

# EASTERN ARIZONA COLLEGE

## Automotive Electrical Systems and Equipment

Course Design  
2009-2010

**Course Information**

**Division** Industrial Technology Education  
**Course Number** AUT 107  
**Title** Automotive Electrical Systems and Equipment  
**Credits** 2  
**Developed by** Brian Coppola  
**Lecture/Lab Ratio** 1 Lecture/3 Lab

**Transfer Status**

ASU	NAU	UA
OMT Dept Elective	CTE Departmental Elective	Non Transferable

**Activity Course** No  
**CIP Code** 47.0604  
**Assessment Mode** Pre/Post Test (25 Questions/100 Points)  
**Semester Taught** Fall  
**GE Category** None  
**Separate Lab** Yes  
**Awareness Course** No  
**Intensive Writing Course** No

**Prerequisites**

None

**Educational Value**

This course is designed to reinforce and apply information, processes, and ideas gained in other courses. The major intent of this course is to enhance the student's ability to work with and diagnose the automotive electrical systems.

**Description**

This course provides a study of automotive starting, supplemental restraint (air bags), and charging electrical systems and components. An emphasis is placed on electrical system diagnosis and electrical repair. Course gives students the opportunity to use various industry standard diagnostic electrical equipment and testing techniques. Prepares the student to take the ASE certification test on electrical/electronic systems.

## **Supplies**

Safety glasses

## **Competencies and Performance Standards**

### **1. Apply proper safety procedures and processes.**

#### **Learning objectives**

*What you will learn as you master the competency:*

- a. Acquaint self with shop environment and hazards.
- b. Acquaint self with emergency procedures and policy.
- c. Accept responsibility for personal well-being and practice and follow safety guidelines.
- d. Acquaint self with material safety data sheets and chemical used in shop.

#### **Performance Standards**

*You will demonstrate your competence:*

- When learner completes safety assignments and written exam at a satisfactory level.

*Your performance will be successful when*

- learner observes and practices safety procedures.

### **2. Diagnose and repair various electrical / electronic vehicle system concerns using a strategy-based process. (NATEF VI A)**

#### **Learning objectives**

*What you will learn as you master the competency:*

- a. Perform trouble-shooting process on electrical components and systems using industry standard tooling, equipment, and reference information.

#### **Performance Standards**

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor).
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The tasks must be completed with limited supervision-entry level).

*Your performance will be successful when*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner provides acceptable oral and/or written responses to questions and /or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.
- learner attends required class and lab sessions and shows up on time.

**3. Diagnose and repair various automotive battery concerns using a strategy-based process. (NATEF VI B)**

***Learning objectives***

*What you will learn as you master the competency:*

- a. Determine condition of various automotive batteries.
- b. Perform battery inspection and service needed.

***Performance Standards***

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The tasks must be completed with limited supervision-entry level).

*Your performance will be successful when:*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.
- learner attends required class and lab sessions and shows up on time.

**4. Diagnose and repair various automotive starting system concerns using a strategy-based process. (NATEF VI C)**

***Learning objectives***

*What you will learn as you master the competency:*

- a. Determine root cause of various vehicle starting (cranking) related problems.
- b. Perform starter bench inspection and testing processes.

***Performance Standards***

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor.)
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The tasks must be completed with limited supervision-entry level.)

*Your performance will be successful when:*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner provides acceptable oral and/or written responses to questions and /or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.
- learner attends required class and lab sessions and shows up on time.

**5. Diagnose and repair various automotive charging system concerns using a strategy-based process. (NATEF VI D)**

***Learning objectives***

*What you will learn as you master the competency:*

- a. Determine root cause of various vehicles charging system problems-on car.
- b. Perform AC bench inspection and testing processes.

***Performance Standards***

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor).
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The task must be completed with limited supervision-entry level).

*Your performance will be successful when:*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner provides acceptable oral and/or written responses to questions and /or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.
- learner attends required class and lab sessions and shows up on time.

**6. Diagnose and repair supplemental restraint system (SRS) hard code concern using recommended manufacturer techniques. (NATEF VI H 5)**

***Learning objectives***

*What you will learn as you master the competency:*

- a. Determine reason for the SRS malfunction indicator light to illuminate beyond manufacturer's requirement.
- b. Perform proper SRS system service and repair processes.

