

## Tárgytematika / Course Description

### Fundamentals of Internal Combustion Engines

AJNB\_BMTA002

Tárgyfelelős neve /

Teacher's name: dr. Hanula Barna

Félév / Semester: 2020/21/2

Beszámolási forma /

Assesment: Vizsga

Tárgy heti óraszám /

Teaching hours(week): 3/0/1

Tárgy féléves óraszám /

Teaching hours(sem.): 0/0/0

---

### OKTATÁS CÉLJA / AIM OF THE COURSE

#### Aim of the course

The aim of the course is to combine the laws of heat and fluidity with practical technical solutions. During the semester, students will be able to deepen their engineering thinking while also understanding the thermal and fluid dynamics of vehicles. Internal combustion engines provide an excellent opportunity to analyze and solve complex problems. To this end, the curriculum addresses today's state-of-the-art solutions, but also shows some important milestones of development, always going from cause to effect.

---

### TANTÁRGY TARTALMA / DESCRIPTION

#### Week 1:

*Basic:*

Engine Engineering Tasks, Realized Cycle Processes, Their Characteristics (Fuel, pV Diagrams)  
Grouping of Engines by Cycle, Cylinder, and Cooling Mode  
Principles, Design, and Construction of 2 and 4 Stage Otto and Diesel Engines

#### Week 2:

*Basics of:*

Thermodynamics Characteristics and description of thermodynamic state indicators, quantities and state changes, description and representation of the Carnot cycle, description and representation of the Otto, Diesel, and Seiliger S. cycles.  
Graphic interpretation and solution of engineering tasks.

#### Week 3:

*Basic:*

Engine Equations Engine characteristic dimensions, characteristic quantities of the gas exchange process (air ratios, air absorption and charge rate), concept of indicated and effective power, analysis of charge change flow diagram. Analysis of shell charts. Interpretation of the difference between combustion heat and calorific value. Comparison of air absorption and charge level

#### **Week 4:**

*Charge Change:*

Flow Dynamics, Flow Change Process (Bernoulli's Law, Pressure Types, Critical Speed), Charge Change Control (Grouping, Types, Valve Arrangements)

#### **Week 5:**

*Combustion Processes:*

Fuel Properties, - Characteristics, - Combustion (Density, Spontaneous Ignition, Measurement, Block Schemes) Ignition of gasoline-air mixture, - Ignition and - Combustion (spark plug, ignition delay, flame front, knock burn)

Diesel fuel injection, inflammation and burning

#### **Week 6:**

*Energy Conversions, Efficiency, Losses:*

The concept of efficiency, perfect Otto and Diesel engine efficiencies (approximations)

Types of losses, - routes, - ratios of Otto and Diesel; suction and charge engines

#### **Week 7:**

*Emissions Emissions:*

Typical ways, locations and causes of emissions in Otto and Diesel engines. Emission Limit Values Possibilities for Treatment of Forged Pollutants (Catalyst Varieties, Particulate Filters)

Triple Catalyst Operation Based on

Air Condition, Causes and Explanations Reduction of Inner Engine Exposure (Non-Treatment Procedures)

Exhaust Gas Recirculation Mechanism of Effect NO<sub>x</sub>. Operation of the SCR catalyst and deNO<sub>x</sub> catalyst.

#### **Week 8:**

*Mixture formation:*

The task, types, types of Otto engines (carburetor, injection systems, homogeneous, layered mixture)

The task of secondary charge movements (turbulence), - The types of Otto and Diesel engines

The task of diesel injection systems,

#### **Week 9:**

*Basics of heat transfer, cooling:*

Basic cases of heat propagation, their characteristics

Processes of convective heat exchange, influence of flow types Flame radiation process, its relation to temperature

Cooling of internal combustion engines, types of cooling

#### **Week 10:**

*Upload:*

The purpose, necessity, types and limits of the upload. Turbocharger design, operation, characteristics and operating limits. Regulation of turbochargers, construction and methods of turbocharging systems. Characteristics, types, advantages and disadvantages of mechanical filling systems

#### **Week 11:**

*Turbocharger Efficiency, Cooling:*

Development of Mechanical and Turbocharger Efficiency Depending on their Pressure Ratio and Volume Flow Advantages, - Thermodynamic Significance and - Construction Methods and Characteristics of Charged Air Cooling. Diagram of compressor processes in Ts diagram. Representation of turbine processes in Ts diagram.

Two-stage charge with intermediate cooling (Ts diagram)

#### **Week 12:**

*Pumps:*

Characteristics of fluid flow in a pipe, grouping of pumps

Types of displacement pumps, their principle of operation and their field of application. Construction, principle of operation of swirl pumps, - function according to impeller design (straight, forward and backward curved blades). Special pump types.

Euler turbine equation and vector diagrams. The concept, effects and avoidance of cavitation

---

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

Mid semester and final exam

Assessment:

- 0 - 49% 1
- 50 - 59% 2
- 60 - 69% 3
- 70 - 79% 4
- 80 - 100% 5

Written exam at the end of the semester (oral exam in case of unsuccessful written exam)

---

## KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

### Compulsory literature

- Dezsényi-Emőd-Finichiu: Design and Investigation of Internal Combustion Engines / Textbook Publisher, 1990 /;
- Dr. Kalmar - Dr. Stukovszky: Processes of Internal Combustion Engines / Műegyetemi Kiadó, 1998 /;
- <http://www.motorlexikon.de/>

### Recommended literature

- Univ.-Prof.Dr.techn. F.Pischinger: Verbrennungsmotoren Band I, II;
  - Rudolf Pischinger, Manfred Klell, Theodor Sams: Thermodynamik der Verbrennungskraftmaschine: Der Fahrzeugantrieb / SpringerWienNewYork, 1989 /;
  - John B. Heywood: Internal Combustion Engine Fundamentals / McGraw-Hill, 1988 /;
  - Richard Basshuysen, Fred Schaefer: Handbuch Verbrennungsmotor: Grundlagen, Komponenten, Systeme, Perspektiven / Vieweg + Teubner Verlag, 2012 /
-