Course Acronym:	ATEC
Course Number:	24
Descriptive Title:	Computer Controlled Engine Management, Fuel Systems and Emissions
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	This course covers the study of computer controlled engine management systems with an emphasis on On-board Diagnostics Generation II (OBD II) protocols, fuel system and fuel injection system testing, diagnosis and service and vehicle emissions. Laboratory activities stress the proper use of modern test equipment utilized in the automotive field. *Note: The two-course sequence Automotive Technology 23 and 24 is equivalent to Automotive Technology 22A.*
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 21 or Automotive Technology 23 or equivalent
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Course Hours:	108
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	

Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Safety Exam** Given an in class exam, based on readings, classroom discussions and demonstrations, the student will be able to work in the Automotive Shop safely and pass the Automotive Safety Exam with 100% accuracy. **SLO #2 Engine Condition and Performance** The student will test and evaluate engine condition and performance using an Engine Analyzer / Scanner lab worksheet to manufacturer specifications. **SLO #3 Fuel System Test** The student will be able to test the performance of an automotive fuel system using the Fuel System Performance Testing lab worksheet and manufacturer specifications.
Course Objectives:	1. Complete a safety test with 100% accuracy. 2. Perform engine diagnosis using a flow chart. 3. Test and diagnosis of an engine using engine testing equipment. 4. Distinguish fuel system components (carburetion). 5. Evaluate and repair fuel systems (carburetion). 6. Diagnose and repair a computer controlled fuel system. 7. Distinguish computer controlled fuel system components. 8. Evaluate and repair fuel injection systems. 9. Diagnose fuel injection components. 10. Diagnose and repair emission control systems. 11. Distinguish emission control components. 12. Analyze fuel system performance data and form a conclusion of recommended needed repairs. 13. Analyze computer controlled engine data and form a conclusion of recommended needed repairs.
Major Topics:	**I. Course Overview and Safety (6 hours, lecture)** A. Safety information and test 1. Course requirements 2. Online Safety and Pollution Prevention training (S/P2) 3. Shop policies B. Personal Protective Equipment (PPE) C. Shop and environmental hazards 1. Commonly used shop chemicals 2. Material Safety Data Sheets (MSDS) 3. Tool and shop equipment hazards D. Proper hand/power tool and shop equipment identification and usage E. Vehicle hoist operation

F. Service information accessing procedures
   1. Published repair procedures and specifications
G. Repair orders
   1. Proper procedures and legal guidelines
   2. California Department of Consumer Affairs, Bureau of Automotive Repair (BAR) - "Write It Right"
   3. Purpose and workflow process
H. Technician training and certifications

II. Tools and Safety (6 hours, lab)

A. PPE usage
B. Shop safety rules demonstration
   1. Proper hand tool identification and usage
   2. Shop equipment identification and usage
C. Safe work area maintenance
   1. In-shop vehicle handling
   2. Proper in-shop engine emissions venting
   3. Safe vehicle hoisting
   4. Clean up procedures
D. Automotive Service Excellence (ASE) technician certification process A-1 through A-8 lab sheet
E. Properly complete vehicle repair work order
F. Introduction to a Digital Volt-Ohmmeter (DVOM), Volt/Amperage Tester (VAT) and a Digital Storage Oscilloscope (DSO)

III. Engine Control Input Sensors (12 hours, lecture)

A. Analog and digital voltage signals identification and analysis
B. Computer input signals
   1. Binary coding
C. Oxygen and Air-Fuel ratio (A/F) sensor design and operation
D. Engine Coolant Temperature (ECT) sensor - it's role and relevance
E. Intake air temperature sensor operation and description
F. Throttle Position Sensor (TPS) design and operation
G. Types of Mass Air Flow (MAF) sensors
H. Manifold Absolute Pressure (MAP) sensor
I. Knock sensors
J. Purpose of the Exhaust Gas Recirculation (EGR) valve position sensor
K. Vehicle speed sensor signal - role and relevance

IV. Engine Control System Diagnosis and Service (12 hours, lab)

A. Diagnostic trouble code retrieval, analysis and erasure
B. Scan tool usage exercises
   1. Perform a continuous self-test
   2. Perform a scan tester diagnosis on various vehicles
C. Cylinder output test
D. Computer voltage supply and ground wire testing and analysis
E. Switch-type input sensors testing and diagnosis
F. Diagnosis and testing exercises
   1. Engine coolant temperature sensors
   2. Intake air temperature sensors

3. Exhaust Gas Recirculation (EGR) valve position sensors
4. Oxygen sensors
5. Knock sensors
6. Vehicle speed sensors
7. Manifold Absolute Pressure (MAP) sensors
8. MAF sensors

V. Computer Outputs (6 hours, lecture)

A. High-side and low-side drivers definition and description
   1. Computer driven output actuator operation
   2. Quad drivers and output driver modules
   3. Duty cycle
   4. Pulse Width Modulation (PWM)
B. Output driver roles
   1. Fuel injector operation
   2. Idle Air Control (IAC) system operation
   3. EGR valve operation
C. Computer output control of electronic ignition spark timing

VI. Computer Output Diagnosis and Service (6 hours, lab)

A. High-side and low-side computer driver circuit diagnosis
B. Computer output actuators diagnosis
C. Fuel injector output driver diagnosis
D. Computer controlled IAC system problem diagnosis
E. Computer operated EGR valve identification and description

