

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO



COURSE OUTLINE

COURSE TITLE: Electrical/Electronic and Emissions Systems

CODE NO. : AST713 **LEVEL:** TWO

PROGRAM: Automotive Service Technician
Apprenticeship – Level 2

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APPROVED: *“Corey Meunier”*
CHAIR **DATE**

TOTAL CREDITS: TWELVE

PREREQUISITE(S): Automotive Service Technician – Level 1

HOURS/WEEK:

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I. COURSE DESCRIPTION:

During the course, students will use circuit calculations to verify Ohm's, Watts and Kirchhoff's Laws with a selection of meters. The apprentice will cover the purpose, construction and principles of operation for diagnostic test equipment, cranking systems, factors effecting cranking system operations and perform testing and diagnostics procedures. They will also cover the construction, principles of operation, inspection and testing of electronic devices; ignition fundamentals; charging systems and control units; electronic-controlled fuel injection systems and emission control systems.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. *Perform Electrical Circuit Calculations***Potential Elements of the Performance:**

Explain the characteristics of electrical circuits.

- series circuits
- parallel circuits
- series – parallel circuits

Perform circuit calculations using Ohms' & Watts' Law.

- series circuits
- parallel circuits
- series – parallel circuits

Measure voltage, amperage and resistance.

- circuit board exercises
- simulated electrical circuits
- vehicle electrical circuits
- compare calculated and measured circuit performance

2. *Operate Diagnostic Test Equipment***Potential Elements of the Performance:**

Explain the purpose and principles of operation of diagnostic test equipment.

- pressure gauges
- vacuum gauges
- compression tester
- hand-held scan tools
- oscilloscopes
- smoke generators
- leak down tester
- pressure transducers

Perform diagnostic tests using the following equipment:

- pressure gauges
- vacuum gauges
- compression tester
- hand-held scan tools
- oscilloscopes
- smoke generators
- leak down tester
- pressure transducers

3. Cranking Systems and Control Circuits

Potential Elements of the Performance:

Explain the purpose and fundamentals of cranking systems.

- cranking motors
- control circuits
- torque, load and cranking speed relationship

Explain the construction, types, styles and principles of operation of cranking motor circuits.

- starter control circuits
 - relay controlled cranking circuits
 - neutral switch
- starter solenoid
- cranking motors
 - gear reduction
 - permanent magnet field type
 - wire wound field type
- cranking motor drives

Disassemble and re-assemble cranking motors.

- inspect and test major components of cranking motors
 - armature for shorts, opens, ground, alignment
 - field coils for shorts, opens, ground
 - identify type of winding
 - pole shoes
 - bushings and bearings
 - brushes and springs

4. Cranking System Diagnostics and TestingPotential Elements of the Performance:

Explain the factors affecting engine cranking system performance.

- ambient temperature
- battery conditions and ratings
- engine mechanical loads
- charging system operation
- oxidation and corrosion of connections
- cable sizes and condition
- engine fuel and ignition system condition
- excessive cranking time and overheating

Perform inspection, testing, and diagnostic procedures on cranking motor circuits.

- Analyze the results.
 - cranking system visual inspection
 - battery load test and verify capacity and performance to application
 - cranking circuit voltage drop tests
 - cranking system current draw test
 - perform ring gear tooth inspection
 - slow cranking
 - no cranking

5. Electronic FundamentalsPotential Elements of the Performance:

Explain the construction, composition, types, principles of operation, and applications of electronic devices.

- diodes
 - forward and reverse bias
 - current control
- transistors
 - switching
 - gain
- capacitors
- sensors
 - permanent magnet pulse generators
 - piezoelectric
 - galvanic
 - hall effect
 - optical

- variable resistors
 - rheostat
 - thermistors
 - potentiometers
 - piezoresistive

Perform inspection and testing procedures for electronic devices.

- diodes
 - forward and reverse bias
 - LED
 - rectifying / zener
 - light emitting
 - photo
- capacitors
- sensors
 - permanent magnet pulse generators
 - piezoelectric
 - galvanic
 - hall effect
 - optical
- variable resistors
 - rheostat
 - thermistors
 - potentiometers
 - piezoresistive

6. ***Electronic Ignition Fundamentals***

Potential Elements of the Performance:

Explain the purpose and fundamentals of electronic ignition systems and controls.

- electronic ignition systems
- computer-controlled timing
- distributorless ignition
- coil over plug
- factors that affect ignition timing
 - engine speed
 - engine load
 - engine temperature
 - input sensors

Explain the construction, types, styles, operation and application of electronic ignition systems devices.

- ignition coils
 - primary windings
 - secondary windings
- distributors
 - magnetic pulse generator
 - hall Effect device
 - optical device
- secondary voltage circuit
 - high tension spark plug wires
 - spark plugs
 - distributor cap and rotor
- modules
- sensors

Inspect, test and diagnose electronic ignition systems devices.

