I. INTRODUCTION

A. An overview of automotive electrical systems including topics in operational theory, testing, diagnosis and repair of batteries, charging and starting, and electrical accessories. Emphasis on electrical schematic diagrams and service manuals.

B. Automotive Electrical Systems (AUMT 1407) is a required course for the completion of a two year Associate of Applied Science degree in Automotive Mechanic/Technician or a Level I or Level II certificate of completion in the Automotive Technician Program.

C. This course is occupationally related and serves as a preparation for a career in the Automotive Service and Repair field.

D. Prerequisites: This course has a prerequisite of AUMT 1405 and 2305 or consent of the Dept. Chair.

E. Alphanumeric coding used throughout this module book denotes integration of SCANS occupational competencies (C1, etc.) and Foundation skills (F1, etc.).

II. LEARNING OUTCOMES

Upon successful completion of this course, Automotive Electrical Systems, the student will:

A. Utilize appropriate safety procedures, the student will interpret wiring schematics and symbols. (C5, 6, 7, 15, 18, 19) (F1, 6, 9, 10, 16)

B. Explain electrical principles. (C5, 6, 7, 18, 19) (F1, 2, 5, 6, 9, 10)

C. Explain the theory and principles of batteries, starting and charging systems, ignition systems and automotive electrical accessories. (C7) (F6)

D. Demonstrate diagnosis and repair of batteries, starting and charging systems, ignition systems and automotive electrical accessories. (C7, 18, 19, 20) (F6)

E. Demonstrate proper use of electrical test equipment. (C7, 9, 18, 19, 20)

F. Describe common automotive circuits. (C7) (F6)

G. Perform common wiring repairs. (C18, 19)

H. Use service publications. (F1) (C7)
I. Explain the basic operation of electric vehicles. (C7) (F6)

J. Describe the typical operation of a hybrid vehicle. (C7) (F6)

K. Explain the difference between parallel and series hybrids. (C7) (F6)

L. Obtain computer controlled generated trouble codes and refer to proper troubleshooting charts in repair manuals, also make repairs as indicated. (C18, 19)

M. Teach others to perform a task. (C10)

III. INSTRUCTIONAL MATERIALS

A. Instructional materials for this course may be found at www.ctcd.edu/books

B. Supplemental Reading: As assigned by the instructor.

C. Audio-visual aids: See resource list at end of this module book.

D. Other instructional material: as selected by the instructor.

IV. COURSE REQUIREMENTS

A. This course is being taught in a self-paced mode. It differs from the traditional college course in that you are allowed to work on your own and at your own speed within limitation. This course is 144 clock hours in length. The student may set his/her own schedule within the time frame the course is offered. You must attend class on the days and at the times you selected when you enrolled in the course.

You will have an assigned instructor. If at any time you do not understand a reading assignment, audio visual presentation or lab work, ask your instructor for assistance. He is there for you!

This module book is designed to inform you of the sequence in which this course will be presented. You must follow this sequence and you must do what the module book says. It contains reading assignments, written assignments, audio visual presentations and lab assignments that you must complete or watch. Written assignments will be turned in as directed by the instructor. Late assignments will not be accepted. You must let your instructor know when you are ready to do a learning activity, performance exam or take a scheduled exam.

B. The student must take notes when viewing filmstrips, slides, or videos. Exams may be taken from audio visual aids, reading and lab assignments. If instructor notes or handouts are given to you, you must study them, exams may be taken from these notes also.

C. The instructor may give written assignments or “pop” quizzes as he deems necessary.

D. Performance Exams:
Each student will clean all tools and equipment that they use and properly store them and clean their work area after the completion of each task.

**Certificate Students**: All lab work will be completed on an individual basis. The student will receive a “pass” or “fail” on the task. Students who fail to complete a task correctly to industry standards must repeat the task. The instructor will date and initial each performance exam task as it is satisfactorily completed. **NOTE**: Students who have selected the alpha-numeric grading system will be graded as outlined for degree students (see below).

**Degree Students**: Laboratory tasks (performance exam) will be completed on an individual basis except when limited by tools and/or materials. **Each performance exam is worth a maximum of 5.9 points**. The maximum lab grade is 100 points. The instructor will deduct points from each lab task score for failure to follow safety precautions and/or a failure to complete the project to industry standards. The instructor will date, initial, and post the points earned for each performance exam as it is completed.

