Tárgytematika / Course Description
Internal Combustion Engine Control

AJNM_BMTA035

Tárgyfelelős neve / Teacher's name:	dr. Knaup Jan Christopher
Félév / Semester:	2024/25/1
Beszámolási forma / Assesment:	Vizsga
Tárgy heti óraszáma / Teaching hours(week):	2/0/2
Tárgy féléves óraszáma / Teaching hours(sem.):	0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

Introduction of system and hardware architectures of engine control units, of the BUS systems used nowadays in the powertrain. Brief explanation how LIN, CAN, FlexRay and MOST work, introduction of their advantages and disadvantages. Development and hardware features of µC's and development of the software for the ECU generations. Explanation of the operating principles "prevention, detection and response" based on specific features of manipulation protection. Requirements for the engine control unit and their implementation under given conditions. Diagram of sensors and actuators used nowadays in gasoline and diesel engines. Software architecture of ECUs (principles, goals, motivation, software functions, self-development, program status, integration planning). Functional development from the idea to the finished function. Introduction of Matlab Simulink and ASCET softwaretools, the INCA-MDA application tool, and the "Design of Experiment" (DoE). Presentation of the procedure, and the DoE model types. Introduction of the functional development and testing of the powertrain in MiL / SiL / HiL environments.

TANTÁRGY TARTALMA / DESCRIPTION

Short content:

1. Introduction of the subject:

Requirements
Plans for the semester

2. Basics of control systems in vehicles:

Tasks and brief summary of control systems
Control technology in vehicles

3. System Architecture of ECUs:

Definition and classification of system architectures
System architecture and the V-Model
Requirement Management
Core Process
Classification of logical and technical architectures
System architecture of the engine control unit
Examples

4. Communication systems (LIN, CAN, FlexRay, MOST), tuning protection:

Basic functions of tuning protection in engine control units: prevention, detection, response
Communication systems: What it is and for what areas of application?
Communication systems in the powertrain.

5. Hardware architecture of engine control units:

Requirements for an engine control unit, motivation and history
Development and operation in the vehicle
Implementation of the requirements in engine control units
Assembling technology
Reading and processing of signals (including networking)
Controlling the actuators
Microcontroller architecture

6. Basics of sensors and actuators in vehicles:

Motivation (protection of components, widen of module boundaries, compliance with emissions, compliance with emission standards, compliance with local requirements "OBD")
Requirements (temperatures, vibration, fluids, pressure, pulsation, permanent contact, vehicle electrical system, EMC)
Function groups / components / signals (speed detection, air flow, charge detection, cooling system, oil system, fuel system, exhaust gas system)
Protocols

7. Functional requirements:

Why are powerful engine management systems necessary? Motivation
Software architecture principles, procedures, rules
Development process using the V-Model
Linking software functionality with engine control hardware

8. Function development:

Development from the idea to the finished function

9. Software tools:

Matlab-Simulink as a software tool for concept and function development:
ASCET as a competitive tool for Matlab-Simulink

10. Application Tools:

INCA-MDA as visualization tool

11. Design of Experiment (DoE):

What is DoE?
DoE procedure
Model types

12. Application:

What is application?
How does application work?

13. System testing (MiL, SiL, HiL):

Model-based functional development
MiL / HiL / Sil tests
Rapid Control Prototyping
Test and calibration of the vehicle

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

Evaluation: Exam

Grade:

$$90 - 100\,\% = 5$$
$$75 - 89\,\% = 4$$
$$60 - 74\,\% = 3$$
$$50 - 59\,\% = 2$$
$$< 50\,\% = 1$$

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

Slides of the lessons

AJÁNLOTT IRODALOM / RECOMMENDED MATERIAL