



**Format CO  
COURSE OUTLINE**

**ELECTRONIC ENGINE MANAGEMENT**

Course Title

**AM214**

Dept. & Course No.

**I COURSE DESCRIPTION**

This course covers the knowledge, skills and attitude required to service and repair electronic controlled fuel injection system and their associated components for both diesel and gasoline engine. And it also includes reading and interpreting engine electrical circuit diagram and troubleshooting engine sensors, actuators, and PCM circuit problems.

**II SEMESTER CREDITS: 3**

**III CONTACT HOURS PER WEEK:**

2

Lecture

3

Laboratory

5

Total

**IV PREREQUISITE: AM112, AM113, and AM125**

**V STUDENTS LEARNING OUTCOMES**

Upon completion of this course the student will be able, with 65% level of accuracy, to:

- 1.) Name Electronic Fuel Injection (EFI) fuel system and explain their functions as per manual specification.
- 2.) Explain the operating principle of electronic fuel injection (EFI) system.

**VI. COURSE CONTENT**

- A. EFI system parts and components and their functions.
  1. Fuel pump assembly
  2. Fuel injectors
  3. Fuel lines and filters
  4. Fuel accumulator
  5. Fuel pressure relief valve
- B. Operating principle of EFI system
  1. Fuel injectors operating principle
  2. Fuel injector spray pattern
  3. Fuel rail
  4. Fuel pressure relieve valve
  5. Accumulator
  6. Types of fuel pump
  7. Operating principles of fuel pump assembly
  8. Types of Fuel lines
  9. Fuel filter
  10. Fuel pressure specifications

- 3.) Check EFI fuel system in a correct procedure.
  - 4.) Name engine sensors and explain their functions as per manual specification.
  - 5.) Explain engine sensors operating principle.
  - 6.) Check engine sensors circuitry in a correct procedure.
  - 7.) Check engine sensors for functionality and rationality in a correct procedure.
- D. EFI fuel system functionality, rationality, and circuitry
    1. Fuel pump assembly
    2. Fuel injectors
    3. Fuel lines and filters
    4. Fuel accumulator
    5. Fuel pressure relief valve
  - E. EFI sensors and their functions
    1. Mass air flow
    2. MAP sensor
    3. Throttle position sensor
    4. Oxygen sensors
    5. Engine speed sensors
    6. Knock sensor
    7. Engine coolant temperature
    8. Idle speed control
    9. Exhaust gas recirculation
  - F. Engine sensors operating principle
    1. Reference voltage
    2. Signal voltage
    3. Ground
    4. Return voltage
    5. Types of sensors
      - \* Active sensors
      - \* Passive sensors
  - G. Engine sensor circuitry
    1. Throttle positioner sensor circuitry
    2. Mass air-flow circuitry
    3. Air temperature sensor circuitry
    4. Manifold absolute pressure circuitry
    5. Engine coolant temperature circuitry
    6. Knock sensor circuitry
    7. Crankshaft sensor circuitry
    8. Camshaft sensor circuitry
    9. Air-con sensor circuitry
    10. Oxygen sensor
    11. Power steering load
  - H. Engine sensor functionality and rationality
    1. Throttle positioner sensor functionality and rationality.
    2. Mass air-flow functionality and rationality.
    3. Air temperature sensor functionality and circuitry.
    4. Manifold absolute pressure

