Tárgytematika / Course Description

Fundamentals of Internal Combustion Engines

AJNB_BMTA002

Tárgyfelelős neve / Teacher's name: dr. Hanula Barna
Félév / Semester: 2019/20/2
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 3/0/1
Tárgy féléves óraszáma / 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 NOx. Operation of the SCR catalyst and deNOx 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 /