## Course Outline

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AUT 114</td>
<td>Automotive Electricity and Electronics</td>
<td>3</td>
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### Hours:

<table>
<thead>
<tr>
<th>lecture/Lab/Other</th>
<th>Co- or Pre-requisite</th>
<th>Implementation</th>
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<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>Spring 2019</td>
</tr>
<tr>
<td>AUT 110 and AUT 111</td>
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### Catalog Description (2018-2019 Catalog):

How electrical/electronic principles are used in current automotive systems. Subjects include on-board computers, starting and charging systems, wiring diagrams and manuals, chassis wiring service, vehicle communication networks, passive restraint systems and other electrical accessory systems. Major emphasis is on diagnostic skills, testing procedures, and proper service and repair of components.

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

Revised

### Required Texts/Other Materials:


### Revision Date:

January 2019

### Course Coordinator:

Jason Evans, ext. 3776, evansj@mcccedu

### Information Resources:

Fiat/Chrysler DealerConnect web-site, Fiat/Chrysler Academy Training Reference Books, Subaru of America resources, Service Manuals, On-line 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: [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:

- apply his/her diagnostic skills to problems relating to the electrical and electronic systems currently in use on today’s automobiles.
- given questions on a test, explain the theories of operation and service procedures used on the electrical accessories found on the automobile.
- successfully diagnose and service the starting and charging systems used on today’s engines.
  - using the computer scan tool, access the individual control modules on the BUS communication network and determine state of operation.
  - given a vehicle with a passive restraint system malfunction, diagnose and repair the problem and return it to proper operation.
  - given a question on a test, explain the operation of each of the individual vehicle communication networks.

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.
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. [Each unit should center around a topic, theme or skill that supports the Course Competencies/Goals (the course-level student learning outcomes [SLOs]) and general education student learning outcomes. For each unit, identify specific student learning outcomes that focus on content knowledge or process skills. Units of study are not simply the chapters of the textbook; they are independent of the selected textbook. Unit-level student learning outcomes should state (in terms that can serve as the frame of reference for ongoing assessment of both student achievement and of the course’s effectiveness) what successful students will be able to demonstrate, perform or exhibit at the end of the unit. Connect the unit-level SLOs back to the course-level SLOs and the General Education and Core Skills SLOs either by cross-referencing them by number or by explaining the connections in a brief narrative. It is not expected that every unit-level SLO will connect to the General Education and Core Skills SLOs; each unit-level SLO, however, must connect to at least one course-level SLO. See the attached examples.]

Unit I: REVIEW OF BASIC ELECTRONIC FUNDAMENTALS

Learning Objectives
The student will be able to...
• given questions on a test, successfully describe the relationship of voltage, current and resistance.
• given an example of a wiring diagram currently found on today’s vehicles, explain the operation of the circuit and each of the individual components.

A. VOLTAGE/CURRENT/RESISTANCE
  1. Definition
  2. Relationship
  3. Applying Ohm’s Law

B. DIGITAL VOLT/OHM METERS
  1. Reading Display
  2. Decimal Conversions

C. REVIEW: THE SIX-STEP ELECTRICAL DIAGNOSIS
  1. Procedure:
     a. Verify the Complaint
     b. Determine Related Symptoms
     c. Analyze the Symptoms
     d. Isolate the Trouble
     e. Correct the Trouble
     f. Check for Proper Operation
  2. Applying to Solve Electrical Problems

D. REVIEW: ELECTRICAL CIRCUITS AND WIRING DIAGRAMS
  1. Wiring Code Identification
  2. Component Symbols
  3. Locating Components in Diagrams
  4. Understanding Electrical Circuits

Unit II: CHARGING SYSTEM PRINCIPLES

Learning Objectives
The student will be able to...
• using the Amps/Volt/Resistance (AVR) Tester, test and diagnose the vehicle charging system.
• disassemble, test and assemble an alternator found on the modern automobile.
A. ALTERNATOR CONSTRUCTION AND COMPONENTS
1. Types of Systems, Design and Identification
   a. Chrysler Alternator
   b. Bosch Alternator
   c. Denso Alternator

2. Alternator Construction
   a. Housing
   b. Rotor
   c. Stator
      1. Delta and Wye Winding
   d. Brushes
   e. Diodes and Rectifier Assemblies

3. Principles of Operation
   a. Magnetic Fields
   b. Output Factors
   c. Energizing the Rotor
   d. Stator Windings
   e. Rectification
   f. Reverse Polarity

4. Principles of Voltage Regulation
   a. Types of Voltage Regulators
   b. Temperature and Voltage Factors
   c. Powertrain Control Module (PCM) Control

HOMEWORK ASSIGNMENT: Read Chapter 21
   Pages 290-302
   Answer Review and Chapter Quiz Questions

B. DIAGNOSIS AND OVERHAUL
1. Visual Inspection
   a. Inspection
   b. Belts
   c. Cables and Wiring
   d. Checking for DTCs with the Scan Tool

2. Circuit Testing
   a. Circuit Resistance Test
   b. Current Output Test
      1. Amps/Volts/Resistance Tester (AVR)
   c. Output Test with the Scan Tool

3. Alternator Component Testing
   a. Disassembly
   b. Component Testing: Rotor Field Coil, Stator, Rectifier Assembly, Brushes
   c. Bearing Service

4. Overhaul Procedures
   a. Component Replacement
   b. Assembly Procedures
UNIT III: STARTING SYSTEM FUNDAMENTALS

Learning Objectives
The student will be able to:

- Remove and replace a starter motor on a modern engine.
- Disassemble, test and reassemble a starter motor.

