SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19OE120 AUTOMOTIVE ELECTRONICS

III YEAR /IV SEMESTER MECHATRONICS

Unit 1 – INTRODUCTION TO ECU

Topic : Electronic Fuel Control System

ELECTRONIC FUEL CONTROL SYSTEM

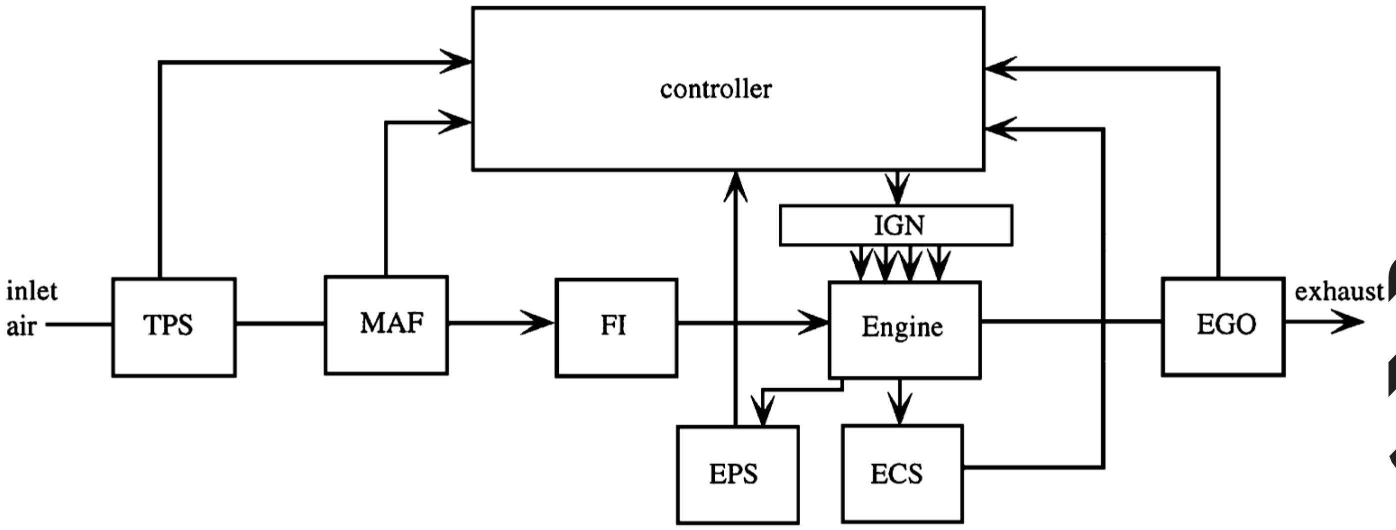
❖ ELECTRONIC FUEL CONTROL SYSTEM

- For an understanding of the configuration of an electronic fuel control system, refer to the block diagram of Figure below.
- The primary function of this fuel control system is to accurately determine the mass air flow rate into the engine.
- Then the control system precisely regulates fuel delivery such that the ratio of the mass of air to the mass of fuel in each cylinder is as close as possible to stoichiometry (i.e., 14.7).
- The components of this block diagram are as follows:

1. Throttle position sensor (TPS)
2. Mass air flow sensor (MAF)
3. Fuel injectors (FI)
4. Ignition systems (IGN)
5. Exhaust gas oxygen sensor (EGO)
6. Engine coolant sensor (ECS)
7. Engine position sensor (EPS)

- The EPS has the capability of measuring crankshaft angular speed (RPM) as well as crankshaft angular position when it is used in conjunction with a stable and precise electronic clock (in the controller).
- The signals from the various sensors enable the controller to determine the correct fuel flow in relation to the air flow to obtain the stoichiometric mixture. From this calculation the correct fuel delivery is regulated via fuel injectors.

- In addition, optimum ignition timing is determined and appropriate timing pulses are sent to the ignition control module (IGN).



❖ Open Loop Control

- The components of an open-loop controller include the electronic controller, which has an output to an actuator.
- The actuator, in turn, regulates the plant being controlled in accordance with the desired relationship between the reference input and the value of the controlled variable in the plant.
- Many examples of open-loop control are encountered in automotive electronic systems, such as fuel control in certain operating modes.
- In the open-loop control system of Figure A below, the command input is sent to a system block, which performs a control operation on the input to generate an intermediate signal that drives the plant.

- This type of control is called open-loop control because the output of the system is never compared with the command input to see if they match.
- The control electronics generates the electrical signal for the actuator in response to the control input and in accordance with the desired relationship between the control input and the system output.
- The operation of the plant is directly regulated by the actuator (which might simply be an electric motor).

