

AUT 181 (A8)
ENGINE PERFORMANCE I

COURSE DESCRIPTION:

Prerequisites: None

Corequisites: None

This course covers the introduction, theory of operation, and basic diagnostic procedures required to restore engine performance to today's vehicles equipped with complex engine control systems. Topics include an overview of engine operation, ignition components and systems, fuel delivery, injection components and systems and emission control devices and emerging engine performance technologies. Upon completion students should be able to describe operation of and diagnose/repair basic ignition, fuel and emission related drivability problems using appropriate test equipment and service information. Course Hours Per Week: Class Hours, 2; Lab, 3, Semester Credit Hours, 3.

SAFETY DISCLAIMER:

Automotive work presents many hazards. A moment's carelessness can cause injury to oneself or to others. Such mishaps can occur quickly due, in part, to the nature of the industrial tools used in automotive work. The weight of automobiles and the equipment used to fix them can even cause fatal injuries. Therefore, great care must always be taken in checking out equipment before use, and in using that equipment to work on automobiles.

As we work to insure the safety of everyone in the DTCC automotive lab, it is the instructor's responsibility to introduce students to equipment and to advise them on its safe operation. Those health and safety procedures are also presented in each textbook for each course in the automotive program. **Students are responsible for mastery of that safety information.** DTCC holds each student in every class responsible for reading and applying all of the information regarding personal and public safety and personal and public health in the required text.

While working in the DTCC automotive lab, safety glasses must be worn by everyone. However, safety glasses are only one small requirement so that students remain injury free. All safety recommendations in the text book and from the instructor must be followed. A student with any questions about a safety procedure should immediately ask an instructor for clarification.

Any student using equipment in the automotive lab must be responsible for using that equipment in a safe manner. Durham Technical Community College holds each student in automotive classes responsible for acting to ensure a safe environment and to ensure both the student's own safety and the safety of his classmates.

LEARNING OUTCOMES:

Upon completion of this course the student will be able to:

- a. Identify engine type and engine management systems.
- b. Utilize technical specifications and troubleshooting procedures.
- c. Analyze and test engine mechanical soundness.
- d. Diagnose and repair vacuum leaks.
- e. Diagnose electrical/electronics system problems and make necessary repairs.
- f. Perform no starting and hard starting diagnostic procedures.
- g. Troubleshoot driveability problems and determine needed repairs.
- h. Perform on-board computer diagnostics.
- i. Inspect and repair engine fuel systems.
- j. Inspect and service exhaust systems.
- k. Perform routine scheduled maintenance procedures.

OUTLINE OF INSTRUCTION:

- I. General Engine Operation (Overview/Review)
 - A. Engine Designs and Classifications
 - 1) Gasoline
 - 2) Diesel
 - 3) Piston
 - 4) Rotary
 - 5) Hybrids
 - 6) New Designs/New Technology
 - a. Fuel Cells
 - b. Others
 - B. Operating Cycles
 - 1) 4 Stroke Cycle
 - 2) 2 Stroke Cycle
- II. Engine Systems (Overview of Basic Operation and Purpose)
 - A. Intake Systems
 - 1) Manifolds
 - 2) Throttle Bodies
 - 3) Air Intake Filters
 - B. Exhaust Systems
 - 1) Components
 - C. Cooling Systems
 - 1) Water Pumps
 - 2) Thermostats
 - 3) Radiators (heat exchangers)
 - 4) Hoses
 - 5) Circulation

- 6) Fans, Clutches
- D. Fuels and Fuel Systems
 - 1) Fuels
 - a. Gasoline
 - b. Diesel
 - c. Alcohol and Blends
 - d. CNG, LPG
 - e. Hydrogen
 - f. Others
 - 2) Fuel Injection
 - a. Multi-port
 - b. Throttle Body
 - 3) Delivery
- E. Ignition Systems
 - 1) “DI” Distributor Ignition
 - 2) “EI” Distributorless Ignition
 - 3) “COP” Coil On Plug
- F. Emission Control Systems
 - 1) PCV Positive Crankcase Ventilation
 - 2) EGR Exhaust Gas Recirculation
 - 3) EVAP Evaporative Control Systems
 - 4) AIR Injection Systems
 - 5) Catalytic Converter Systems