***Performance Standards***

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor).
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The tasks must be completed with limited supervision-entry level).

*Your performance will be successful when:*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner provides acceptable oral and/or written responses to questions and /or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.

- learner attends required class and lab sessions and shows up on time.

## **7. Perform industry standard electrical repairs on various automotive electrical systems.**

### ***Learning objectives***

*What you will learn as you master the competency:*

- a. Perform proper electrical wire and connector repair.

### ***Performance Standards***

*You will demonstrate your competence:*

- When learner completes NATEF aligned assignment and job sheets listed in the related learning plan. (The assignment and job sheets must be completed at a satisfactory level to the instructor).
- When the learner performs the priority NATEF tasks listed in the related learning plan. (The tasks must be completed with limited supervision-entry level).

*You will demonstrate your competence:*

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan.
- learner provides acceptable oral and/or written responses to questions and /or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan.
- learner actively participates in the NATEF task requirements listed in the related learning plan.
- learner attends required class and lab sessions and shows up on time.

### ***Types of Instruction***

Classroom Presentation

Lab

Individualized/Independent Study

Simulated or Actual Work Experience

## **Grading Information**

### **Grading Rationale**

Grading Weights

Lab=45%

Class (Includes Test and Assignments)=45%

Final Exam (Post Test is the Final)=10%

### Grading Methods

Class score calculation-

Quizzes, assignments and job sheet points shall be added and carry a weight equal to one test score.

All exams except the final shall have equal weight (test scores averaged) and used in class score calculations.

The final (post test) will be worth at least 10% of the overall final grade calculation.

Lab score calculation-

Instructor should evaluate each student's work habits using lab time card.

Each student should be evaluated on productivity and progress on task requirements, working in a professional manner, clean-up and safe work habits. Instructor is also required to evaluate each student's skill level in achieving the NATEF task requirement outlined in the various learning plans.

Instructors are encouraged to reward students for showing up on time and attending each class and lab session. This can be done by requiring students to make arrangements with the instructor to make-up any lost time prior to missed day. All students need to notify the instructor of sick days through voice mail, etc. on the day of sickness. Instructors should not allow for any work to be turned in late or any test made up without some type of deduction for late assignments/test. Suggested deduction 50% of original score.

### **Grading Scale**

A 90% - 100%

B 80% - 89 %

C 70% - 79%

D 60% - 69%

F Below 60%

Pass/Fail A non-major student may choose to have a grade of P or F rather than a letter grade. A grade of P will require that the student receive a percentage grade of at least 70%. A grade less than this will result in a grade of F.

## **Learning Plan**

### **Safety**

#### **Overview**

In this learning plan you will develop the knowledge needed to work safely in a shop environment. You will learn safety procedures, the location of safety equipment, and the safety features of various shop equipment. The instruction will cover general shop safety processes, fire safety, battery safety, lifting procedures, and health-related hazards.

#### **1. Apply proper safety procedures and processes.**

#### **Learning Activities**

- \_\_\_\_1. Complete a worksheet/assignment sheet.
  
- \_\_\_\_2. Collect a current article that relates to concepts and issues about which you are studying.
  
- \_\_\_\_3. Listen and observe a lecture covering safety procedures and practices - review a safety and hazards video.
  
- \_\_\_\_4. Operated hoist, floor jack (jack stands) and any equipment needed during assigned lab activities.
  
- \_\_\_\_5. Identify location of safety equipment, first aid kit, phone, fire blanket, fire extinguishers, exits, light switches, and vents.

#### **Assessment Activities**

- \_\_\_\_1. Participate in safety discussion.
  
- \_\_\_\_2. Complete activities in lesson.
  
- \_\_\_\_3. Complete written safety test.

## **Learning Plan**

### **Electrical/Electronic Vehicle Systems' Concerns**

#### **Overview**

To diagnose electrical/electronic vehicle systems' concerns.

