SYLLABUS

Code: AUTO 244  
Title: Automotive Electricity/Electronics II and Air Conditioning

Institute: STEM  
Department: Automotive

Course Description: This course is for General Motors ASEP students only. It reviews the fundamentals of electricity, and then proceeds into capacitance, magnetism, semi-conductors, amplifiers, integrated circuits and microprocessors and how they relate to the power accessories commonly found on modern automobiles. It also covers the heating, cooling and refrigeration systems, and how these systems are electronically integrated. Service and diagnosis, as well as diagnosis and repair of the HVAC system will be emphasized.

Prerequisites: AUTO123 AND AUTO141 with a grade of “C” or higher.

Prerequisites or Corequisites: --

Credits: 4  
Lecture Hours: 3  
Lab/Studio Hours: 3

Required Textbook/Materials: 
GM Electronics Training I, II, and III, available in bookstore and

AUTOMOTIVE TECHNOLOGY
AUTHOR: HALDERMAN
EDITION: 4TH
COPYRIGHT YEAR: 2012
PUBLISHER: PEARSON EDUCATION
ISBN: 9780132542616

Additional Time Requirements: 
Lab hours as assigned.

Course Learning Outcomes: 
Upon completion of this course, students will be able to:

- Describe both in verbal and written form, the operational characteristics of capacitors, magnetically operated devices, semi-conductors, amplifiers, integrated circuits and microprocessors.
- Perform standard industry tests on the above components as they apply to automotive circuits.
- Diagnose advanced automotive electrical problems using appropriate test equipment and available service information.

Grading Standard: 

I. Grading 
The final grade for the course you are taking will be determined by several factors. It will combine performance in both classroom and laboratory activities as stated below:

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CLASSROOM GRADING
For all grades, attendance and tardiness will be monitored and will be a determining factor in your final grade. After 3 unexcused class sessions, students will be advised to drop the class.

All classroom assignments must be completed satisfactorily.

The final grade will be determined by classroom testing, homework, completion of online training as applicable, and the successful completion of ALL lab assignments.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>95 -100</td>
</tr>
<tr>
<td>A-</td>
<td>92 - 94</td>
</tr>
<tr>
<td>B+</td>
<td>88 - 91</td>
</tr>
<tr>
<td>B</td>
<td>84 - 87</td>
</tr>
<tr>
<td>B-</td>
<td>80 - 83</td>
</tr>
<tr>
<td>C+</td>
<td>75 - 79</td>
</tr>
<tr>
<td>C</td>
<td>70 - 74</td>
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<tr>
<td>D</td>
<td>60 - 69</td>
</tr>
<tr>
<td>F</td>
<td>Below 60</td>
</tr>
<tr>
<td>INC</td>
<td>This grade is given at the discretion of the instructor. Minimally, the student must have completed 70% of both the classroom and laboratory assignments at a satisfactory level.</td>
</tr>
</tbody>
</table>

It is the student's responsibility to approach the instructor to request an INC grade prior to the end of the term. Incomplete assignments must be completed within 21 working days after the end of the term in which they received INC grade.

LABORATORY GRADING

ALL LAB ASSIGNMENTS MUST BE COMPLETED. A GRADE OF "C" OR BETTER IS REQUIRED ON ALL LAB ASSIGNMENTS TO PASS THIS COURSE.

The following describes the basic levels of performance a student must demonstrate to receive one of the grades listed below on LABS ONLY.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Students need to meet the requirements listed below for “C” and “B” level work, and in addition, the student must demonstrate superior skill level and professional work habits, while working on a “live” vehicle (where appropriate).</td>
</tr>
<tr>
<td>B</td>
<td>Students must meet the requirements for “C” level work as listed below, and in addition, the student must be able to demonstrate an in depth understanding of the system being serviced.</td>
</tr>
<tr>
<td>C</td>
<td>The student must complete all tasks at a mastery level. Mastery is defined as: the ability to perform a task at a level that restores, services, or repairs components or systems to an adequate and safe level of performance in accordance with standard industry practice.</td>
</tr>
</tbody>
</table>
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D Inability to complete Lab assignments to acceptable industry standards as described in C grade above. **Students will need to perform lab again.**
F Unsatisfactory preparation and performance of Lab assignment. **Students will be referred to instructor.**

II. STUDENT RESPONSIBILITIES

1. Students must be prepared to perform each lab correctly and **safely**. Research your assignment in the appropriate service information resource prior to beginning lab work. (electronic service information, service manual, technical service bulletins, text book, etc.).
2. Familiarize yourself with the tools, equipment and procedures that will be required to complete your assignment.
3. Schedule adequate time to complete your lab work. Be prompt -- bays will be held for only 15 minutes.
4. Students are required to provide the basic hand tools that are needed to complete each lab assignment.
5. Students must report to tool room and fill out a grade sheet before beginning lab assignment.
6. Have your work checked and lab sheet initialed by a learning assistant at each designated point in the lab.
7. Upon completion of your lab work:
   o CLEAN and return all equipment to the tool room.
   o Sweep and mop entire bay area.
   o Clean work benches, tool carts and any other work areas used.
   o Have lab assistant grade your work.

