COURSE OUTLINE OF RECORD

Number: AUTO G121  TITLE: Electrical/Electronic Systems: Advanced

ORIGINATOR: Eli Jaramillo

EFF TERM: Summer 2010

FORMERLY KNOWN AS:

DATE OF OUTLINE/REVIEW: 03-06-2012

CROSS LISTED COURSE:

TOP NO: 0948.00

CID:

SEMESTER UNITS: 5.0

HRS LEC: 72.0    HRS LAB: 54.0    HRS OTHER: 0.0

CONTACT HRS TOTAL: 126.0

STUDY NON-CONTACT HRS RECOMMENDED: 144.0

CATALOG DESCRIPTION:

This is an advanced course that provides students with theory, knowledge, and skills necessary to understand electrical flow and advanced automotive electronic diagnostic and repair concepts. Coursework presented is based on the Automotive Service Excellence (ASE) A-6 Electrical/Electronics Tasks and Standards intended to prepare students for the ASE Certification Examination. Lecture and Lab.

JUSTIFICATION FOR COURSE:

PREREQUISITES:

COREQUISITES:

ADVISORIES:

• AUTO G120: Electrical/Electronic Systems: Introductory

ASSIGNED DISCIPLINES:

Automotive technology

MATERIAL FEE: Yes [ ] No [X] Amount: $0.00

CREDIT STATUS: Noncredit [ ] Credit - Degree Applicable [X] Credit - Not Degree Applicable [ ]

GRADING POLICY: Pass/No Pass [X] Standard Letter [X] Not Graded [ ] Satisfactory Progress [ ]

OPEN ENTRY/OPEN EXIT: Yes [ ] No [X]

TRANSFER STATUS: CSU Transferable[X] UC/CSU Transferable[ ] Not Transferable[ ]

BASIC SKILLS STATUS: Yes [ ] No [X] LEVELS BELOW TRANSFER: Not Applicable

CALIFORNIA CLASSIFICATION CODES: Y - Not Applicable

NON CREDIT COURSE CATEGORY: Y - Not applicable, Credit Course

OCCUPATIONAL (SAM) CODE: B

REPEATABLE ACCORDING TO STATE GUIDELINES: No [X] Yes [ ] NUMBER REPEATS:

REQUIRED FOR DEGREE OR CERTIFICATE: No [ ] Yes [X]

GE AND TRANSFER REQUIREMENTS MET:

COURSE LEVEL STUDENT LEARNING OUTCOME(S) Supported by this course:
1. Demonstrate an ability to self-assess progress and development in a specific area and to further design and pursue a course of action based on the self-assessment.

2. Discriminate and explain advanced electrical diagnostics.

3. Analyze and diagnose automotive engines and related components for correct system operation.

4. Demonstrate mastery of diagnostic tools and equipment used for automotive repair.

**COURSE OBJECTIVES:**

1. Pass the SP-2 Mechanical Safety and Mechanical Pollution Prevention Test.
2. Analyze and interpret complex wiring diagrams and electrical power flow on advanced circuits such as multiplex and Body Control Module (BCM)-controlled circuits.
3. Perform systematic analysis on advanced automotive electrical systems using industry-accepted testing procedures, and diagnostic tools and equipment such as test lights, logic probes, Digital Volt Ohm Meters (DVOM’s), Digital Storage Oscilloscopes (DSO’s), and scan tools.
4. Retrieve and interpret service and repair information and wiring diagrams.
5. Perform precision electrical measurements and compare against factory specifications.
6. Identify electrical component failures on complex circuits using analytical skills, processes, and industry-accepted procedures.
7. Apply industry-accepted processes and principles for advanced circuit analysis and repairs.
8. Apply learned safety concepts when servicing HEV’s, identifying the location of high voltage service disconnect switches, warning devices, and following proper safeguards and correct set-up procedures.

**COURSE CONTENT:**

**LECTURE CONTENT:**

A. Safety Instruction and SP-2 Shop Safety and Pollution Prevention Test.

B. Review of electrical fundamentals and basic test equipment
   1. Current flow in electrical circuits
   2. AC vs. DC voltage concepts
   3. Insulators vs. conductors
   4. Ohm’s law to figure voltage, current, and resistance values.
   5. Voltage values and voltage drop concepts
   6. Circuit protection: Fusible links, circuit breakers and fuses
   7. Switches, connectors, wire types and sizes
   8. Electrical sensors
   9. Electrical malfunctions: Shorts, grounds, opens, and high resistance issues
   10. Key-off battery parasitic drain
   11. Diagnosis of electrical circuits using fused jumper wires
   12. Voltmeters, Ammeters, Ohmmeters
   13. Test lights, multimeters, logic probes

C. Electrical circuit analysis
   1. Series circuits
   2. Parallel circuits
   3. Series-parallel circuits
   4. Circuits that perform work
   5. Control circuits
   6. Circuit diagnostics

D. Advanced electronics fundamentals
1. Analog vs. digital circuits
2. Concepts of Kirchhoff’s law
3. Solid state principles

E. Electronic control devices:
1. Electronic Control Units (ECU)
2. Body Control Modules (BCM)
3. Inputs vs. outputs
4. Actuators

F. Advanced circuitry: Concepts and principles
1. Integrated circuits
2. Multiplex circuits
3. Controller Area Network (CAN) concepts
4. Local Area Network (LAN) circuits
5. Binary Unit System (BUS) concepts
6. Other advanced on-board circuits
   a. Supplemental Restraint System (SRS)
   b. Timer-controlled circuits
   c. Duty cycle and pulse width

