

LEWIS AND CLARK COMMUNITY COLLEGE  
GODFREY, ILLINOIS  
**AUTO 246 - ELECTRICAL SYSTEMS DIAGNOSIS AND REPAIR**  
Course Syllabus

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## **A. COURSE DESCRIPTION**

### **AUTO 246 ELECTRICAL SYSTEMS DIAGNOSIS AND REPAIR (Fall Semester Only)**

Focuses on automotive electrical systems theory and designs. Emphasizes operating principles, diagnosis, repair and/or replacement of batteries, starting and charging systems, electrical wiring harnesses, connectors, terminals, lighting and accessories. Shop experience with test equipment necessary for the diagnosis and service of electrical accessories and components. Identification of hybrid vehicle high voltage circuits and circuit disconnects (service plugs) will be performed. *Prerequisite: AUTO 145 or concurrent enrollment.* (PCS 1.2, 4 credit hours: 3 hours lecture, 3 hours lab)

## **B. LEARNING OBJECTIVES**

Upon successful completion of the course, a student should be able to:

1. Recognize and apply shop safety procedures
2. Demonstrate the ability to use various automotive repair and specification manuals and software
3. Define the various terms used in the automotive electrical industry
4. Identify the names of the various components of automotive starting and charging systems, electrical wiring, lighting and accessories
5. Demonstrate the ability to use various specialty tools and equipment utilized in the diagnosis, service and repair of automotive electrical systems
6. Discuss vehicle problem(s) with vehicle owner and/or instructor and test drive to verify customer concern and determine needed service and/or repairs
7. Prepare a vehicle work order including customer information, vehicle information, customer concern, related service history, cause and recommended vehicle service and/or repairs
8. Diagnose the cause(s) of overcharge, undercharge or no-charge conditions of an automotive charging system
9. Perform diagnostic tests to determine intermitted, dim, brighter than normal and non-functional headlights, parking lights, taillights, dash lights, stoplights, courtesy lights, turn signals

hazard

lights and back-up lights

10. Inspect, service and replace fusible links, circuit breakers, fuses, battery cables, connectors and clamps

11. Describe the proper procedure for checking for continuity, applied voltage, voltage drop, current flow/draw, resistance and open shorts and grounds on electrical circuits and components with the use of test light, analog and digital meters and specialized test equipment

12. Perform battery cleaning, filling, replacement, state-of-charge test, capacity test, constant drain test, three minute charge test and slow and fast charging of both conventional and maintenance free batteries

13. Properly jump start a vehicle with jumper cables and a booster battery or auxiliary power supply

14. Rebuild starter motors and components including inspection, testing, removal, disassembling, cleaning, and replacement of switches, connectors, wires, relays, solenoids, starter drive, brushes, bushings, field coils, armature and reassemble, performing free-running bench tests

before reinstalling on vehicle

15. Test charging system performance including alternator and regulator output and repair or replace components as needed

16. Rebuild alternators and components including inspection, testing, removal, disassembling, cleaning and replacement of connectors, wires, bearings, brushes, diodes and/or rectifier assemblies, stators, rotors, capacitors and reassemble, performing output bench tests before reinstalling on vehicle

17. Service automotive lighting and driver information systems including the inspection, testing, repair and/or replacement of switches, relays, sockets, connectors, wires, motors, flasher units, bulbs, printed circuit boards, voltage limiters, sending units and other related components

18. Apply the recommended procedures for the diagnosis and repair of constant, flow, intermittent

or nonfunctioning automotive electrical accessories including driver information, horn, windshield

wiper, windshield washer, heated mirrors, power windows, power seats, rear window defogger,

power locks, cruise controls and anti-theft systems

19. Demonstrate the ability to diagnose the cause of intermittent, high, low, or no gauge readings on both analog and digital dash units
20. Identify high voltage circuits and circuit disconnects (service plugs) following manufacturer's recommended safety procedures
21. Isolate HV circuitry on HEV systems
22. Perform insulation leakage test on HEV systems
23. Demonstrate knowledge of PPE equipment testing procedures
24. Diagnose HV system electrical failures
25. Jump start auxiliary battery on HEV
26. Jump start HV battery on HEV

### **C. MATERIALS OF INSTRUCTION**

Required and optional student instructional materials must be approved by the department and/or dean.

