



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 1220 Basic Automotive Electricity

Date: Spring 2022

Credit Hours: 3

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): None

Enrollment by assessment or other measure? Yes No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor: Yes No

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **2 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended
 Virtual Class Meeting (VCM)

Offered: **Fall** **Spring** **Summer**

CATALOG DESCRIPTION and IAI NUMBER (if applicable):

This is a basic automotive electricity course dealing with voltage, current, resistance, series and parallel circuits, digital multimeter, digital storage oscilloscope, basic electronics, wiring diagrams, batteries, starting systems, and charging systems.

ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

COURSE TOPICS AND CONTENT REQUIREMENTS:

- I. Basic Shop Safety
 - A. Explain basic shop safety
 - B. Identify hazardous waste products in the shop
 - C. Explain the use of material safety data sheets (MSDS)
 - D. Define the purpose of OSHA and EPA
 - E. Explain the different types of fires and fire extinguishers
 - F. Explain basic eye, ear, static, shop and electrical safety
- II. Basic Automotive Electricity Theory
 - A. Electron Theory
 - B. Electrical Terms and Principles
 1. Direct Current
 2. Alternating Current
 3. Current Flow
 4. Voltage
 5. Resistance
 - C. Factors of Electricity
 1. Magnetism
 2. Electromagnetism
 3. Electromagnetic Induction (EMI)
 - D. Electrical Rules
 1. Ohm's Law
 2. Watt's Law
 - E. Types of Electrical Circuits
 1. Series
 2. Parallel
- III. Measurement System
 - A. Metric prefix system
 - B. Scientific Calculator
- IV. Components of an Electrical Circuit
 - A. Automotive Wiring
 1. Primary Wire
 2. Secondary Wire
 3. Stranded Wire
 4. Metric/AWG Wire
 - B. Electrical Connectors
 - C. Soldering
 1. Design and Types
 2. Technique
 - D. Resistive Devices
 1. Fixed

- 2. Variable
- 3. Stepped
- E. Circuit Protection Devices
 - 1. Fuse Design
 - a. Glass, ceramic, Pacific Element, and Blade
 - 2. Fuse Ratings
 - 3. Fusible Link
 - 4. Circuit Breakers
 - a. Manual and Automatic Design
- F. Electrical Switches
 - 1. SPST/SPDT
 - 2. Ganged
 - 3. Mercury
 - 4. Electromagnetic
- G. Capacitors
 - 1. Application and Rating
- V. Meters and Measuring Devices
 - A. Analog Meters
 - B. Polarity
 - C. Impedance
 - D. Digital Multimeter
 - 1. Electrical test Equipment (Digital Multimeter)
Voltmeter (dc and ac), ammeter, ohmmeter, diode checker, frequency, temperature, duty cycle, dwell, millivolts, milliamps, 10 megaohm impedance, minimum/maximum feature, and sleep mode
 - 2. Measurements: Voltage, Amperage, Resistance, and Diode voltage
 - E. Test Lights
 - 1. Low and High Current Types
 - 2. Troubleshooting
 - 3. Self-Powered
 - F. Wiring Diagrams
 - 1. How to Read
 - 2. How to Use to Service Vehicles
 - G. Automotive Oscilloscopes
 - 1. Digital Storage Oscilloscope
 - a. Amplitude, Time Divisions, Single and Dual Trace
 - 2. Analog and Digital Signals
 - 3. Buffer Circuits
- VI. Circuits
 - A. Series Circuit and Laws
 - B. Parallel Circuit and Laws
 - C. Series-Parallel Circuit and Laws
 - D. Exercises
- VII. Troubleshooting Techniques and Specifications For
 - A. Open Circuits
 - B. Short Circuits
 - C. Voltage Drops
 - D. Parasitic Drains