**COURSE CONTENT:**

<table>
<thead>
<tr>
<th>UNIT #</th>
<th>UNIT TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Electrical Fundamental Review</td>
</tr>
<tr>
<td>2.</td>
<td>Series Circuits, Parallel and Series/Parallel Circuits</td>
</tr>
<tr>
<td>3.</td>
<td>Wire Repair, Reading Schematics</td>
</tr>
<tr>
<td>4.</td>
<td>Capacitance and Magnetism</td>
</tr>
<tr>
<td>5.</td>
<td>Solid State Semi-Conductors</td>
</tr>
<tr>
<td>6.</td>
<td>Fundamentals of Refrigeration</td>
</tr>
<tr>
<td>7.</td>
<td>Servicing of the HVAC system</td>
</tr>
<tr>
<td>8.</td>
<td>Strategy for Diagnosis</td>
</tr>
</tbody>
</table>

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UNIT #1

UNIT TITLE: Fundamentals

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Explain the concepts of voltage, current, and resistance.
2. Describe the relationship between voltage and current, resistance and current, voltage and resistance.
3. Use safe practices regarding electricity and handling static sensitive parts.
4. Describe the conductors, insulators, and semi-conductors.
5. Explain multimeter features and uses of each.
6. Read resistor color codes.

UNIT CONTENT OUTLINE

I. Fundamentals
   A. Voltage, electromotive force (E)
   B. Current, intensity (I)
   C. Resistance (R)
   D. Counter-electromotive force

II. OHM's Law
   A. \( E = I \times R \) circle
   B. Relationships between each.
   C. Conventional and electron theory
   D. Meter types, general use
   E. High impedance voltmeter
   F. Safety precautions for meter use

III. Atomic Structure
   A. Protons, neutrons, electrons
   B. Orbits, electrical attraction vs. centrifugal force
   C. Valance ring
   D. Atomic number and electrical classification
   E. Insulators, conductors, semi-conductors

IV. Safety
   A. "Danger High Voltage"
   B. High voltage/low current
   C. Low voltage/high current
   D. Our body resistance
   E. Lightning bolts
   F. Static electricity
   G. How not to become part of a circuit

V. Multimeters
   A. Analog and digital signals
   B. Frequency
   C. Voltmeters
      1. High impedance
   D. Ammeter
      1. Fuse testing

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2. Fuse replacement
E. Ohmmeter
   1. Power off
   2. Isolate component
   3. Discharge capacitors
   4. Conductance and resistance
F. Diode Test
G. Capturing Intermittents
H. Frequency
I. Pulse Width Modulation
J. Capacitor Testing

VI. Resistor Color Coding

UNIT # 2

UNIT TITLE: Series Circuits, Parallel and Series/Parallel Circuits

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Explain the characteristics of voltage, current, and resistance in Series Circuits, Parallel and Series/Parallel Circuits.
2. Use a digital multimeter to measure circuit voltage, voltage drop, current and resistance.
3. Troubleshoot Series, Parallel, and Series Parallel circuits.

UNIT CONTENT OUTLINE

I. Series Circuits
   A. Voltage
   B. Current
   C. Resistance
   D. Measuring voltage drop
   E. Open circuit voltage test
   F. Current measurement
   G. Resistance measurement
   H. Voltage divider network

II. Troubleshooting a Series Circuit
   A. Using a digital multimeter
   B. Using a test light
   C. Using alligator test leads

III. Parallel Circuits
   A. Voltage
   B. Current
   C. Resistance
   D. Using a digital multimeter to measure voltage, current and resistance in a parallel circuits.
   E. Effect of aftermarket accessories on parallel circuits.

IV. Series/Parallel Circuits
   A. Separating circuits into series and parallel parts for troubleshooting.

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V. Troubleshooting parallel and series/parallel circuits
   A. Using a digital multimeter.
   B. Using a test light.
   C. Using alligator test leads.

UNIT #3

UNIT TITLE: Wire Repair, Reading Schematics

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Identify symbols, numbers, components, etc., found on a wiring schematic
2. Locate electrical circuit diagnosis information in the computer terminal and the service manual.
3. Locate and print out wiring diagrams from the computer terminal
4. Replace wire terminals
5. Replace connectors
6. Splice wires
7. Solder terminals and splices
8. Repair supplemental inflatable restraint wires and terminals
9. Use crimp’n’seal splice sleeves
10. Replace fusible links
11. Replace harness isolation diodes

UNIT CONTENT OUTLINE

I. Symbols used on Schematics
   A. Resistors, sensors, motors, fuses, fusible links, electronic circuit breakers, lights, modules, switches, etc.