1. Required student materials:

- a. *Diagnosis & Troubleshooting Auto Electrical, Electronic & Computer Systems My Automotive Lab Access*, Halderman, Pearson Prentice Hall, latest edition
- b. NATEF Task sheets by Hadfield
- c. Student hand tool set (required list will be distributed at the outset of the course)
- d. Safety glasses (available in the LCCC Bookstore)
- e. Dress code appropriate for automotive repair activities

2. Optional student materials:

- a. Uniforms, Lab Coats and/or Coveralls
- b. Recommended Additional Hand Tools

3. Miscellaneous instructor and/or student material (films, slides, software, workbooks, etc.):

- a. Audio visual materials
- b. Mitchell auto repair manuals and On-Demand software
- c. Specialty tools and equipment
- d. Handouts of current articles
- e. Student progress report sheet
- f. Homework assignment and answer sheets
- g. Automotive lab safety rules
- h. Automotive student information sheet
- i. AUTO 246 course outline

### **D. LEARNING RESOURCE CENTER SUPPORT MATERIALS**

The Learning Resource Center may have supplemental materials that students can use to access additional information.

## **E. METHODS OF INSTRUCTION**

Instructional methods in this course may include, among others, the following:

1. Lecture including the use of audio-visual materials and component parts
2. Demonstrations of the use of auto repair and specification manuals
3. Demonstrations of various diagnostic and repair procedures
4. Demonstrations of the use of various specialty tools and equipment
5. Question and discussion
6. Individual and group laboratory instruction
7. Industry field trips (as appropriate)
8. Industry sponsored clinics (when available)

## **F. EVALUATION OF STUDENT ACHIEVEMENT**

The instructor's policies on evaluation will be distributed to students and the division office at the outset of the course.

The methods of evaluating student achievement will include, at minimum, the following:

1. Lab assignments (including the completion of job sheets and required NATEF tasks)
2. Eighteen homework assignments
3. Two written exams and two quizzes
4. Department of Labor SCAN Skills (Secretary's Commission on Achieving Necessary Skills)
5. Attendance and classroom/lab participation

Additional methods of evaluation may be used and described in the course outline.

## **G. ATTENDANCE POLICY**

Regular attendance is expected. The instructor's policies on attendance will be distributed to students and the division office at the outset of the course.

## **H. COURSE CONTENT**

The following topics are to be covered during the instructional process:

1. Shop safety procedures
2. Automotive electrical diagnostic equipment
  - a. Sun VAT 40 and VAT 45
  - b. Analog and digital volt/ohm/amp meters
  - c. Oscilloscopes
    1. Bear PACE
    2. Bear ACE
  - d. Circuit powered and self-powered test lights

- e. Fluke dual-trace lab scopes
- f. Computer scanners/monitors
- 3. Review of basic electricity and basic circuits
  - a. Volts
  - b. Ohms
  - c. Amps
  - d. Series
  - e. Parallel
  - f. Series-Parallel
- 4. Automotive wiring and basic circuit components
  - a. Wiring harnesses
    - 1. Diameter
    - 2. Length
  - b. Basic circuit components
    - 1. Switches
    - 2. Relays and solenoids
    - 3. Buzzers and flashers
    - 4. Sockets and bulbs
    - 5. Connectors and cables
    - 6. Fuses and fusible links
    - 7. Circuit breakers and printed circuits
    - 8. Timers and motors
  - 5. Electrical symbols, schematics and color coding
  - 6. General electrical system diagnosis
    - a. Open, shorts and grounds
    - b. Voltage drop and resistance
    - c. Applied voltage
    - d. Current flow/draw
  - 7. General electrical system service, repair or replace
    - a. Open, short and grounded circuits
    - b. Deficient voltage supply
    - c. Excessive voltage drop and resistance
    - d. Fusible links and fuses
    - e. Reset and/or replace circuit breakers
    - f. Improper current flow/draw
  - 8. Battery diagnosis
    - a. Battery state-of-charge test
    - b. Battery capacity test
    - c. Three minute charge test
  - 9. Battery service and replace
    - a. Inspect, clean, fill or replace
    - b. Slow and fast charge conventional and maintenance free
    - c. Cables, connectors and clamps
    - d. Properly jump start a vehicle
  - 10. Starting system diagnosis
    - a. Cables and connectors continuity