- E. Feedback Circuits
- VIII. Basics of Electronics and Computers
 - A. Semiconductors
 - 1. P and N Type Materials
 - 2. Diodes
 - 3. Transistors
 - 4. Testing
 - B. Binary Code
- IX. Batteries
 - A. Basic Theory
 - B. Conventional Battery Construction
 - C. Maintenance Free Construction
 - D. Deep Cycle Battery Construction
 - E. Recombination Battery Construction
 - F. Battery Load Ratings
 - G. Battery Testing
 - 1. Terminal Voltage Drop
 - 2. State-of-Charge
 - 3. Open Circuit Voltage Test
 - 4. Load Testing Equipment
 - 5. Electronic Tester
 - 6. Specific Gravity
 - H. Battery Charging Procedures and Safety
 - I. Battery Jump Starting
 - J. Battery Removal and Cleaning
 - K. Care and Servicing
 - L. Sales and Purchasing
 - M. Storage
- X. Starting System
 - A. Magnetism and Motor Principles
 - B. Starting Circuit Components
 - 1. Starter Pinion Drives
 - 2. Starter Solenoid
 - 3. Starter Relay
 - C. Starter Motor Designs
 - 1. Direct Drive
 - 2. Positive Engagement
 - 3. Gear Reduction
 - 4. Permanent Magnet
 - D. Neutral Safety Switch
 - E. Starter System Testing
 - 1. Starter Current Draw Test
 - 2. Starter Voltage Drop Test
 - 3. Starter Open Circuit Test
 - 4. Starter Pinion Gear Clearance
 - F. Starter Motor Service
 - 1. Disassembly Procedures
 - 2. Growler Tests
 - 3. Reassembly Procedures

- XI. Charging System
 - A. Charging System Principles
 - 1. Direct Current Generators
 - 2. Alternating Current Generators
 - B. Charging System Components and Operation
 - 1. Stator Assembly Designs
 - 2. Rotor Assembly Design
 - C. Alternating Current Rectification
 - D. Charging System Regulation
 - 1. Field Current Control
 - a. A-Circuit, B-Circuit, or PCM
 - 2. Mechanical
 - 3. Transistorized
 - 4. Diode Testing
 - E. Charging System Testing
 - 1. Visual Inspection
 - 2. State of Charge
 - 3. Drive Belt Inspection
 - 4. AC Ripple Test

INSTRUCTIONAL METHODS:

- 1. Lecture
- 2. Demonstrations
- 3. Practical (Lab)
- 4. Power Point
- 5. Class Discussion
- 6. Handouts
- 7. Quizzes and Tests

EVALUATION OF STUDENT ACHIEVEMENT:

- 1. Complete all lab objectives (ASE Education Foundation Tasks)
- 2. Attendance
- 3. Work Habits
- 4. Attitude
- 5. Safety Practices
- 6. Ability to Work with Others
- 7. Written Exams and Quizzes
- 8. Class Participation

INSTRUCTIONAL MATERIALS:

Textbooks

Duffy, James E. *Auto Electricity and Electronics*. The Goodheart-Willcox Company, Inc., 2021. ISBN: 978-1-64564-073-8
Automotive E-Learning Software (Electude.com).

Resources

- 1. Pro-Demand – Information System
- 2. All Data Pro - Information System

LEARNING OUTCOMES AND GOALS:

Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
7. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information.
8. Use fused jumper wires to check operation of electrical circuits per service information.
9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems.
10. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action.
11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.
12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.
13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

B. Batteries (Conventional 12-volt)

1. Perform battery state-of-charge test; determine needed action.
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test; determine needed action.
3. Maintain or restore electronic memory functions as recommended by manufacturer.
4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs.
5. Perform battery charging according to manufacturer's recommendations.

6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.
7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

C. Starting System

1. Perform starter current draw test; determine needed action.
2. Perform starter circuit voltage drop tests; determine needed action.
3. Inspect and test starter relays and solenoids; determine needed action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; determine needed action.
6. Demonstrate knowledge of an automatic idle-stop/start-stop system.
7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition.
8. Diagnose a no-crank condition using a wiring diagram and test equipment; determine needed action.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

D. Charging System

1. Perform charging system output test; determine needed action.
2. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment; determine needed action.
3. Remove, inspect, and/or replace generator (alternator); determine needed action.
4. Perform charging circuit voltage drop tests; determine needed action.
5. Diagnose charging system for causes of undercharge, no-charge, or overcharge conditions; determine needed action.

FOUNDATIONAL TASKS – 2022

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as:

supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.

14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

Personal Standards

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.