II. Schematic Numbers
   A. Circuit numbers
   B. Numbers for connectors, splices, grounds, pass-through
   C. Wire size numbers

III. Lines
   A. Dotted line meanings
   B. Solid line meaning
   C. Underlined words

IV. Notes on Schematic Pages

V. Warning Symbols
   A. Static sensitive parts
   B. S. I. R. related circuits

VI. Electronic Service Information
   A. Operating the terminal
   B. Locating information
   C. Printing out information

VII. Wire Terminals

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A. Identification
B. Removal from connectors
C. Testing for tightness
D. Replacement
E. S. I. R. terminals with gold plating

VIII. Connectors
A. Identification
B. Cavity identification for wire location
C. Environmental seals
D. Primary and secondary locks
E. S. I. R. connectors with shorting bars

IX. Splices
A. Butt connector terminals
B. Splice clips
C. Crimp'n'seal splice sleeves

X. Soldering
A. Solder type, size
B. Soldering gun tip cleaning, tinning
C. Soldering heat application to wires and solid state components
D. Safety
   1. Molten solder
   2. Soldering gun magnetic fields
   3. Excessive heat
E. Ultra-torch use
   1. Lighting and operation
   2. Safety in use

XI. Supplemental Inflatable Restraint Wire Repair
A. Terminal differences/replacement
B. Soldering
C. Connector differences/replacement
D. Pigtails
E. Repair kits

XII. Fusible Link Replacement
A. Types
B. Purpose
C. Identification
D. Determining replacement gauge
E. Replacement guidelines

XIII. Isolation Diodes
A. Markings for identification
B. Correct installation
C. Determining correct replacement part
D. Soldering/heat control

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UNIT # 4

UNIT TITLE: Capacitance and Magnetism

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Explain the operation of capacitors and condensers
2. Describe the effect of capacitance on circuit operation
3. Determine condenser application for circuit noise problems
4. Describe magnetism and magnetic fields
5. Explain uses of magnetic fields
6. Identify problems caused by magnetic field interference
7. Determine remedies for magnetic interference

ESTIMATED TIME TO COMPLETE: 2 Weeks

UNIT CONTENT OUTLINE

I. Capacitors/Condensers
   A. Ratings - Farads
   B. Operation and effect on circuit operation
   C. Circuit "noise"
   D. Testing

II. Magnetism
   A. Sources
   B. Characteristics of magnetic fields
   C. Uses for magnetic fields
   D. Symptoms of magnetic interference
   E. Reducing the effect of magnetic interference

UNIT # 5

UNIT TITLE: Solid State Semi-Conductors

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Describe, demonstrate use of, and test diodes
2. Describe, and test zener diodes
3. Describe, demonstrate use of, and test transistors, amplifiers, orquad-drivers
4. Describe and explain how to troubleshoot a computer re-set condition

UNIT CONTENT OUTLINE

I. Diodes
   A. Composition, N-material, P-material
   B. Forward bias
   C. Reverse bias
   D. Diode specifications
   E. Current limitation
   F. Applications
      1. Rectifier bridge
      2. Circuit isolation

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3. Clamping
   a. de-spiking
   b. suppression

G. Zener diodes
   1. Avalanche voltage
   2. Reverse current
   3. Applications

H. Testing diodes and zener diodes

II. Transistors
   A. Composition
   B. Types
      1. PNP
      2. NPN
      3. Field effect
   C. Specifications
   D. Current limitation
   E. Applications
      1. Solid state switch
      2. Solid state relay
      3. Quad-driver
      4. Amplifier
      5. Photo-transistor
   F. Current testing driver circuits

III. Automotive Computer Re-set Troubleshooting
   A. Re-set condition description
   B. Symptoms during re-set
   C. Causes of re-set
   D. Troubleshooting the re-set condition

UNIT # 6

UNIT TITLE: AUTOMOTIVE AIR CONDITIONING SYSTEMS, THEORY & OPERATION

UNIT OBJECTIVE: Upon completion the student will be able to verbally and in written form describe the operation of a typical Air conditioning system, to include identification of components.

