required texts & Other materials:** Halderman, James D., Manual Drivetrains and Axles, Edition 8. Pearson Education Publishing, 2018
ISBN-13: 9780134628363

Access to a personal laptop computer, tablet, or Chromebook is strongly recommended during class and lab.

Students must purchase safety glasses, work boots, and appropriate clothing to work in the automotive lab. This requirement is reviewed with the students on the first day of class. These items are not needed for the first class meeting of the term.

The following is provided at no charge to the students:
Vehicle service information provided though Stellantis, Subaru of America, Audi of America, or ALLDATA.

**Accreditation Statement:**
The Automotive Technology, Mopar CAP, Program is Master Automotive Service Technology (MAST) accredited by Automotive Service Excellence Education Foundation.
https://www.aseeducationfoundation.org/

## Course Student Learning Outcomes (SLO):

***Upon successful completion of this course the student will be able to:***

1. Explain the differences in design and application between front-wheel drive (FWD), rear-wheel drive (RWD), all-wheel drive (AWD), and four-wheel drive (4x4) systems. [Supports ILG # 1, 10; PLO # 3]
2. Demonstrate diagnosis, disassembly, and assembly procedures of components and systems studied in the course, using published service procedures. [Supports ILG # 4, 10 ; PLO # 2, 3]
3. Demonstrate the removal and installation process of a manual transmission, clutch disc, pressure plate, release bearing, and pilot bearing in a vehicle equipped with a manual transmission or transaxle. [Supports ILG # 4, 10, 11; PLO # 1, 2, 4]
4. Demonstrate the disassembly and assembly process of a manual transmission, by following the proper procedures outlined in the manufacturer's published service information. [Supports ILG # 4, 10, 11; PLO # 1, 2, 4]
5. Demonstrate the disassembly and assembly process of a manual transaxle, by following the proper procedures outlined in the manufacturer's published service information. [Supports ILG # 4, 10, 11; PLO # 1, 2, 4]
6. Demonstrate the disassembly and assembly process of a transfer case or power transfer unit, following the proper procedures outlined in the manufacturer's published service information. [Supports ILG # 4, 10, 11; PLO # 1, 2, 4]
7. Analyze critical measurements of a differential assembly (live axle) to identify its condition [Supports ILG # 4, 10, 11; PLO # 1, 2, 3, 4]
8. Demonstrate the disassembly and assembly process of a differential, by following the proper procedures outlined in the manufacturer's published service information. [Supports ILG # 2, 4, 10, 11; PLO # 1, 2, 3]
9. Recognize when specialty service tools and equipment are necessary for proper diagnosis and repair of driveline systems and components. [Supports ILG # 4, 10; PLO # 3]
10. Demonstrate industry acceptable diagnostic techniques to find the cause of noise, vibration, and harshness (NVH) concerns. [Supports ILG # 1, 2, 3, 4, 10, 11 ; PLO # 1, 2, 3 ]

## Course-specific Institutional Learning Goals (ILG):

**Institutional Learning Goal 1. Written and Oral Communication in English.** Students will communicate effectively in both speech and writing.
**Institutional Learning Goal 2. Mathematics.** Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
**Institutional Learning Goal 3. Science.** Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
**Institutional Learning Goal 4. Technology.** Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
**Institutional Learning Goal 10. 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.
**Institutional Learning Goal 11. Critical Thinking:** Students will use critical thinking skills understand, analyze, or apply information or solve problems.

## Program Learning Outcomes for Automotive Technology (PLO)

1. Diagnose, service, and repair current automotive technologies.
2. Demonstrate desirable attitudes and work habits while working individually or with others.
3. Obtain service repair information and procedures from online websites and electronic databases.
4. Communicate effectively and professionally with customers and fellow technicians.

**Units of study in detail – Unit Student Learning Outcomes:**

**Unit I** **Introduction to Driveline Components: Inspection and Maintenance [Supports Course SLO # 1]**

***Learning Objectives***

***The student will be able to:***

- Identify the type and model number of the components found in the driveline of a given vehicle by researching a vehicle's build information on the manufacturer's service information database.
- Use a visual inspection of a vehicle's driveline components to check for fluid leaks and other operational problems that can be checked without the use of special tools and equipment.
- Analyze rubber driveline mounts, brackets, and fasteners for wear and broken or missing parts.
- Choose service information to locate proper fluid fill type and quantity for a given driveline component.
- Analyze fluid level in a manual transmission/transaxle, differential, and transfer case/PTU.
- Describe corrective action necessary to repair any concerns found during a visual inspection and fluid level check of driveline components.
- Explain routine services required for manual transmission/transaxles, transfer cases/power transfer units, differentials, driveshafts, and half-shafts.

**Unit II** **Theory, Operation, and Service of Clutch Systems [Supports Course SLO # 2, 3, 7]**

***Learning Objectives***

***The student will be able to:***

- Explain the operation of and components found in a manual transmission clutch assembly.
- Demonstrate the removal and install procedures for a clutch assembly in a vehicle equipped with a manual transmission or transaxle by following procedures outlined in the manufacturer's published service information.
- Explain different failures common with clutch assemblies.
- Demonstrate how to diagnose clutch performance concerns.
- Explain how to diagnose bearing noises caused by a transmission input shaft bearing, clutch release bearing, or clutch pilot bearing.