- identify and locate electronic ignition system components on various vehicles
 - distributor components
 - coils, modules
 - sensors
- check and test ignition timing operation using a scan tool
- diagnose electronic ignition system components
 - high tension wires
 - spark plugs
 - distributor cap and rotor

7. *Charging Systems and Control Circuits*

Potential Elements of the Performance:

Explain the purpose and fundamentals of charging systems and control circuits.

- alternators
- voltage regulation
- electromagnetic induction principles
- factors affecting alternator output
 - battery condition and temperature
 - circuit condition
 - engine speed
 - electrical loads

Explain the construction, types, principles of operation and application of charging systems and voltage regulations.

- alternators
 - rectifier & diodes
 - stator
 - rotor
 - field winding, poles, slip rings
 - brush assemblies
 - bearings
 - pulleys
 - cooling fans
 - idlers and tensioners
- clutch pulleys / damper
- voltage regulator

Inspect, test and diagnose alternator and voltage regulation systems.

- perform charging system visual inspection
 - belt tension and alignment
 - connections and wiring
- perform charging system current and voltage output tests
- disassemble, test and re-assemble alternator
 - rotor field tests
 - rectifier diodes
 - stator

8. Gasoline Fuel Injection Fundamentals

Potential Elements of the Performance:

Explain the purpose and fundamentals of gasoline fuel injection systems.

- port injection
- throttle body injection
- direct injection

Explain the construction, types, styles, operation and application of gasoline fuel injection and delivery systems.

- fuel tanks, lines and fittings
- filters and pumps
- injectors
- pressure regulators
- electronic control units
- returnless fuel systems

Inspect and test fuel injection systems.

- perform fuel pump tests
 - pressure
- visual inspection
 - leaks

9. ***Emission Control System***

Potential Elements of the Performance:

Explain the principles of operation of emission control systems.

- exhaust gas re-circulation systems
 - vacuum controlled
 - electronic controlled
- positive crankcase ventilation
- evaporative emissions systems
 - carbon canister
 - computer controlled fuel evaporative emission solenoids
- air injection systems
 - air pumps
 - air switching valves
- catalytic converters
 - three-way
- sensors / actuators

Inspect and test emission control systems.

- exhaust gas re-circulation systems
- positive crankcase ventilation
- evaporative emission systems
- air injection systems
- catalytic converters

III. **TOPICS:**

1. Electrical Circuit Calculations
2. Diagnostic Test Equipment
3. Cranking Systems and Control Circuits
4. Cranking System Diagnostics and Testing
5. Electronic Fundamentals
6. Electronic Ignition Fundamentals
7. Charging Systems and Control Circuits
8. Gasoline Fuel Injection Fundamentals
9. Emission Control Systems

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:**Title:** Automotive Technology: A Systems Approach**Edition:** 06 ed., 17810#**Author:** Erjavec**V. EVALUATION PROCESS/GRADING SYSTEM:**

Evaluation is broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

<u>Theory Testing</u>	<u>Practical Application Testing</u>
70%	30%

The following semester grades will be assigned to students:

Grade	<u>Definition</u>	<i>Grade Point Equivalent</i>
A+	90 – 100%	4.00
A	80 – 89%	3.00
B	70 - 79%	2.00
C	60 - 69%	1.00
D	50 – 59%	0.00
F (Fail)	49% and below	
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

VI. SPECIAL NOTES:**Attendance:**

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

It is the departmental policy that once the classroom door has been closed, the learning process has begun. Late arrivers will not be granted admission to the room.

Safety:**Eye, Face and Foot Personal Protection Equipment (PPE)**

Students are required to wear appropriate Personal Protection Equipment (PPE) in designated areas at all times. The designated areas for eye and foot protection in the Motive Power areas are: C1073 (Automotive), C1000, C1010, and C1040 (Truck/Coach and Heavy Equipment) and C1120 (Marine and Small Engines). Appropriate PPE must also be worn when facing hazards outside of these designated areas.

Eye Protection:

All protective eye wear shall meet the requirements of:

C.S.A. - Z94.3 or A.N.S.I. - Z87.1 +.

Approved safety glasses (lens and frames) shall have side protection such as wrap around design or fixed side shields.

The minimum acceptable eye protection is a spectacle (class 1A on chart Z94.3). Dark tinted spectacles will not be accepted for general indoor use. Additional eye and face protection is required for specific hazards. Chart Z94.3 outlines the appropriate PPE for specific hazards.

Foot Protection:

- 1. Boot height- minimum 5 ½" uppers, measured from the top of the sole.**
- 2. CSA Green Patch rating.**

Safety boots must be properly laced and not be worn or damaged as to impair their effectiveness.

Food and drink are not permitted in C1070**VII. COURSE OUTLINE ADDENDUM:**

The provisions contained in the addendum located on the portal form part of this course outline.