SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19OE120 AUTOMOTIVE ELECTRONICS

III YEAR /IV SEMESTER MECHATRONICS

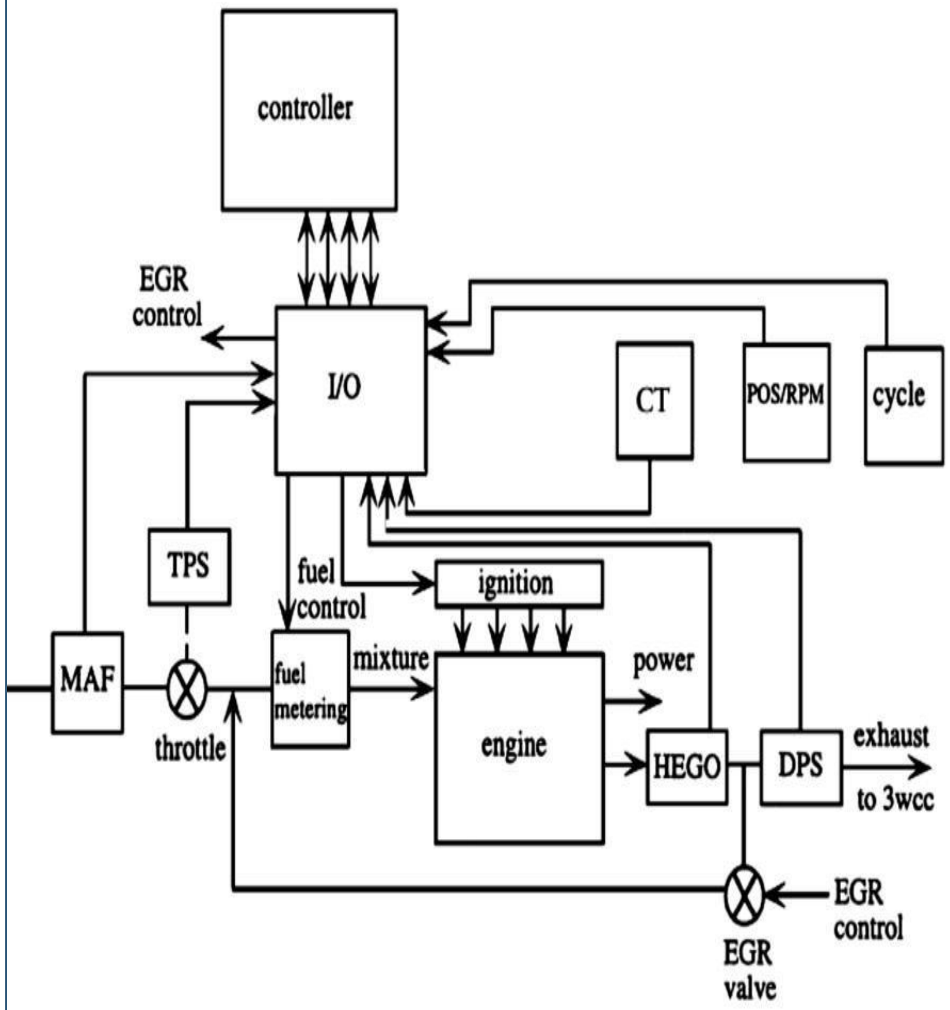
Unit 1 – INTRODUCTION TO ECU

Topic : Concept of an Electronic Engine Control System

Concept of an Electronic Engine Control System

❖ Electronic Engine Control:

- The engine control system is responsible for controlling fuel and ignition for all possible engine operating conditions.
- However, there are a number of distinct categories of engine operation, each of which corresponds to a separate and distinct operating mode for the engine control system.
- The differences between these operating modes are sufficiently great that different software is used for each.



- The control system must determine the operating mode from the existing sensor data and call the particular corresponding software routine.
- For a typical engine there are seven different engine operating modes that affect fuel control: **engine crank, engine warm-up, open-loop control, closed-loop control, hard acceleration, deceleration, and idle**.
- The program for mode control logic determines the engine operating mode from sensor data and timers.
- In the earliest versions of electronic fuel control systems, the fuel metering actuator typically consisted of one or two fuel injectors mounted near the throttle plate so as to deliver fuel into the throttle body.
- These throttle body fuel injectors (TBFI) were in effect an electromechanical replacement for the carburetor.

- Requirements for the TBFI were such that **they only had to deliver fuel at the correct average flow rate for any given mass air flow**. Mixing of the fuel and air, as well as distribution to the individual cylinders, took place in the intake manifold system.
- The more stringent exhaust emissions regulations of the late 1980s and the 1990s have demanded more precise fuel delivery than can normally be achieved by TBFI.
- These regulations and the need for improved performance have led to timed sequential port fuel injection (TSPFI).
- In such a system there is a fuel injector for each cylinder that is mounted so as to spray fuel directly into the intake of the associated cylinder.
- Fuel delivery is timed to occur during the intake stroke for that cylinder.

- When the ignition key is switched on initially, the mode control logic automatically selects an engine start control scheme that provides the low air/ fuel ratio (rich mixture) required for starting the engine.
- Once the engine RPM rises above the cranking value, the controller identifies the “engine started” mode and passes control to the program for the engine warm-up mode.
- This operating mode keeps the air/fuel ratio low (rich mixture) to prevent engine stall during cool weather until the engine coolant temperature rises above some minimum value.
- The particular value for the **minimum coolant temperature is specific to any given engine** and, in particular, to the fuel metering system. (Alternatively, the low air/fuel ratio may be maintained for a fixed time interval following start, depending on startup engine temperature.)

- When the coolant temperature rises sufficiently, the mode control logic directs the system to operate in the open-loop control mode until the **EGO sensor warms up enough to provide accurate readings.**
- This condition is detected by monitoring the EGO sensor's output for voltage readings above a certain minimum rich air/fuel mixture voltage set point.
- When the **EGO sensor has indicated rich mixture at least once** and after the engine has been in open loop for a specific time, the control mode selection logic selects the closed-loop mode for the system. (Note: other criteria may also be used.)
- The engine remains in the closed-loop mode until either the EGO sensor cools and fails to read a rich mixture for a certain length of time or a hard acceleration or deceleration occurs. If the sensor cools, the control mode logic selects the open-loop mode again.

- During hard acceleration or heavy engine load, the control mode selection logic chooses a scheme that provides a rich air/fuel mixture for the duration of the acceleration or heavy load.
- This scheme provides maximum torque but relatively poor emissions control and poor fuel economy regulation as compared with a stoichiometric air/fuel ratio.
- After the need for enrichment has passed, control is returned to either open-loop or closed-loop mode, depending on the control mode logic selection conditions that exist at that time.