UNIT CONTENT OUTLINE

I. Air Conditioning System Operation
   A. Purpose
   B. Heat transfer
   C. Change of state
      1. Solid
      2. Liquid
      3. Vapor
   D. A/C cycle
   E. Temperature variations (touch test)
   F. Pressure/temperature relationship
   G. Safety concerns

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II. Component Identification and Function
   A. Compressor
   B. Condenser
   C. Orifice tube
   D. Evaporator
   E. Accumulator
      1. Oil bleed
      2. Desiccant bag
      3. Compressor protection baffle
   F. Cycling pressure switch
   G. High and low side pressure switches
   H. High pressure relief valve
   I. Clutch coil
   J. O-rings
   K. Sealing washers
   L. High and low fittings
   M. System filters

UNIT # 7

UNIT TITLE: AUTOMOTIVE AIR CONDITIONING SYSTEM SERVICE

UNIT OBJECTIVE: Upon completion the student will be able to demonstrate how to properly and safely store and use air conditioning service tools to diagnose, identify, evacuate, recover, and recharge R134a systems.

UNIT CONTENT OUTLINE

I. Service Tools
   A. Manifold pressure gauges
   B. Leak detectors
      1. R12
      2. R134a
   C. High side adapters
   D. Thermometer
   E. Vacuum pump
   F. Charging station
   G. Recovery equipment
   H. Safety Issues

II. Performance Tests
   A. Manifold gauge set
      1. Hook-up
      2. Interpretation of gauge readings
   B. Touch test
   C. Inside temperature readings

III. System Service (R134a)
   A. Refrigerant storage, identification and recovery
   B. Evacuation
   C. Charging and oil replenishment
   D. Recycling

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E. Leak detection

UNIT # 8

UNIT TITLE: A/C CONTROLS AND AIR DELIVERY SYSTEMS

UNIT OBJECTIVE: Upon completion the student will be able to verbally describe the operation, perform diagnostics, service and repair manual and automatic air conditioning controls associated with air delivery systems.

UNIT CONTENT OUTLINE

I. Manual Controls- Operation and Diagnosis
   A. Blower
      1. Relays
      2. Resistors
      3. Control head selector switch
      4. Service manual wire diagrams for diagnosis
   B. Air Delivery
      1. Vacuum actuators and valves
      2. Control head vacuum switch
      3. Service manual vacuum diagrams for diagnosis
      4. Electronic Controls

II. Automatic Controls - Operation and Diagnosis
   A. Components
      1. Control head
      2. Vacuum hoses
      3. Actuators and Motors
      4. Programmer
   B. Diagnostics
      1. On-Board
      2. Scan tool
      3. Service manual

UNIT # 9

UNIT TITLE: Strategy for Diagnosis

UNIT OBJECTIVE: Upon completion of this unit, the student will be able to:

1. Develop a plan for diagnosing electrical problems
2. Follow prescribed directions in a logical sequence
3. Determine needed repairs or replacements
4. Make necessary repairs

UNIT CONTENT OUTLINE

I. Confirming the Problem
   A. Verify the problem by operating the system in ALL its functions or modes.

II. Perform Preliminary Checks
   A. Perform a visual inspection
   B. Access computer system diagnostic trouble codes

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C. Perform an operational check if not already done

III. Look for the Unusual and don't forget the basics
   A. Search for service bulletins
   B. Check fuses, do the service manual easy checks

IV. Perform a system check as outlined in the service manual by locating the service manual system performance test or the system operational check chart.

V. Code, No code, No matching symptom in the service manual, Intermittent, Operating normally.
   A. If a code is obtained, follow the code chart in the service manual
   B. If no code is found, select a symptom from the service manual symptom chart and perform the diagnostics as instructed.
   C. If no matching symptom is found, develop your own diagnostics from the wiring diagrams, your experience and understanding of circuits.
   D. If the problem is intermittent, refer to the service manual intermittent diagnostic details
   E. If the system is operating normally, explain its operation to the customer to eliminate misunderstandings.

VI. Repair or Re-examine the complaint
   A. Repair the cause of the problem and verify system operation
   B. If the cause of the problem is not found, re-examine the complaint

DEPARTMENT POLICIES:
For Department Policies, please refer to our website at:
http://www.brookdalecc.edu/fac/autotech/

College Policies:
As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student’s disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit www.brookdalecc.edu/support.

For information regarding:
- Brookdale’s Academic Integrity Code
- Student Conduct Code
- Student Grade Appeal Process

Please refer to the BCC STUDENT HANDBOOK AND BCC CATALOG.

NOTIFICATION FOR STUDENTS WITH DISABILITIES:
Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Disabilities Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability, and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

ADDITIONAL SUPPORT/LABS:
See the Tutoring Center for information https://www.brookdalecc.edu/academic-tutoring/tutoring-center/.

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Mental Health:
- Mental Health Crisis Support: From a campus phone, dial 5555 or 732-224-2329 from an external line; off-hours calls will be forwarded to BCC police (2222 from a campus phone)
- Psychological Counseling Services: 732-224-2986 (to schedule an appointment during regular hours)

The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arises.