- 5. Engine coolant temperature functionality and circuitry.
    - 6. Knock sensor functionality and rationality.
    - 7. Crankshaft sensor functionality and rationality.
    - 8. Camshaft sensor functionality and rationality.
  - 8.) Name engine actuators and explain their functions as per repair manual specifications.
  - 9.) Check engine actuator circuitry in a correct procedure.
  - 10.) Check engine actuator functionality and rationality in a correct procedure.
  - 11.) Name power train control module terminals and explain their uses as per repair manual specifications.
- I. Functions of Engine actuators
    - 1. Fuel injectors
    - 2. Throttle valve motor
    - 3. Idle speed control
    - 4. Exhaust gas recirculation (EGR) modulator
    - 5. Canister actuator
    - 6. Air-con condenser fan motor
    - 7. Ignition coil
    - 8. adaptive cruise control
  - J. Engine actuator circuitry
    - 1. Fuel injectors
    - 2. Throttle valve motor
    - 3. Idle speed control
    - 4. Exhaust gas recirculation (EGR) modulator
    - 5. Canister actuator
    - 6. Air-con condenser fan motor
    - 7. Ignition coil
    - 8. adaptive cruise control
  - K. Engine actuator functionality and rationality
    - 1. Fuel injectors
    - 2. Throttle valve motor
    - 3. Idle speed control
    - 4. Exhaust gas recirculation (EGR) modulator
    - 5. Canister actuator
    - 6. Air-con condenser fan motor
    - 7. Ignition coil
    - 8. adaptive cruise control
  - L. Power Train Control module terminal
    - 1. Sensor terminals
    - 2. Actuator terminals
    - 3. Ground terminals
    - 4. Power supply terminals
    - 5. Return voltage terminals
    - 6. Voltage sensing circuit / device

12.) Explain the operating principle of Power Train control Module

M. Power Train Control Module principles of operation.

1. Concepts of cybernetics
2. Computer operating principle
3. Digital electronics
4. Binary numbers, gates circuits, circuit sensing functions
5. Significance of reference voltage, and computer sensors function.

13.) Check power train control module circuitry in a correct procedure.

M. Power train control module circuitry

1. Batt terminal (power supply)
2. +B terminal (Main relay supply)
3. +B1 terminal (Main relay supply)
4. Warning light terminal (check engine)
5. ECU ground terminal

14.) Check power train control module functionality and rationality in a correct procedure.

N. Power train control module functionality and rationality.

1. Batt terminal (power supply)
2. +B terminal (Main relay supply)
3. +B1 terminal (Main relay supply)
4. Warning light terminal (check engine)
5. ECU ground terminal

## VII MATERIALS AND EQUIPMENT

Materials	Equipment
Engine oil (for gas engine)	OBD II (On-Board Diagnostic Generation II)
Engine oil (for Diesel engine)	Stethoscope
Spark plug	Fuel pressure gauge
Shop rugs	Compression tester (diesel)
Hand soap	Diesel injector tester
Gasoline fuel	Gas analyzer (gas & diesel)
Diesel fuel	Oscilloscope tester
Fuel filter	Fuel injector tester
Gasket silicon	
Vellumoid gasket	
Cork gasket	
Washing solvent	
Carburetor and injector cleaner	
Auto wire	

## VIII TEXT AND REFERENCES

A Required Text:

Steve V. Hatch, **Computerized Engine Controls**. Ninth Edition, Cengage Learning. 2012 Delmar, USA.

IX METHOD OF INSTRUCTION

- A. Lecture
- B. Visual Aid
- C. Demonstration
- D. Discussion

X METHOD OF EVALUATION:

1.) The components with corresponding weight in percent included in the computation of the final grade are:

Course work (quizzes / class works / homework / projects) .....	30%
Skill Tests .....	40%
Exam (Midterm and final exam) .....	30%
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	100%

2.) The transmutation of the total percent to a letter grade is as of follows:

- 90 – 100 ..... A
- 80 – 89 ..... B
- 70 – 79 ..... C
- 65 – 69 ..... D
- 0 – 64 ..... F



**Form NC-2  
TASK LISTING SHEET**

**AM214 ELECTRONIC ENGINE MANAGEMENT**

**Credits: 2**

**1**

**48 hours**

Course No. & Title

Lec.

Lab

Total lab Hrs.

