

## Tárgytematika / Course Description Hybrid Electric Vehicles

AJNM\_BMTA034

**Tárgyfelelős neve /**

**Teacher's name:** dr. Tóth-Nagy Csaba

**Félév / Semester:** 2025/26/1

**Beszámolási forma /**

**Assesment:** Vizsga

**Tárgy heti óraszám /**

**Teaching hours(week):**

**Tárgy féléves óraszám /**

**Teaching hours(sem.):**

---

### OKTATÁS CÉLJA / AIM OF THE COURSE

#### Goals of the course:

To create vehicle dynamics simulation model of a hybrid electric vehicle in Matlab, Simulink, or Python (your choice)

Prerequisite knowledge is advisable, but students can also catch up on the following topics: Matlab. Environmental, energy issues, and legislative movements that prompted the development of alternative vehicles. Alternative drive systems, energy converters, energy storage devices, and fuels.

The class is project based. In the class, students will learn to design a drive system and size the main driveline components of a given vehicle for given driving parameters. Students will learn to model vehicles and vehicle drive components.

---

### TANTÁRGY TARTALMA / DESCRIPTION

#### Contents:

Modeling and simulation of alternative vehicles  
Backward looking and forward looking simulation models  
Complete vehicle dynamic model  
Final drive model, Clutch model  
Transmission model  
Internal Combustion Engine Model  
Fuel consumption l/100 km, CO2 emission model g/km  
Electric motor model  
Battery model  
Series Hybrid electric vehicle model  
Control strategy of e series hybrid  
Parallel Hybrid Electric Vehicle model  
Control strategy of a parallel hybrid

#### Prerequisite knowledge/ Knowledge for self-study:

Environmental issues, decreasing oil reserves, emission standards in Europe, USA, and Japan, challenges...  
Alternative energy, energy converters, internal and external combustion engines, architecture and operating principles.  
Electric machines, motors, alternators, inverters, converters, architecture and operating principles.  
Hybrid-electric drive systems, architecture and operating principles. Series, parallel.  
Hybrid-electric drive systems, architecture and working principles. Combination, power split.  
Fuel cells. Architecture and working principles.  
Alternative fuels. F-T diesel, bio-diesel, ethanol, methanol, hydrogen.  
Decreasing exhaust gas emissions and fuel consumption with alternative drive technology.  
Testing principles of alternative vehicles, methodical differences, standards and recommended practices.

---

### **SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESSMENT'S METHOD**

Continuous course work. Students will prepare project works. They will be graded on their project works.

---

### **KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL**

Textbook of the class by Dr. Tóth-Nagy

Bosch Yellow Jackets: Hybrid Drives, Fuel Cells, Alternative Fuels, ISBN-13: 978-0-8376-1606-3, Robert Bosch GmbH, 2008

Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi: Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, ISBN 9781138330498, 2018

---

### **AJÁNLOTT IRODALOM / RECOMMENDED MATERIAL**