- 2. Diagnose and repair various electrical / electronic vehicle system concerns using a strategy-based process. (NATEF VI A)**

#### **Learning Activities**

- \_\_\_\_ 1. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action. (P1 NATEF VI A7)
- \_\_\_\_ 2. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action. (P1 NATEF VI A8)
- \_\_\_\_ 3. Locate cause for static and or weak radio reception; determine necessary action. (P-3 NATEF VI H 6)
- \_\_\_\_ 4. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action. (P1 NATEF VI A9)

#### **Assessment Activities**

- \_\_\_\_ 1. Participate in discussion of the subject. Listen, take notes, and discuss material provided in lectures.
- \_\_\_\_ 2. Complete assignment and job sheet which meet NATEF learning activities. Complete assignment and job sheets related to voltage, current and resistance measurements using DVOM. Complete FORD computerized instructional activities related to voltage, voltage drop, and resistance, current and identifying electronic / electrical components.
- \_\_\_\_ 3. Complete written test related to electrical basic terms, theory, and basic measurement.

## **Learning Plan**

### **Automotive Battery Concerns**

#### **Overview**

To diagnose automotive battery concerns.

#### **3. Diagnose and repair various automotive battery concerns using a strategy-based process. (NATEF VI B)**

#### **Learning Activities**

- \_\_\_\_\_1. Perform system operational check to determine reason for radio static and weak or no reception. (P-3 NATEF VI 6)
  
- \_\_\_\_\_2. Check battery state-of-charge using hydrometer and open circuit voltage. (P1 NATEF VI B1)
  
- \_\_\_\_\_3. Check battery capacity to determine needed service. (P1 NATEF VI B2)
  
- \_\_\_\_\_4. Inspect, clean, fill, and replace battery. (P2 NATEF VI B4)
  
- \_\_\_\_\_5. Maintain electronic memory functions. (P-2 NATEF VI B 3)
  
- \_\_\_\_\_6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed. (P1 NATEF VI B6)
  
- \_\_\_\_\_7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications. (P1 NATEF VI B7)

#### **Assessment Activities**

- \_\_\_\_\_1. Participate in discussion of the subject. Listen, take notes, and discuss material provided in battery lecture.
  
- \_\_\_\_\_2. Complete assignment and job sheets sheet related to battery construction, operational theory

and testing. Assignment sheet battery ID types and construction. Job sheets related o cell testing, load testing, and battery maintenance.

\_\_\_\_\_3. Complete written test covering the automotive battery.

## Learning Plan

### Automotive Starting System Concerns

#### Overview

To diagnose automotive starting system concerns.

4. **Diagnose and repair various automotive starting system concerns using a strategy-based process. (NATEF VI C)**

#### Learning Activities

- \_\_\_\_ 1. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action. (P1 NATEF VI A3)
- \_\_\_\_ 2. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action. (P1 NATEF VI A5)
- \_\_\_\_ 3. Check electrical circuits using jumper wires; determine necessary action. (P2 NATEF VI A6)
- \_\_\_\_ 4. Check starter current draw to determine necessary action. (P1 NATEF VI C1)
- \_\_\_\_ 5. Check starter circuit voltage drop on positive and negative sides. (P1 NATEF VI C2)
- \_\_\_\_ 6. Inspect and test starter relays and solenoids. (P2 NATEF VI C3)
- \_\_\_\_ 7. Remove and install starter. (P2 NATEF VI C4)
- \_\_\_\_ 8. Perform starter bench tests to determine necessary action. (P3 NATEF VI C5)
- \_\_\_\_ 9. Inspect and test switches, connectors, and wires of starter control circuits. (P2 NATEF VI C6)

\_\_\_\_\_10. Disassemble, clean, inspect, and test starter components. (P3 NATEF VI C7)

**Assessment Activities**

\_\_\_\_\_1. Participate in discussion of the subject. Listen, take notes, and discuss material related to starting system's components ID and testing. Also, material related to charging system testing and failure diagnosis and repair.

\_\_\_\_\_2. Complete assignment and job sheets related to starting system and component testing and repair. Complete assignment sheet covering component ID, wiring ID, starter component repair, circuit wiring testing & repair. Perform items listed on job sheets related to starting system's components off vehicle testing and on vehicle testing / repair. Complete Ford computerized instructional module related to batteries and starting system testing and repair.