A. REVIEW ELECTRIC MOTOR PRINCIPLES
1. Motor Principles
   a. Magnetic Field Coils
   b. Armature Assembly
   c. Drive Pinion
   d. Overrunning Clutch

2. Starter Motor Types and Construction
   a. Construction
   b. Types and Applications
      1. Gear Reduction
      2. Permanent Magnet

B. Components- Starter Circuit
1. Battery
2. Ignition Switch
3. Neutral Start Switch
4. Starter Relay
   a. Connects Battery to Starter Solenoid
   b. Current Flow
   c. Neutral Start Switch
   d. PCM Starter Override
5. Starter Solenoid
   a. Solenoid Windings
      1. Pull-in Torque
      2. Hold-in Windings
6. Starter Assembly
7. Wiring
8. PCM
4. Starter Ground Test  
5. Control Circuit Tests  
6. Starter Armature Testing  
7. Starter Component Testing  

D. Overhaul procedures  
1. Disassembly Procedures  
2. Armature Service  
3. Brush Replacement  
4. Clutch Drive Replacement  
5. Reassembly  

HOMEWORK ASSIGNMENT: Read Chapter 20  
Pages 274-288  
Answer Review and Chapter Quiz Questions  

LAB ACTIVITY L-4: STARTER COMPONENT TESTING AND OVERHAUL  

UNIT IV: BODY ELECTRICAL PART I- VEHICLE COMMUNICATIONS  

Learning Objectives  
The student will be able to….  
• Given a vehicle equipped with a J1850/PCI bus network, describe the characteristics of the network with 100% accuracy.  
• Given a vehicle equipped with a J1850/PCI bus network, diagnose a bus failure with 100% accuracy.  
• Given a vehicle equipped with a CAN bus, describe the characteristics of CAN B and CAN C systems with 100% accuracy.  
• Given a vehicle equipped with a CAN bus, diagnose a bus failure with 100% accuracy.  
• Given a vehicle equipped with a Chrysler PowerNet communication bus, describe the operating characteristics of the network with 100% accuracy.  

A. THIS IS A FIAT/CHRYSLER ACADEMY TRAINING COURSE  

UNIT V: ELECTRICAL POWER MANAGEMENT/ ACCESSORY SYSTEMS  

Learning Objectives  
The student will be able to….  
• Using a vehicle with an electronic instrument cluster, diagnose and test the assembly using the proper computer scan tool.  
• Given a vehicle with a malfunction in the electronic speed control, repair the system using the proper diagnostic procedures as outlined in the service information.  
• Given a question on a test, successfully describe the operation of today’s sound systems including the radio, amplifier and speakers.  
• Using a scan tool or DVOM, determine when a module has “gone to sleep” and is no longer drawing power or communicating on the network.  

A. Instrument Clusters  
1. Mechanical  
   a. Bi-Metallic/ Thermal Type Gauges  
   b. Magnetic Gauges  
2. Electronic/ Mechanical Instrument Cluster (MIC)  
   a. Bus Communication  
   b. Diagnosis and Testing
LAB ACTIVITY L-5 INSTRUMENT CLUSTER DIAGNOSIS

B. ELECTRONIC SPEED CONTROL
   1. System Components and Operation
      a. Interactive Speed Control
      b. Components and Operation
         1. PCM
         2. Control Switches
         3. Speed Control Assembly
         4. Solenoid Valve Body
         5. Vacuum Servo/ Reservoir
         6. Throttle Cable
         7. Electronic Throttle Control

   2. Diagnosis
      a. Road Test
      b. Component Tests
         1. Speed Control Switch Test
         2. Stop Lamp Switch Test
         3. Speed Sensor Test (manual Transmission)
         4. Vacuum Servo and Reservoir

LAB ACTIVITY L-7: ELECTRONIC SPEED CONTROL COMPONENT TESTS

C. ELECTRONIC RADIO AND ACCESSORIES
   1. Operation and Identification
      a. AM/FM Stereo
      b. AM/FM Stereo with CD
      c. Amplifiers
      d. Frequency and Reception
   2. Sound System Diagnosis
      a. Diagnosis Questionnaire
      b. Radio Noise
         1. Radiated Noise
         2. Conducted Noise
      c. System Checks
         1. Sound System
         2. Speaker System
         3. Interference/ Noisy Reception
         4. Weak Radio Signal/ Intermittent Reception
         5. Radio Inoperative
         6. Memory Loss
   3. Noise Suppression
      a. Ground Strap Locations
      b. Accessory Motor Capacitors
      c. Alternator Capacitor
LAB ACTIVITY L-8: ELECTRONIC RADIO SERVICE