E. The following is part of the course requirements: Each student will assist in lab clean-up at the close of the evening classes and will assist in unloading and storing supply shipments. Failure to do so will result in a failure to complete all course requirements and the student could receive a “F” or “N” for the course.

F. There will be eight (8) written examinations in this course (7 module/unit exams and an exit exam). **Written exams must be completed before taking the performance exam for each module**. The exit exam is a comprehensive exam that covers the entire course. Certificate students must score 70% on the exit exam. Certificate students will be allowed to take the exit exam a maximum of three (3) times. Failure to achieve a 70% score on the exit exam in three (3) tries will result in an "N" for the course and the student must retake the course. **Degree Students should refer to the "grading" section of this outline for guidance**.

G. The student must complete the written assignments to receive a grade. **Written assignments for each unit will be turned into the instructor prior to starting performance exams for that module**. Degree students must complete reading and written assignments at home.

H. If you have special needs because of learning disabilities or other kinds of disabilities, please feel free to discuss this with the instructor. The instructor will attempt to meet your needs with the assistance of counselors, tutors (Project Mainstream), and the assistance of the Disabilities Services Office. Program/course integrity will not be sacrificed. Students must meet all course requirements.

**GRADING**

**Certificate Students**: Students will be graded using the standard Skills Center "Pass-Fail" system used for self-paced programs. To satisfactorily complete the written exams, the student must score 80% on tests (except the exit exam, 70%). Students who fail to make the 80% on any exam (except the exit exam) must retake the exam. The current test re-take policy will apply to all
certificate students. The student must satisfactorily complete all written and performance exams to receive a passing grade ("P").

**Degree Students:** Students will be graded using an "alpha-numeric" system as outlined below. Grades made on performance and written exams will be the grade received, including the exit exam. **Students will not be allowed to retake written exams or redo performance exams.**

A. **Written exams:** Average of written exams will count 40% of the final grade.

B. **Completion of written assignments/activities** will count 10% of the student’s final grade.

C. **Performance Exams (Lab work)** will count 50% of the final grade.

D. **Grade Computations:** (Example)

   **Written Exam Scores:** (There will be 7 written exams)
   
<table>
<thead>
<tr>
<th>Exam</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>90</td>
</tr>
<tr>
<td>Exam 2</td>
<td>80</td>
</tr>
<tr>
<td>Exam 3</td>
<td>70</td>
</tr>
</tbody>
</table>

   240 divided by 3 = 80 (Average Written Exams)

   - **Written Exam Score Average:** 80 x 40% = 32 points
   - **Written Assignments:** 100 x 10% = 10 points
   - **Performance Exam Score:** 80 x 50% = 40 points

   **Total =** 82 points = B

V. **NOTES AND ADDITIONAL INSTRUCTIONS FROM THE COURSE INSTRUCTOR**

A. **Course Withdrawal:** It is the student’s responsibility to officially withdraw from a course if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file a Central Texas College Application for Withdrawal (CTC Form 59). The withdrawal form must be signed by the student.

   CTC Form 59 will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is:

   - **10-week session:** Friday of the 8th week
   - **8-week session:** Friday of the 6th week
   - **5-week session:** Friday of the 4th week

   The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

   A student who officially withdraws will be awarded the grade of “W” provided the student’s attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the College before they may be considered for withdrawal.
A student may not withdraw from a class for which the instructor has previously issued the student a grade of “F”, “N”, “FN”, or “XN” for nonattendance.

B. **Administrative Withdrawal**: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on CTC Form 59 for submission to the registrar.

C. **Incomplete Grade**: The College catalog states, “An incomplete grade may be given in those cases where the student has completed the majority of the coursework but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course. . .” Prior approval from the instructor is required before the grade of “I” for Incomplete is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an “F” for the course.

D. **Cellular Phones and Beepers**: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

E. **American’s With Disabilities Act (ADA)**: Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

F. **Instructor Discretion**: The instructor reserves the right of final decision in course requirements.

G. **Civility**: Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

H. Absence from the class may be unavoidable in some situations. These include illness, military/civilian job requirements, or a death in the immediate family. Documentation is required in the case of excused absences for job requirements. Excuses will be on company letterhead stationary signed by the immediate supervisor stating the reason for the absence for civilian jobs. Excuses for military personnel must be signed by the 1st Sergeant or the Company Commander. **NOTE**: This does not apply to VA, VA/Voc, or Financial Aid students. There are no excused absences for these students. Talk to your funding agency if you have questions.