Laboratory Objectives	Time allotment
<p>1.) <b>Check EFI fuel system in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check fuel pump assembly for functionality, rationality, and circuitry.</li> <li>b. Check EFI fuel injector for functionality, rationality, and circuitry.</li> <li>c. Check fuel lines for clogged and leakage</li> <li>d. Check fuel filter for clogged and contamination.</li> <li>e. Check Relief valve, and accumulator for functionality.</li> </ul>	8 hours
<p>2.) <b>Check engine sensors circuitry in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check Throttle positioner sensor for circuitry.</li> <li>b. Check Mass air-flow for circuitry.</li> <li>c. Check Air temperature sensor for circuitry.</li> <li>d. Check Manifold absolute pressure for circuitry.</li> <li>e. Check Engine coolant temperature for circuitry.</li> <li>f. Check Knock sensor for circuitry.</li> <li>g. Check Crankshaft sensor for circuitry.</li> <li>h. Check Camshaft sensor for circuitry.</li> <li>i. Check Air-con sensor for circuitry.</li> <li>j. Check Oxygen sensor for circuitry.</li> <li>k. Check Power steering load for circuitry.</li> </ul>	15 hours
<p>3.) <b>Check engine sensors for functionality and rationality in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check Throttle positioner sensor for functionality and rationality.</li> <li>b. Check Mass air-flow for functionality and rationality.</li> <li>c. Check Air temperature sensor for functionality and circuitry.</li> <li>d. Check Manifold absolute pressure for functionality and circuitry.</li> <li>e. Check Engine coolant temperature for functionality and circuitry.</li> <li>f. Check Knock sensor for functionality and rationality.</li> <li>g. Check Crankshaft sensor functionality and rationality.</li> <li>h. Camshaft sensor functionality and rationality.</li> </ul>	10 hours
<p>4.) <b>Check engine actuator for functionality and rationality in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check fuel injector for functionality and rationality.</li> <li>b. Check actuators that controls engine idling for functionality and rationality.</li> <li>c. Check actuators circuitry that maintains engine speed during cruising for functionality and rationality.</li> <li>d. Check actuators circuitry that controls engine emission for functionality and rationality.</li> </ul>	4 hours

<p>5.) <b>Check power train control module for circuitry in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check Batt terminal (power supply) of PCM for circuitry.</li> <li>b. Check +B terminal (Main relay supply) of PCM for circuitry.</li> <li>c. Check +B1 terminal (Main relay supply) of PCM for circuitry.</li> <li>d. Check Warning light terminal (check engine) of PCM for circuitry.</li> <li>e. Check ECU ground terminal for circuitry.</li> </ul>	<p>7 hours</p>
<p>6.) <b>Check power train control module for functionality and rationality in a correct procedure.</b></p> <ul style="list-style-type: none"> <li>a. Check Batt terminal (power supply) for functionality and rationality.</li> <li>b. Check +B terminal (Main relay supply) for functionality and rationality.</li> <li>c. Check +B1 terminal (Main relay supply) for functionality and rationality.</li> <li>d. Check Warning light terminal (check engine) functionality and rationality.</li> <li>e. Check ECU ground terminal functionality and rationality.</li> </ul>	<p>4 hours</p>



**PALAU COMMUNITY COLLEGE**  
**AM214 ELECTRONIC ENGINE MANAGEMENT**  
**COURSE LEARNING OUTCOMES**

During the course experience, the course learning outcomes (CLO's) will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical ratings of 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance of each of the course learning outcomes listed below:

**Rating Scale:**

- 3 Highly Competent ..... 85% to 100%
- 2 Competent ..... 70% to 84%
- 1 Beginner ..... Below 70%

**Course learning Outcome #1: Service EFI (Electronic Fuel Injection) Fuel System**

**Paper based assessment:** Name electronic fuel injection system parts and components and explain their functions, and explain the operating principle of EFI system.

**Authentic Assessment:** Service EFI fuel system parts and components and/or check fuel accumulator, fuel relief valve, fuel pressure, fuel filter, fuel lines, fuel pump relay, and/or fuel pump motor for functionality, rationality, and circuitry.