VII. Emission Control Systems (12 hours, lecture)

A. Federal emission standards
   1. Clean Air Act of 1990
   2. Federal vehicle emission ratings
B. California emission standards
   1. California Air Resources Board (CARB)
   2. California vehicle emission ratings
C. Smog-producing emissions
   1. Hydrocarbon (HC) emission production process
   2. Carbon Monoxide (CO) emission production process
   3. Oxides of Nitrogen (NOx) production process
D. Exhaust oxygen content production process
E. Carbon Dioxide production process
F. Evaporative emissions control system operation and purpose
G. Positive Crankcase Ventilation (PCV) system operation and purpose
H. Knock sensor and electronic spark control module purpose and operation
I. EGR valves
   1. Differential Pressure Feedback EGR (DPFE) valve
   2. Digital EGR valve
   3. Linear EGR valve
J. EGR system controls
K. Catalytic converter construction, purpose and operation
L. Secondary Air Injection System (AIR)

M. On-Board Refueling Vapor Recovery (ORVR) purpose and operation

VIII. Emission Control System Diagnosis and Service (12 hours, lab)

A. Differing state vehicle emissions Inspection/Maintenance (I/M) control programs identification and description
B. Evaporative Emissions (EVAP) system diagnosis and service
C. Canister purge valve testing
D. PCV system part inspection and replacement
E. Improper EGR operation diagnosis and service
   1. Identifying and servicing different EGR valves and control solenoids
F. Catalytic converter efficiency check
G. Diagnosing and servicing secondary air injection systems

IX. OBD II and Computer Systems (12 hours, lecture)

A. Primary provisions of OBD II
B. OBD II system monitors and enable criteria
   1. OBD II warm-up cycle
   2. Trip and drive cycle
   3. Continuous and non-continuous monitors
   4. Comprehensive Component Monitor (CCM)
   5. Requirements to illuminate the Malfunction Indicator Light (MIL)
C. Engine misfire detection
   1. Type A misfires
   2. Type B misfires
D. Catalyst monitoring
   1. Purpose of two oxygen sensors in an exhaust system
E. Five mandates in OBD II
F. Purpose of Random-Access Memory (RAM) and Read-Only Memory (ROM)
   1. Volatile and nonvolatile memory
G. Diagnostic trouble code numbering and types

X. OBD II System Diagnosis and Service (12 hours, lab)

A. OBD II system preliminary checks
B. OBD II system problem diagnosis
C. Scan tool diagnostic usage
D. Troubleshooting
   1. Symptom chart
   2. Diagnostic flow chart
E. OBD II diagnostics definitions
F. Illuminated MIL, Diagnostic Trouble Codes (DTCs)
   1. Root cause identification
   2. Basic format description
G. OBD II system components monitoring
H. Diagnosing intermittent problems
I. OBD II circuit repair

	XI. Networks and Networking (6 hours, lecture) A. Vehicle computer networking 1. Serial data bus 2. Multiplexing B. UART, J1850, KWP2000, and ISO 9141 communications 1. Peer-to-peer communication 2. Master-to-slave communication C. Controller Area Network (CAN) operation D. Types of vehicle module wiring configurations E. Network module function and Powertrain Control Module (PCM) relationship **XII. Servicing Networks (6 hours, lab)** A. Vehicle network module function diagnosis B. Serial data bus interpretation 1. Network electrical schematics 2. Schematic circuit and component identification 3. Multiplexing process description C. Networking speeds and method retrieval D. CAN, network wiring, and peer-to-peer/master-to-slave communication observation and analysis E. Network module list and identification F. Antitheft systems and stand-alone modules G. CAN Bus testing and diagnosis H. Replace and reprogram network module procedure description
Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Sketch a drawing of a complete emission control system for a contemporary automobile. Submit drawing to the instructor.
Critical Thinking Assignment 1:	Perform a vehicle fuel system inspection and record data on a fuel system lab sheet. Analyze data using manufacturer's specifications to determine recommended service and/or repairs and parts required. Submit lab sheet to the instructor.
Critical Thinking Assignment 2:	Perform a four gas exhaust test to generate a data print out. Analyze data using manufacturer's specifications to determine adjustments and/or recommended repairs to include parts required. Record findings on data print out and submit to the instructor.
Other Evaluation Methods:	Performance Exams Other Exams Quizzes Laboratory Reports Class Performance

	Multiple Choice Completion Matching Items True/False Other (specify): PERFORMANCE OF MANUFACTURER'S SERVICE PROCEDURES
Instructional Methods:	Demonstration Discussion Field trips Group activities Guest speakers Laboratory Lecture Multimedia presentations
If other:	COMPONENT MODELS
Work Outside of Class:	Study Answer questions Required reading Problem solving activities
If Other:	
Up-To-Date Representative Textbooks:	James D. Halderman, AUTOMOTIVE ENGINE PERFORMANCE, 5th edition, Prentice Hall, 2017. Discipline Standard
Alternative Textbooks:	
Required Supplementary Readings:	Lab sheets, procedure sheets and shop manuals
Other Required Materials:	Three ring binder notebook and paper Pen and pencil Digital Volt Ohm Meter Safety glasses Shop safe clothing
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the	

requisite skill(s). If applicable	
Requisite course:	Automotive Technology 21 or Automotive Technology 23
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Knowledge of engine construction, design and four stroke engine operation.** ATECH 21 - Distinguish engine components. ATECH 21 - Perform an analysis of an engine condition by conducting compression, cylinder leakage, and vacuum tests. ATECH 23 - Distinguish between various engine components. ATECH 23 - Determine engine condition by performing compression, cylinder leakage, and vacuum tests.
Requisite Skill:	or equivalent
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	If students have not taken Automotive Technology 21 or Automotive Technology 23 but have taken a similar course at another college or have basic automotive work or tune up experience, students will have the skills needed to take this course. It is highly recommended that students have basic automotive or tune up skills to enhance their success in this course.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Robert E. Beaudoin
Date:	10/25/1985
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Michael Anderson
Date:	03/03/2022
Last Board Approval Date:	12/19/2022