G. Advanced diagnostic equipment:
1. The Digital Storage Oscilloscope (DSO)
   a. DSO slope switch and trigger
   b. Reading and interpreting a DSO pattern
   c. Pulsing DC voltage signal and frequency
   d. Using a current probe with a DSO
   e. Analyzing the DSO multiple-trace function
2. Scan tools: Factory and aftermarket


LABORATORY CONTENT:

After acquiring the appropriate lecture information, the successful student will demonstrate skill accomplishment by completing worksheet-driven NATEF-approved tasks. NATEF (National Automotive Technicians Education Foundation) is a non-profit agency that evaluates technician training programs against standards developed by the automotive industry. All of the current NATEF approved tasks for this class are listed below, and are also contained in a separate document that is handed out on the first day of class.

ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

A. General Electrical System Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
2. Identify and interpret electrical/electronic system concern; determine necessary action.
3. Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins.
4. Locate and interpret vehicle and major component identification numbers.
6. Use wiring diagrams during diagnosis of electrical circuit problems.
7. Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems, including: source voltage, voltage drop, current flow, and resistance.
8. Check electrical circuits with a test light; determine necessary action.
9. Check electrical/electronic circuit waveforms; interpret readings and determine needed repairs.
10. Check electrical circuits using fused jumper wires; determine necessary action.
11. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.
12. Measure and diagnose the cause(s) of excessive parasitic draw; determine necessary action.
13. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.
15. Remove and replace terminal end from connector; replace connectors and terminal ends.
16. Repair wiring harness (including CAN/BUS systems).
17. Perform solder repair of electrical wiring.
18. Identify location of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures.

B. Battery Diagnosis and Service

1. Perform battery state-of-charge test; determine necessary action.
2. Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action.
3. Maintain or restore electronic memory functions.
4. Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs.
5. Perform battery charge.
6. Start a vehicle using jumper cables or an auxiliary power supply.
7. Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions.
8. Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect.
9. Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures.

C. Starting System Diagnosis and Repair

1. Perform starter current draw tests; determine necessary action.
2. Perform starter circuit voltage drop tests; determine necessary action.
3. Inspect and test starter relays and solenoids; determine necessary action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.
6. Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.

D. Charging System Diagnosis and Repair

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

E. Lighting Systems Diagnosis and Repair
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.
2. Inspect, replace, and aim headlights and bulbs.
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.
4. Identify system voltage and safety precautions associated with high intensity discharge headlights.

F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair
1. Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action.
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.
4. Inspect and test sensors, connectors, and wires of electronic (digital) instrument circuits; determine necessary action.

G. Horn and Wiper/Washer Diagnosis and Repair
1. Diagnose incorrect horn operation; perform necessary action.
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.
3. Diagnose incorrect washer operation; perform necessary action.

H. Accessories Diagnosis and Repair
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.
2. Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action.
3. Diagnose incorrect electric lock operation (including remote keyless entry); determine necessary action.
4. Diagnose incorrect operation of cruise control systems; determine necessary action.
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action.
6. Disarm and enable the airbag system for vehicle service.
7. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.
8. Remove and reinstall door panel.
9. Diagnose body electronic system circuits using a scan tool; determine necessary action.
10. Check for module communication (including CAN/BUS systems) errors using a scan tool.
11. Diagnose the cause of false, intermittent, or no operation of anti-theft systems.
12. Describe the operation of keyless entry/remote-start systems.
13. Perform software transfers, software updates, or flash reprogramming on electronic modules.

METHODS OF INSTRUCTION:
A. Lecture:
B. Lab:
C. Independent Study:

INSTRUCTIONAL TECHNIQUES:
COURSE ASSIGNMENTS:

Reading Assignments

Required readings:

Websites: Web-based assignments:
Autoshop101.com
CTEOnline.com
Other topic specific websites as needed.

Out-of-class Assignments

Writing Assignments

1. Create repair orders, perform complex math exercises for flat rate labor, parts, and materials totals.
2. Demonstrate an understanding of advanced electrical concepts, perform math exercises to validate voltage, current flow, and resistance in a circuit.
3. Use information and concepts learned in class to successfully pass a practicum or written test or assignment.
4. Use on-line service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostics.

METHODS OF STUDENT EVALUATION:

Midterm Exam
Final Exam
Short Quizzes
Written Assignments
Essay Examinations
Objective Examinations
Report
Problem Solving Exercises
Skills Demonstration

Demonstration of Critical Thinking:

1. Demonstrate the ability to analyze and troubleshoot complex electrical circuits and restore them to proper service.
2. Analyze, confirm, and diagnose complex electrical faults based on symptoms indicated on repair orders.
3. Relate diagnostic test results directly to electrical circuit or component failures based on readings or measurements.
4. Analyze complex wiring diagrams to determine circuit integrity.

Required Writing, Problem Solving, Skills Demonstration:

1. Create repair orders, perform complex math exercises for flat rate labor, parts, and materials totals.
2. Demonstrate an understanding of advanced electrical concepts, perform math exercises to validate voltage, current flow, and resistance in a circuit.
3. Use information and concepts learned in class to successfully pass a practicum or written test or assignment.
4. Use on-line service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostics.

TEXTS, READINGS, AND RESOURCES:

TextBooks:

Other:
1. GWC Auto Tech work shirt
2. A basic hand tool set

LIBRARY:
Adequate library resources include:

Comments:

Attachments:
Attached Files