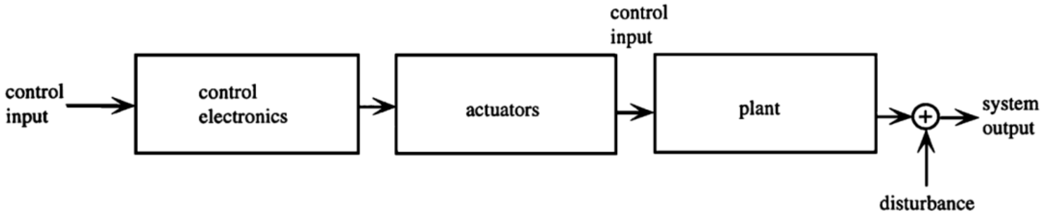
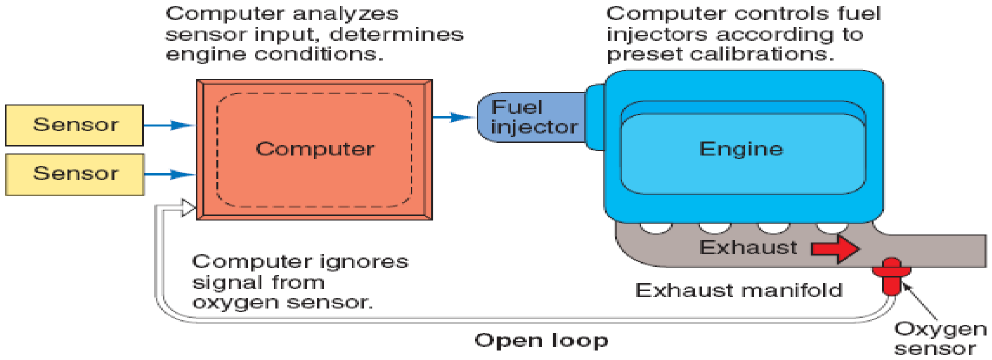


Figure. A



- The system output may also be affected by external disturbances that are not an inherent part of the plant but are the result of the operating environment.
- One of the principal drawbacks to the open-loop controller is its inability to compensate for changes that might occur in the controller or the plant or for any disturbances.
- This defect is eliminated in a closed-loop control system, in which the actual system output is compared to the desired output value in accordance with the input.
- Of course, a measurement must be made of the plant output in such a system, and this requires measurement instrumentation.

- During engine cranking the mixture is set rich by an amount depending on the engine temperature (measured via the engine coolant sensor).
- Once the engine starts and until a specific set of conditions is satisfied, the engine control operates in the open-loop mode. In this mode the mass air flow is measured (via MAF sensor).
- The correct fuel amount is computed in the electronic controller as a function of engine temperature.
- The correct actuating signal is then computed and sent to the fuel metering actuator. In essentially all modern engines, fuel metering is accomplished by a set of fuel injectors.After combustion the exhaust gases flow past the EGO sensor, through the TWC, and out the tailpipe.
- Once the EGO sensor has reached its operating temperature (typically a few seconds to about 2 min), the EGO sensor signal is read by the controller and the system begins closed-loop operation.

❖ Closed Loop Control

- In a closed-loop control system a measurement of the output variable being controlled is obtained via a sensor and fed back to the controller.
- The measured value of the controlled variable is compared with the desired value for that variable based on the reference input.
- An error signal based on the difference between desired and actual values of the output signal is created, and the controller generates an actuating signal that tends to reduce the error to zero.
- In addition to reducing this error to zero, feedback has other potential benefits in a control system.

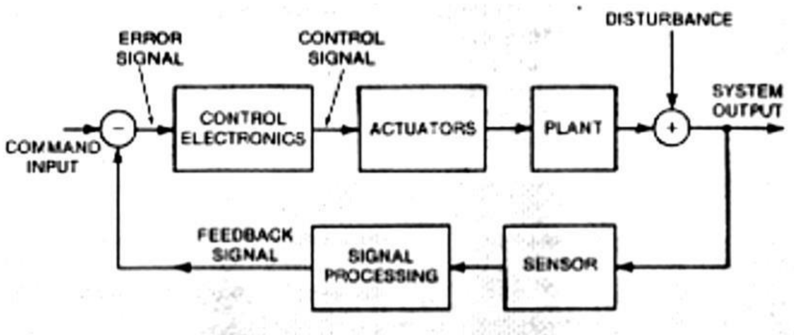
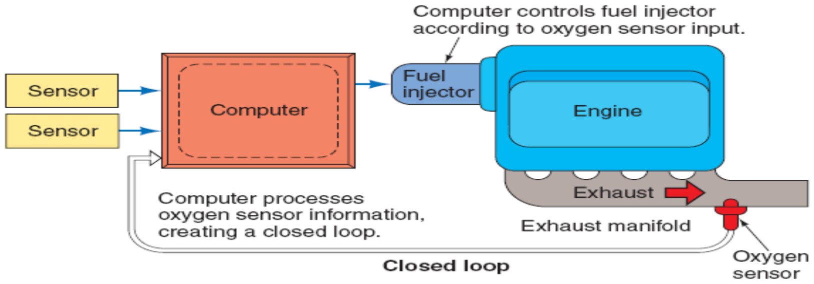


Fig. B



- It can affect control system performance by improving system stability and suppressing the effects of disturbances in the system.
- For any given set of operating conditions, the fuel metering actuator provides fuel flow to produce an air/fuel ratio set by the controller output.
- This mixture is burned in the cylinder and the combustion products leave the engine through the exhaust pipe.
- The EGO sensor generates a feedback signal for the controller input that depends on the air/fuel ratio.
- This signal tells the controller to adjust the fuel flow rate for the required air/fuel ratio, thus completing the loop.