III. The Diagnostic Process

- A. Verify the Problem
- B. Gather Customer Information and Vehicle History
- C. Visual Inspection and Basic Tests
- D. Retrieve and Record DTC’s
- E. Collect Service Information and Check TSB’s
- F. Scan Tool Data
- G. Identify the Problem Cylinder or System
- H. Repair Problem and Determine Root Cause
- I. Verify Repair and Clear Codes

IV. Scan Tool Introduction

- A. Diagnostic Trouble Codes
 - 1) Retrieval
 - 2) Clearing
- B. Data Streams (scan tool data)
- C. OBD I On-Board Diagnostics (Gen I)
 - 1) History
 - 2) System(s) Overview
- D. OBD II On-Board Diagnostics (Gen II)
 - 1) History
 - 2) System(s) Overview

V. General “Mechanical” Condition

- A. Compression Tests
 - 1) Dry
 - 2) Wet
 - 3) Running
- B. Cylinder Leakage Test
- C. Vacuum Gauge Tests
- D. Power Balance
- E. Abnormal Noises
- F. Exhaust Smoke
- G. Internal/External Leaks
- H. Valve/Camshaft Timing

VI. Computers and Basic Operation

- A. Computer Operation
- B. Voltage Signals
 - 1) Analog
 - 2) Digital
- C. Types of Input Sensors and Switches
 - 1) Reference Voltage
 - 2) Voltage Generating
- D. Output Devices
 - 1) Relays
 - 2) Solenoids
 - 3) Motors
- E. Types of Memory
 - 1) RAM Random Access Memory
 - 2) ROM Read Only Memory
 - 3) PROM Programmable Read Only Memory
 - 4) EEPROM Electronically Erasable PROM
 - 5) KAM Keep Alive Memory
- F. Adaptive Strategies

VII. “DI” Electronic Distributor Ignition

- A. Purpose of Ignition Systems
 - 1) Spark Production
 - 2) Spark Timing Control
 - 3) Spark Distribution
- B. Ignition Circuits and Operation
 - 1) Primary
 - a. Battery
 - b. Ignition Switch
 - c. Ignition Coil Primary Winding
 - d. Triggering Devices
 - i. Magnetic Pick-ups
 - ii. Hall-Effect Switches

- iii. Optical Pick-ups/Sensors
 - iv. Control Modules
 - 2) Secondary
 - i. Ignition Coil Secondary Winding
 - ii. Distributor Caps/Rotor
 - iii. Ignition/Spark Plug Cables (some models)
 - iv. Spark Plug

VIII. "EI" Distributorless Ignition

- A. Purpose and Advantages
- B. Circuits and Operation
- C. Waste Spark Operation
- D. "COP" Coil On Plug System

IX. Fuel Delivery Systems

- A. Description and Operation
- B. Tanks/Lines/Filters
- C. Pumps
- D. Pressure Regulation
- E. Testing
 - 1) Return Line Systems
 - 2) Returnless Systems

X. Electronic Fuel Injection

- A. Throttle Body Injection
- B. Multiport Fuel Injection
- C. Input Sensors
 - 1) O₂ Oxygen
 - 2) A/F Air Fuel Ratio
 - 3) ECT Engine Coolant Temperature
 - 4) IAT Intake Air Temperature
 - 5) TP Throttle Position
 - 6) Accelerator Pedal Position
 - 7) MAP Manifold Absolute Pressure
 - 8) MAF Mass Air Flow
- D. Output Devices
 - 1) Simple On-Off
 - a. Relays
 - b. Solenoids
 - 2) Duty Cycle
 - 3) PWM Pulse Width Modulation
 - a. Fuel Injectors
 - i. Fuel Trim
 - b. IAC Idle Air Control
 - c. EGR Exhaust Gas Recirculation

- XI. Diagnosis and Repair of Driveability Problems
 - A. MIL Malfunction Indicator Light Diagnosis
 - B. Interpretation of Scan Tool Data
 - C. OBD II Requirements
 - 1) Drive Cycles
 - 2) Monitors
 - 3) Utilization of Snapshot/Freeze Frame Data
 - 4) Output Controls
 - D. No MIL - Symptom Based Diagnosis

- XII. Routine and Preventative Maintenance
 - A. The “Tune-up” Process and Procedure
 - B. 30K and 60K Maintenance
 - C. Timing Belt Replacement

- XIII. New Engine Performance Technologies

REQUIRED TEXTBOOKS AND MATERIALS:

To be announced by the instructor.

NATEF:

This course fulfills 80 of the 220 hours required by **NATEF** for A8. See COE 111.