\_\_\_\_\_3. Complete written test covering starting system.

## Learning Plan

### Automotive Charging System Concerns

#### Overview

To diagnose automotive charging system concerns.

5. **Diagnose and repair various automotive charging system concerns using a strategy-based process. (NATEF VI D)**

#### Learning Activities

- \_\_\_\_ 1. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action. (P1 NATEF VI A3)
- \_\_\_\_ 2. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action. (P1 NATEF VI A5)
- \_\_\_\_ 3. Check electrical circuits using jumper wires; determine necessary action. (P2 NATEF VI A6)
- \_\_\_\_ 4. Check charging system output test to determine necessary action. (P1 NATEF VI D1)
- \_\_\_\_ 5. Inspect charging system for the cause of undercharge, no-charge, and overcharge conditions. (P1 NATEF VI D2)
- \_\_\_\_ 6. Inspect condition and adjust generator (alternator) drive belts. (P1 NATEF VI D3)
- \_\_\_\_ 7. Inspect and test voltage regulator/regulating circuit. (P2 NATEF VI D4)
- \_\_\_\_ 8. Remove, inspect, and install generator (alternator). (P2 NATEF VI D5)
- \_\_\_\_ 9. Disassemble generator (alternator), clean, inspect, and test components. (P3 NATEF VI D6)

\_\_\_\_10. Check charging circuit voltage drop on positive and ground sides. (P1 NATEF VI D7)

***Assessment Activities***

\_\_\_\_1. Participate in discussion of the subject. Listen, take notes, and discuss material related to charging systems components ID and testing. Also, material related to charging system testing and failure diagnosis and repair. Participate in discussion of the subject.

\_\_\_\_2. Complete assignment and job sheets related to charging system and component testing and repair. Complete assignment sheet covering component ID, wiring ID, AC generator component repair, field circuit testing & repair. Perform items listed on job sheets related to charging system's components off vehicle testing and on vehicle testing / repair. Complete Ford computerized instructional module related to batteries and charging systems testing and repair.

\_\_\_\_3. Complete written test covering charging system.

## **Learning Plan**

### **Supplemental Restraint System (SRS)**

#### ***Overview***

To diagnose supplemental restraint system (SRS) concerns.

- 6. Diagnose and repair supplemental restraint system (SRS) hard code concern using recommended manufacturer techniques. (NATEF VI H 5)**

#### ***Learning Activities***

\_\_\_\_1. Pull SRS code using proper techniques. (P2 NATEF VI H5)

\_\_\_\_2. Remove and reinstall driver's air bag assembly using manufacturer's guidelines.

\_\_\_\_3. Review safety presentations list in SRS service material.

#### ***Assessment Activities***

\_\_\_\_1. Participate in discussion of the subject. Listen, take notes, watch AV presentation, and discuss SRS components, operation, and safety guidelines.

\_\_\_\_2. Complete all activities associated with this topic. Identify SRS related hard code and repair fault, remove and replace air bag assembly.

\_\_\_\_3. Complete written quiz covering SRS safety procedures, operation, and component ID.

## **Learning Plan**

### **Electrical Repairs**

#### **Overview**

To perform industry standard electrical repairs.

#### **7. Perform industry standard electrical repairs on various automotive electrical systems.**

#### **Learning Activities**

- \_\_\_\_ 1. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action. (P1 NATEF VI A10)
  
- \_\_\_\_ 2. Repair wiring harnesses and connectors. (P1 NATEF VI A11)
  
- \_\_\_\_ 3. Perform solder repair of electrical wiring. (P1 NATEF VI A12)

#### **Assessment Activities**

- \_\_\_\_ 1. Participate in discussion of the subject. Watch and discuss proper wire repair techniques; review techniques listed in MFG. reference material.
  
- \_\_\_\_ 2. Complete all activities associated with this topic. Complete job sheet related to soldering, splicing, connector replacement / repair, using heat shrink and crimping connecting.
  
- \_\_\_\_ 3. Complete hands-on quiz related to wire repair.