Disability Support Services provides services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Review the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.
VI. **FIRST CLASS MEETING**

A. The instructor will introduce the course and show the student the textbook.

B. The instructor will verify the class roster/enrollment form:
   1. Call roll
   2. Have each student verify the spelling of his/her name and the social security number by initialing the class roster/enrollment form.
   
   **NOTE:** When a student’s name does not appear on the degree program class roster, they must bring it to the attention of the instructor and must present the instructor with CTC Form 29 (Add/Drop Slip) reflecting that he/she has properly registered for the course.

C. The instructor will have the student read and sign the course requirements sheet.

D. The instructor will discuss the following topics with the student:
   1. Course requirements, objectives and how the course works
   2. Policy letters
   3. Student handouts
   4. Lab sheet and lab work (Learning activities, Performance exams, competency profile)
   5. Exam, grading, reading and written assignments.
   6. Absences
   7. Shop/classroom cleanup–tools
   8. Dress code
   9. Parking
   10. Sign-in computer
   11. Course outline/fact sheets/student handouts
   12. Hazardous communications/MSDS information
   13. Shop safety
COURSE OUTLINE OR SEQUENCE:

I. Module 1407-01: Safety, Basic Electrical Theories and Introduction To Automotive Electrical and Electronic Systems

A. Time:
Certificate Students  24 Clock Hours
Degree Students      2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Explain electrical principles. (F1, 2, 5, 6, 8, 9, 10) (C5, 6, 7, 15, 18, 19)
2. Demonstrate a knowledge of electrical safety. (C5, 7) (F1, 6, 8, 9, 10, 16)

C. Study the Glossary in Resource 004A (Classroom Manual) to learn electrical terminology.

D. Read Chapters 1 and 2 in Resource 004A (Classroom Manual) and answer the review questions at the end of each chapter and turn the written assignment into the instructor.

E. Read Chapter 1 and 2 in Resource 004B (Shop Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

F. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

G. View Audio Visuals: (See your instructor)
2. "Electricity for Auto Technicians", 5 parts, Bergwall #DA26 (CD ROM) (Resource 1407-01)
3. “Multimeters Explained”, 3 parts, Bergwall #DE10 (CD ROM) (Resource 1407-14)

H. See your instructor and ask him to explain any part of the audio visuals that you do not understand.

I. See your instructor and complete the following exercises on the Nida trainer:
The instructor must check your work.
1. 1407-01
   a. Introduction to CAI
   b. Introduction to Automotive Electricity
   c. Metric Notation
   d. Voltage, Current, Resistance
   e. Ohm’s Law
   f. Series, Parallel, Series-Parallel Circuits
   g. Voltage Divider Circuits
   h. Introduction to Multimeters
   i. Multimeters Uses
   j. Voltage Measurement
   k. Current Measurement
   l. Resistance Measurement
m. Into to Oscilloscope

J. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.

K. Refer to the Laboratory Learning Activities in this module book and complete the learning activities for this module. (See your instructor)

L. Review for Module 1407-01 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

M. Module 1407-01 Written Exam: (See your instructor)

N. Critique Module 1407-01 Written Exam: (See your instructor)

O. Performance Exam Module 1407-01: Refer to the Laboratory Learning Activities in this module book and complete the Performance exam for this module (See your instructor)

P. Certificate students should complete this module by the end of the 24th clock hour. Degree students should complete this module by the end of the 2nd.

A. Time:
- Certificate student: 26 Clock Hours
- Degree Student: 3 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Interpret and use wiring schematics and symbols. (F1, 6, 9, 10) (C7, 18, 19)
2. Properly use electrical test equipment. (C7, 9, 18, 19, 20)
3. Use service publications. (F1) (C7)
4. Describe common automotive circuits. (C7) (F6)
5. Perform common wiring repairs. (C18, 19)

C. Read Chapters 3 and 4 in Resource 004A (Classroom Manual) and answer the review questions at the end of each chapter and turn the written assignment into your instructor.

D. Read Chapters 3 and 4 in Resource 004B (Shop Manual) and answer the review questions at the end of each chapter and turn the written assignment into your instructor.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor).

1. "The Electrical System", Vocational Media Associates #31374 (Resource 1407-05)
2. "Wiring of the Future-Multiplexing", Standard #AF5733 (Resource 069)

Review the following audio visuals as you deem necessary.

1. "Electricity for Auto Technicians” 5 parts, Bergwall #DA26 (Resource 1407-01). (The portion that pertains to wiring and test equipment - review as needed).
2. "Soldering Tools and Techniques" (Resource 013)

G. See your instructor and ask him to furnish you a vehicle that you can look at the electrical systems on. Ask him to explain any part of the systems that you do not understand.