Numerical Value	
<b>Highly Competent</b> <b>3</b> <b>(10 points)</b>	Student demonstrates the knowledge and skills in servicing EFI (Electronic Fuel Injection) Fuel System with 85% to 100% performance accuracy.
<b>Competent</b> <b>2</b> <b>(7 points)</b>	Student demonstrates the knowledge and skills in servicing EFI (Electronic Fuel Injection) Fuel System with 70% to 84% performance accuracy.
<b>Beginner</b> <b>1</b> <b>(3 points)</b>	Student demonstrates the knowledge and skills in servicing EFI (Electronic Fuel Injection) Fuel System with below 70% performance accuracy.

**Course learning Outcome #2: Service Electronic Fuel injection (EFI) Sensors**

**Paper based assessment:** Name EFI sensors and explain their functions, Explain the operating principle of EFI sensors, and explain the concepts of controlling injection timing and fuel volume.

**Authentic Assessment:** Check water temperature sensor, intake air temperature sensor, mass air flow sensor, throttle position sensor, manifold absolute pressure sensor, knock sensor, crankshaft sensor, crankshaft sensor, and oxygen sensor for functionality, rationality, and circuitry.



Numerical Value	
<b>Highly Competent</b> 3 (10 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel injection (EFI) Sensors with 85% to 100% performance accuracy.
<b>Competent</b> 2 (7 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel injection (EFI) Sensors with 70% to 84% performance accuracy.
<b>Beginner</b> 1 (3 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel injection (EFI) Sensors with below 70% performance accuracy.

**Course learning Outcome #3: Service Electronic Fuel injection (EFI) Actuators**

**Paper based assessment:** Name electronic fuel injection actuators and explain their function or uses, Explain the operating principle of EFI actuators.

**Authentic Assessment:** Service EFI actuators, clean stepper motor assembly and/or Check electronic fuel injectors, stepper motor, electric controlled throttle valve for functionality, rationality, and circuitry.

Numerical Value	
<b>Highly Competent</b> 3 (10 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel Injection Actuators with 85% to 100% performance accuracy.
<b>Competent</b> 2 (7 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel Injection Actuators with 70% to 84% performance accuracy.
<b>Beginner</b> 1 (3 points)	Student demonstrates the knowledge and skills in servicing Electronic Fuel Injection Actuators with below 70% performance accuracy.

**Course learning Outcome #4: Service Engine Computer Control Unit (OBD-1 capability)**

**Paper based assessment:** Explain the concepts of cybernetics, computer operating principle, digital electronics, binary numbers, gates circuits, circuit sensing functions, significance of reference voltage, and computer sensors function.

**Authentic Assessment:** Interpret engine control module PID's, and/or check PCM power circuits, grounds circuits, and computer sensors input.

Numerical Value	
<b>Highly Competent</b> 3 (10 points)	Student demonstrates the knowledge and skills in servicing Engine Computer Control Unit (OBD-1 capability) with 85% to 100% performance accuracy.
<b>Competent</b> 2 (7 points)	Student demonstrates the knowledge and skills in servicing Engine Computer Control Unit (OBD-1 capability) with 70% to 84% performance accuracy.
<b>Beginner</b> 1 (3 points)	Student demonstrates the knowledge and skills in servicing Engine Computer Control Unit (OBD-1 capability) Electric Fuel Pump Assembly with below 70% performance accuracy.

**Course learning Outcome #5: Analyze Electronic Engine Management Problems**

**Paper based assessment:** Read engine circuit wiring diagram, and analyze cause and effect involving EFI systems problems.

**Authentic Assessment:** Scan diagnostic trouble codes (DTC's), analyze DTCs results, Freeze frame data, analyze live data, analyze oscilloscope pattern, and/or erase DTC's.

<b>Numerical Value</b>	
<b>Highly Competent</b> <b>3</b> <b>(10 points)</b>	Student demonstrates the knowledge and skills in analyzing Electronic Engine Management Problems with 85% to 100% performance accuracy.
<b>Competent</b> <b>2</b> <b>(7 points)</b>	Student demonstrates the knowledge and skills in analyzing Electronic Engine Management Problems with 70% to 84% performance accuracy.
<b>Beginner</b> <b>1</b> <b>(3 points)</b>	Student demonstrates the knowledge and skills in analyzing Electronic Engine Management Problems with below 70% performance accuracy.