- b. Relays and solenoids operation
- c. Starter motor
  - 1. Current draw test
  - 2. Voltage drop test
- 11. Starting system service, repair or replace
  - a. Switches, connectors and wires
  - b. Excessive voltage drop and current draw
  - c. Relays and solenoids
  - d. Starter motors
  - e. Starter motor components
    - 1. Starter drives
    - 2. Bushings
    - 3. Brushes and brush holders
    - 4. Field coils and armatures
- 12. Charging system diagnosis
  - a. Overcharge
  - b. Undercharge
  - c. No-Charge
  - d. Charging system tests
    - 1. Alternator output test
    - 2. Voltage regulator test
    - 3. Charging system voltage drop test
- 13. Charging system service, repair or replace
  - a. Excessive voltage drop and resistance
  - b. Alternator drive belts
  - c. Regulator and alternator
  - d. Connectors and wires
  - e. Alternator components
    - 1. Bearings, pulleys and fans
    - 2. Brushes and brush holders
    - 3. Diodes or rectifier assemblies
    - 4. Stators and rotors
    - 5. Capacitors
- 14. Lighting systems diagnosis
  - a. Intermittent
  - b. Too dim
  - c. Brighter than normal
  - d. Non-functioning
- 15. Lighting system service, repair or replace
  - a. Switches
    - 1. Dimmer
    - 2. Headlight
    - 3. Brake light
    - 4. Parking brake
    - 5. Courtesy light
    - 6. Turn signal

- 7. Hazard light
- 8. Back-Up
  - b. Bulbs and sockets
  - c. Flasher units and buzzers
  - d. Relays and motors
  - e. Connectors and wires
- 16. Gauges, warning devices and driver information diagnosis
  - a. Intermittent readings
  - b. High gauge readings
  - c. Low gauge readings
  - d. No gauge readings
- 17. Gauges, warning devices and driver information systems service, repair or replace
  - a. Gauge circuit voltage limiters
  - b. Gauges and sending units
  - c. Gauge circuits
  - d. Warning light/driver information systems circuits and components
  - e. Audible warning device circuits and components
- 18. Horn and wiper/washer diagnosis
  - a. Constant operation
  - b. Intermittent operation
  - c. Non-Functioning
- 19. Horn and wiper/washer service, repair or replace
  - a. Horn system and components
  - b. Wiper system and components
  - c. Washer system and components
- 20. Electrical accessories diagnosis
  - a. Constant operation
  - b. Slow operation
  - c. Intermittent operation
  - d. Non-Functioning
- 21. Electrical accessories service, repair or replace
  - a. Power windows and components
  - b. Power seats and components
  - c. Rear window defogger and components
  - d. Power door locks and components
  - e. Electrically operated sunroofs and convertible tops
  - f. Electrically operated heated mirrors
  - g. Cruise controls and components
  - h. Anti-theft components
- 22. HEV System Design
  - a. Series
  - b. Parallel
  - c. Series-Parallel
  - d. Battery design
    - 1. Ni-MH
    - 2. Li-Ion

#### e. HEV Service

1. Safety
  2. PPE inspection
  3. PPE Usage
  4. Familiarization
  5. Isolation
  6. Insulation Failure Testing (Short circuit)
  7. CVT
- a. MG
  - b. Belt/Sheave

### **I. ACCOMMODATION STATEMENT**

If you need an accommodation based on the impact of a disability, please inform me as soon as possible. An appointment will be arranged where we will discuss the course format, anticipate your needs and explore potential accommodations. I rely on Mary Hough, Special Learning Needs Counselor, for assistance in verifying the need for accommodations and accommodation strategies. If you have not previously contacted her, I encourage you to do so at 468-4128 or 468-4121. This does not apply to High School dual credit students.

### **J. ACADEMIC DISHONESTY**

Assignments that have been copied from another student or another source will not be scored. "Academic dishonesty including, but not limited to, cheating, plagiarism, and forgery, violates the STUDENT CONDUCT CODE and will lead to disciplinary action up to and including expulsion" (2004-2005 LCCC Catalogue, page 14). The following website will give you in-depth information on the definition of plagiarism and more: [http://www.turnitin.com/research\\_site/e\\_what\\_is\\_plagiarism.html](http://www.turnitin.com/research_site/e_what_is_plagiarism.html) . Please visit this site if you need clarification.

**PERSONAL TECHNOLOGY DEVICES IN THE CLASSROOM** In an effort to preserve the integrity of the academic environment, extraneous use of personal electronic devices (cell phones, bluetooth, PDAs, iPods, etc.) is prohibited during all class meetings. The instructor reserves the right to examine the device in instances where allegations of academic dishonesty are suspected. In emergency situations students must inform the instructor to receive permission to leave the classroom when their cellular phones vibrate (do not have cell phone ring or otherwise disturb the class).

**The attachments below, if any, represent Form 13 Articulation Exhibits from various universities.**