H. See your instructor and ask him to show you the electrical test equipment and wiring repair tools and equipment that you will use in this course. Ask him to demonstrate the proper use of the tools and equipment that you do not know how to use.

I. Ask your instructor for a service manual that contains electrical circuits and diagrams for the vehicle that he assigned you. Practice tracing several diagrams. Locate the system and components on the diagrams on the vehicle. See your instructor if you need help.
J. See your instructor and complete the following exercises on the Nida trainer:
   The instructor must check your work.
   1. 1407-02
      a. Relay Operation
      b. Magnetism Relays Meters
      c. Basic Soldering Techniques
      d. Basic Connector Terminator Techniques
      e. Basic Wiring Wrapping Techniques
      f. Basic Wiring and Connector (TS) Theory
      g. Wiring Trouble Shooting
      h. Wiring and Connector (BT)

K. Ask your instructor if there is anything else that you should read or see that pertains to this module.

L. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

M. Review for Module 1407-02 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

N. Module 1407-02 Written Exam: (See your instructor)

O. Critique Module 1407-02 Written Exam: (See your instructor)

P. Performance Exam 1407-02: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

Q. Certificate students should complete this module by the end of the 50th clock hour. Degree students should complete this module by the end of the 5th week.

III. Module 1407-03: Batteries

A. Time:
   Certificate Student  16 Clock Hours
   Degree Student  2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Explain the theory of batteries. (C7) (F6)
   2. Demonstrate diagnosis and repair of batteries (C7, 18, 19, 20) (F6)
   3. Use electrical test equipment. (C7, 9, 18, 19, 20)

C. Read Chapter 5 in Resource 004A (Classroom Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.
D. Read Chapter 5 in Resource 004B (Shop Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor.)
   1. "Understanding and Testing Batteries", Interstate Battery (Video) (Resource 1407-03)
   2. "Troubleshooting Ignition-Off Battery Drain", Interstate Battery (Video) (Resource 1407-04)
   3. "Troubleshooting Voltage Drops", Interstate Battery (Video) (Resource 1407-05)

G. See your instructor and ask him to explain any part of the audio visuals that you do not understand.

H. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.

I. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

J. Review for Module 1407-03 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

K. Module 1407-03 Written Exam: (See your instructor)

L. Critique Module 1407-03 Written Exam: (See your instructor)

M. Performance Exam 1407-03: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

N. Certificate students should complete this module by the end of the 66th clock hour. Degree students should complete this module by the end of the 7th week.

V. Module 1407-04: Starting Systems

A. Time:
   Certificate students 18 Clock Hours
   Degree students 2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Locate and identify the components of the starting system. (C7) (F6)
2. Demonstrate diagnosis and repair of starting systems. (C7, 18, 19, 20) (F6)
3. Use electrical test equipment. (C7, 9, 18, 19, 20)
4. Explain the theory and principles of starting systems. (C7) (F6)

C. Read Chapter 6 in Resource 004A (Classroom Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

D. Read Chapter 6 in Resource 004B (Shop Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor)
   1. "Starting System Explained", Bergwall #29 (5 videos) (Resource 1407-09)
   2. "Troubleshooting the Starting System", Interstate Battery (video) (Resource 1407-10)

G. See your instructor and ask him to furnish you a vehicle that you can use to locate the starting system on. Ask him to explain any part of the system that you do not understand.

H. See your instructor and complete the following exercises on the Nida trainer. The instructor must check your work.
   1. 1407-05
      a. Relay Operation
      b. Starting Systems

I. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.

J. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

K. Review for Module 1407-05 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

L. Module 1407-05 Written Exam: (See your instructor)

M. Critique Module 1407-05 Written Exam: (See your instructor)

N. Performance Exam Module 1407-05: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

O. Certificate students should complete this module by the end of the 84th clock hour. Degree students should complete this module by the end of the 9th clock hour.

AUMT1407 13
VI. Module 1407-05: Charging Systems

A. Time:
   Certificate student  18 Clock Hours
   Degree student 2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Locate and identify the components of the charging system. (C7) (F6)
   2. Demonstrate diagnosis and repair of charging systems. (C7, 18, 19, 20) (F6)
   3. Use electrical test equipment. (C7, 9, 18, 19, 20)
   4. Explain the theory and principles of charging systems. (C7) (F6)

C. Read Chapter 7 in Resource 004A (Classroom Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

D. Read Chapter 7 in Resource 004B (Shop Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor)
   1. "Charging System Explained", Bergwall #A34 (5 videos) (Resource 1407-07)
   2. "Troubleshooting The Charging System", Interstate Battery (video) (Resource 1407-08)

G. See your instructor and ask him to furnish you a vehicle that you can use to locate the charging system on. Ask him to explain any part of the system that you do not understand.