**Unit III** **Theory, Operation, and Service of Manual Transmissions and Transaxles [Supports Course SLO # 1, 2, 4, 5, 7, 8]**

***Learning Objectives***

***The student will be able to:***

- Describe the principles of operation of a manual transmission and transaxle.
- Use published procedures to inspect, disassemble, and assemble a rear-wheel drive (RWD) transmission.
- Use published procedure to inspect, disassemble, and assemble a front-wheel drive (FWD) transaxle.
- Identify specialty tools and equipment necessary to properly disassemble and assemble a transmission or transaxle.
- Explain diagnostic strategies used to pinpoint the cause of four-wheel drive and all-wheel drive system faults.
- Explain the importance of installing the correct fluid type and quantity in a transmission or transaxle.

**Unit IV** **Theory, Operation, and Service of Four-Wheel Drive (FWD)/All-Wheel Drive (AWD) Systems [Supports Course SLO # 1, 2, 6, 8]**

***Learning Objectives***

***The student will be able to:***

- Explain the purpose of four-wheel drive and all-wheel drive systems.
- Explain the different control strategies and configurations for four-wheel drive and all-wheel drive systems.
- Use published procedures to inspect, disassemble, and assemble a four-wheel drive transfer case by following the outlined procedures in the manufacturer's published service information.
- Use published procedures to inspect, disassemble, and assemble an all-wheel drive (AWD) power transfer unit (PTU) by following the outlined procedures in the manufacturer's published service information.
- Explain diagnostic strategies used to pinpoint the cause of four-wheel drive and all-wheel drive system faults.
- Explain the importance of installing the correct fluid type and quantity in a transfer case or power transfer unit.

**Unit V** **Theory, Operation, and Service of Differential Assemblies [Supports Course SLO # 1, 2, 7, 8]**

***Learning Objectives***

***The student will be able to:***

- Describe the principles of operation of a differential assembly.
- Use published procedures to inspect, disassemble, and assemble a front or rear differential by following the procedures outlined in the manufacturer's published service information.
- Demonstrate the procedures for measuring ring gear backlash, pinion torque to turn, total torque to turn, carrier bearing preload, ring gear runout, and pinion gear to ring gear contact pattern.
- Describe the methods used to adjust ring gear backlash, pinion torque to turn, total torque to turn, carrier bearing preload, ring gear runout, and pinion gear to ring gear contact pattern.
- Explain the difference between full-floating and semi-floating differential assemblies.
- Explain the difference between an open differential and a locking differential.
- Describe the different locking control mechanisms that may be found in various locking differentials.
- Explain diagnostic strategies used to pinpoint the cause of front and rear differential system faults.
- Explain the importance of installing the correct fluid type and quantity in an open differential and locking differential.

**Unit VI** **Noise, Vibration, and Harshness (NVH) [Supports Course SLO # 2, 8, 9, 10]**

***Learning Objectives***

***The student will be able to:***

- Use industry acceptable tools and methods to pinpoint the cause of an NVH concern.
- Construct a plan of action to correct NVH concerns.
- Use special tools to measure and calculate the frequency of rotating vehicle components.
- Compare measured vibration frequency with calculate frequency of rotating vehicle components.
- Explain the difference between 1$^{st}$ order, 2$^{nd}$ order, 3$^{rd}$ order, etc. vibrations.
- Describe how normal component wear or road damage can cause an NVH concern.
- Describe how improper service and repair procedures can induce an NVH concern.

**Evaluation of student learning:**

Students are evaluated using weekly quizzes, a mid-term exam, a final exam, graded homework assignments, and hands-on work assignments in the automotive laboratory. Students are expected to read the assigned textbook chapters, handouts, and complete vehicle manufacturers' training material (if applicable) outside of class and at appropriate times throughout the course.

Please note that:

- Any student who scores below a 60% (D) on the final exam must repeat the course
- AUT 224 is a prerequisite course to AUT 225. Therefore, a minimum course grade of 70% (C) is needed to pass AUT 224.
- Students enrolled in the any automotive program option sponsored by a vehicle manufacturer (Mopar CAP, Subaru University, or Audi AEP) must complete all vehicle manufacturer web courses, post-tests, and proctored assessments assigned at the start of the semester. The assigned web courses, post-test, and proctored assessments are in addition to the standard course assignments shown below. Due dates for each assigned web course, post-test, and proctored assessment is discussed in class, but all of them must be finished and passed before the beginning of the last week of the term.

Below is a list of the tools used for assessing student learning outcomes in this course. The percentages shown after each assessment tool refers to the weight each assessment has on a student's final course grade. Percentages shown are approximate.

Exams 40%
Quizzes 15%
Hands-On Lab Assignments 40%
Homework 5%

**Policy Statement for Missed Lab Demonstrations:**

Due to the concerns for student and staff safety, a student who does not attend tool, equipment, and procedure demonstrations performed by the course instructor, prior to a hands-on learning activity, may be excluded from participating in the hands-on activity. This occurs because the tools, equipment, and chemicals necessary to complete automotive diagnosis and service often present safety hazards for users and observers if the correct handling procedures are not followed.

Reasons for not attending demonstrations may include full or partial absence during the demonstration, or if a student does not give his or her full attention during the demonstration. Enforcement of this classroom policy is at the discretion of the course instructor, and is based largely on the dangers involved with the use of the necessary tools, equipment, and chemicals required to complete the hands-on activity, and the time necessary to complete a make-up demonstration.