D. POWER DOOR LOCKS
   1. Operation and Components
      a. Components
         1. Lock Motor
         2. Switches
         3. Circuit Breaker
         4. Rear Deck Solenoid
      b. Operation
         1. Voltage Requirements
         2. Ground Connections
         3. Switch Operation
         4. Deck Lid Operation
         5. Door Lock Motor R & R
      c. Diagnosis
         1. Circuit Breaker Test
         2. Switch Voltage Test
         3. Electric Motor Test

E. POWER WINDOW ASSEMBLY
   1. Components
      a. Lift Motor
      b. Gear and Pinion
      c. Regulator Assembly
   2. Operation
   3. Problem Diagnosis and Service
      a. Lift Motor Test
      b. Switch Voltage Test

F. WINDSHIELD WIPER/ WASHER ASSEMBLY
   1. Components
      a. Motor Designs
      b. Circuit Protection
      c. Noise Suppressor
      d. Body Control Module (BCM)
      e. Washer Assembly
   2. Diagnosis
      a. Wiring Schematics
      b. Electrical Troubleshooting

G. Heated Rear Window (Electric Backlight)
   1. Components and Operation
      a. Electric Window Grid
      b. Control Switch/Timer Relay Assembly
      c. Relay Circuit
   2. Diagnosis and Service
      a. System Tests
      b. Grid Repair
UNIT VI: OCCUPANT RERAINTS AND SAFETY SYSTEMS

Learning Objectives:
The student will be able to:

- Given a classroom vehicle, locate and identify all restraint system components.
- List all components requiring replacement or inspection after deployment on a classroom vehicle.
- Identify the symptoms relating to a passive restraint system malfunction.
- Identify the cause of an illuminated Airbag Warning Lamp.
- Identify DTCs stored on the subject vehicle and list the possible causes.
- Given questions on a test, describe the safety precautions that must be followed when servicing a passive restraint system component.

A. SAFETY, STORAGE AND HANDLING
   1. Warning Labels
   2. Airbag Module Assembly
   3. Service Information

B. SYSTEMS OVERVIEW
   1. Distributed System
   2. Single-Point System
   3. Mechanical System
   4. Multi-Stage Airbags
   5. Occupant Classification System
   6. Electronic Airbag Deactivation (On/Off Switch)

C. COMPONENTS AND OPERATION
   1. Control Modules (ORC)
   2. Impact Sensors
   3. Airbag Modules
      a. Conventional
      b. Hybrid
      c. Multi-stage
      d. Side Curtain
      e. Seat Mounted
      f. Propellants
   4. Knee Blocker
   5. Clockspring
   6. On/Off Switch
   7. Airbag Warning Lamp
   8. Seatbelt Warning Lamp

D. DIAGNOSIS, TESTING AND COMPONENT REPLACEMENT
   1. Diagnosing Airbag/Restraint System Problems
      a. Scan Tool Usage
      b. Diagnostic Trouble Codes
   2. ORC Circuit Diagnosis
   3. Isolating the Cause of Airbag Circuit Problems
   4. Component Replacement After Deployment
a. Airbag Module Assembly
b. Clockspring
c. Impact Sensor(s)
d. Occupant Restraint Control Module

E. ACTIVE RESTRAINTS- SEATBELTS
1. Inertia-Locking
2. Retractors
3. Pretensioners

HOMEWORK ASSIGNMENT: Read Chapter 27
Pages 434-447
Answer Review and Chapter Quiz Questions

UNIT VII: COURSE REVIEW/FINAL EXAM

A. REVIEW OF BASIC ELECTRONIC FUNDAMENTALS
B. CHARGING SYSTEM PRINCIPLES
C. STARTING SYSTEM FUNDAMENTALS
D. BODY ELECTRICAL I: VEHICLE COMMUNICATIONS
E. ELECTRICAL POWER MANAGEMENT SYSTEMS
   1. Instrument Clusters
   2. Electronic Speed Control
   3. Electronic Radio and Accessories
   4. Power Door Locks
   5. Power Window Assemblies
   6. Windshield Wiper/Washer Assembly
   7. Heated Rear Window
F. OCCUPANT RERAINTS AND SAFETY SYSTEMS
G. FINAL EXAM

Evaluation of student learning:

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<th>Component</th>
<th>Percentage</th>
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<tr>
<td>A. Lab Work</td>
<td>40%</td>
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<tr>
<td>B. Quizzes/Exams</td>
<td>50%</td>
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<td>C. Homework</td>
<td>10%</td>
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<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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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 ensuring the full participation of all students in all activities, programs and services. If you have a documented differing ability or think that you may have a differing ability that is protected under the ADA and Section 504 of the Rehabilitation Act, please contact Arlene Stinson in LB 216 stinsona@mccc.edu for information regarding support services.

If you do not have a documented differing ability, remember that other resources are available to all students on campus including academic support through our Academic Learning Center located in LB 214.