H. See your instructor and complete the following exercises on the Nida trainer. The instructor must check your work.
   1. 1407-06
      a. Charging and Ignition
      b. Charging Systems

I. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.

J. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

K. Review for Module 1407-06 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

L. Module 1407-06 Written Exam: (See your instructor)

M. Critique Module 1407-06 Written Exam: (See your instructor)
N. Performance Exam Module 1407-06: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

O. Certificate students should complete this module by the end of the 102th clock hour. Degree students should complete this module by the end of the 11th week.

IV. Module 1407-06: Lighting and Accessory Systems

A. Time:
   Certificate Students    18 Clock Hours
   Degree Students         2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Explain the theory of lighting and accessory systems. (C7) (F6)
   2. Demonstrate diagnosis and repair lighting and accessory systems. (C7, 18, 19, 20) (F6)
   3. Demonstrate the proper use of electrical test equipment. (C7, 9, 18, 19) (F6)

C. Read Chapters 8 in Resource 004A (Classroom Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

D. Read Chapters 8 in Resource 004B (Shop Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor.)
   1. "Troubleshooting The Electrical System", Bergwall #A36 (5 Videos) (Resource 1407-06)

G. See your instructor and ask him to explain any part of the audio visuals that you do not understand.

H. See your instructor and complete the following exercises on the Nida Trainer. The instructor must check your work.
   1. 1407-04
      a. Intro to the Automobile
      b. Electrical Systems
      c. Turn Signal Systems
      d. Engine Cooling and Climate

I. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.
J. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

K. Review for Module 1407-06 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

L. Module 1407-06 Written Exam: (See your instructor)

M. Critique Module 1407-06 Written Exam: (See your instructor)

N. Performance Exam 1407-06: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

O. Certificate students should complete this module by the end of the 118th clock hour. Degree students should complete this module by the end of the 13th week.

VII. Module 1407-07: Hybrid Vehicles and Alternative Power Sources

A. Time:
  Certificate student 16 Clock Hours
  Degree student 2 Weeks

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Explain the basic operation of electric vehicles. (C7) (F6)
2. Describe the typical operation of a hybrid vehicle. (C7) (F6)
3. Explain the difference between parallel and series hybrids. (C7, 18, 19, 20)
4. Describe the purpose of regenerative braking. (C7, 9, 18, 19, 20)
5. Describe the purpose of the 42-volt system. (C7) (F6)
6. List and describe the different fuels that can be used in a fuel cell system. (C7) (F6)
7. Teach others to perform a task. (C10)

C. Read Chapter 16 in Resource 004A (Classroom Manual) and answer the review questions at the end of the chapter and turn the written assignment into the instructor.

D. Read Chapter 16 in Resource 004B (Classroom Manual) and answer the review questions at the end of the chapter and turn in the written assignment into the instructor. E. See your instructor and ask him to explain any part of the reading assignment that you do not understand.

F. View Audio Visuals: (See your instructor)

G. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)
H. See your instructor and ask him if there is anything else that you should read or see that pertains to this module.

I. Review for Module 1407-07 Written Exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

J. Module 1407-07 Written Exam: (See your instructor)

K. Critique Module 1407-07 Written Exam: (See your instructor)

L. Performance Exam Module 1407-07: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

M. Certificate students should complete this module by the end of the 138th clock hour. Degree students should complete this module by the end of the 15th week.

VIII. Module 1407-08: Exit Exam

A. Time:
   Certificate students: 6 Clock Hours
   Degree students: 1 Week

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Use basic thinking skills and demonstrate personal qualities and work practices used in the work place.
2. Complete the Exit Exam.

C. Review for Exit Exam: Review all previous assignments.

D. See your instructor and ask him to explain anything that you do not understand about electronics fundamentals.

E. Module 1407-08 Written (Exit) Exam: (See your instructor) You must complete this exam by the end of the 16th week.

F. Critique Module 1407-08 Written (Exit) Exam: (See your instructor)

G. There is no performance exam for this module.

H. End of Course Critique and enrollment in the next course in the program. (See your instructor)