This course can be adapted to virtual classroom mode

Introduction to Engine Management: Practical Approach by Modeling & Simulation

9 days **CMCS-EN-A**

Overview

LEVEL

Expert

PURPOSE

This course provides a deeper knowledge on the strategies used to manage the engine operation in order to improve performances.

LEARNING OBJECTIVES

Upon completion of the course, participants will be able to:

determine and to carry out SI and Diesel engines set torque, by air, timing and fuel management,

know depollution and OBD strategies necessary to meet the standards,

understand the relationship between engine physics and control,

know engine control basics,

understand the relationship between EMS design and customer requirements,

understand engine management system process development,

identify the components necessary to control the engine and its requirements as well as to describe their operation,

design and develop engine control strategies,

validate and calibrate engine control strategies.

WAYS AND MEANS

This training provides an overview of engine management systems. It is based on concrete examples and a pragmatic approach by modeling and simulation. A control project underlies learning. Students are active throughout the training: they develop, realize, test and validate themselves the control software they have developed.

The steps in this active learning are:

Design, build and calibration of control strategies in Matlab-Simulink.

Engine model development for torque structure design with Matlab-Simulink.

Strategies validation with an engine model (MIL) with Matlab-Simulink.

Agenda

ENGINE MANAGEMENT INTRODUCTION & DISCOVERY BY PRACTICE — 3.5 d

Stakes, definitions, architectures, sensors, actuators, ECU, control strategies.
Automatisms: PID regulators (principle, tuning, gasoline idle speed and Diesel EGR control), new tuning methods and prospects.
Diesel and gasoline engines physics applied to the management problem, by the following parameters: air, fuel, torque, speed, depollution.
Control law “hands design”. All introductory concepts are reworked with the example of a spark ignition engine: design and implementation of a torque structure, design and implementation of an idle speed control strategy.

SPARK IGNITION ENGINE TORQUE & EMISSIONS CONTROL

1.75 d

Interpreting of the driver's intentions and taking external requirements into account.
Taking driving pleasure into account, idle speed.
How to meet the set torque.
Air management: translating the instruction into an air quantity and in throttle driving, airflow measurements with the pressure/velocity strategy, exhaust gas recirculation EGR.
Fuel management: fuel supply, starting, evaporative emission system (canister).
Managing the injection pressure and the injected quantity, injector driving, injection modes.
Timing management: torque variations driving by the ignition/knocking advance (ignition computing sequence).
Operation of pollutant strategies to control engine out and after-treatment.

DIESEL ENGINE TORQUE & EMISSIONS CONTROL

1.75 d

How to meet the set torque. Diesel torque structure. Torque control by injection control.
Air management: translating the torque instruction into an air quantity, supercharching control.
Fuel management: fuel supply, starting, managing the injection pressure and the injected quantity, injector driving, injection modes, control of the injection patterns. Injections corrections strategies.
Operation of pollutant strategies to control engine out and after-treatment. Pollutants and air diesel chain: controlling the amount of air, amount of fresh air and EGR rate.
After-treatment control systems: oxidation catalyst, DPF, SCR and NOx trap.

ENGINE CROSS CONTROL

2 d

Engine synchronization: crankshaft and cam timing. Strategies, operating technologies and components.
Powertrain supervision: Interpreting the driver will, choice of the powertrain operating point, intersystem arbitration.
OBD: issue of OBD in a Euro 6 context: impact on the architecture of motor control. Globalized approach to diagnosis.
Intersystem: functional issues of CAN, VAN, digital links sensors-ECU intersystem networks.