Tárgytematika / Course Description

Drivetrain development for racing applications

AJNM_BMTA028

Tárgyfelelős neve / Teacher's name: dr. Hanula Barna
Félév / Semester: 2022/23/2
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 2/0/0/0
Tárgy féléves óraszáma / Teaching hours(sem.): 0/0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

Goal of the subject

Students can learn high-level application of individual engineering competencies and the ability to work efficiently in a team within the frame of project work while designing racing applicated optimized components. During the documenting and presenting this project on a weekly basis, as well as active participation in the lecturer's lectures, the course aims to as-sist in the preparation of diploma, TDK documents, professional publications and any other scientific and engineering work.

TANTÁRGY TARTALMA / DESCRIPTION

The content of the subject

On the first week of the semester, after the introduction of various topics related to motor-sport - pre-defined by the Department of Internal Combustion Engines -, student teams will be compiled to fulfill the given project. Of course, consular help is available for each topic for the student teams. Requirements for the completion of the course will be defined, covering both the expected result of the given task, the level of presentations and documentation submitted, as well as the field of continuous class attendance and consultation.

In the following weeks, in the lecturer's presentations, students will learn about the charac-teristics of racing engines, the need for unique developments and the challenges they face. They can also gain insights into the design and optimizing processes of crankcases, crankshafts, and other components optimized for motorsports, the use of various types of chargers, and other essential elements for successful racing such as engine applications. During the lectures, students can acquire engineering-level presentation competencies, and in the second half of the lesson, use forms of practical application of consulting skills. The weekly schedule of lectures is as follows:

1. ICloseCurlyQuotell be an engineer

This is the introductory lecture of the course, which aims to motivate students to work actively, passionately and successfully on their work during the presentation of the competencies required for becoming an engineer. By introducing examples, you can learn about the essential elements of efficient work (timeplan making, appoint-ment of responsible, consultation, presentation, documentation)

2. The importance and application of mass optimization

With the same power level, we can achieve greater acceleration by reducing the we-ight of the racing vehicle. For this reason, the so-called mass optimization has partic-ularly importance in the design phase of racing cars and engines, where the aim is to load its function with the smallest possible mass. The presentation presents its possi-bilities and software implementations. You can get to know the technology of 3D printing and its great potential in this field.

3. Designing a crank mechanism

In racing vehicles - powered by internal combustion engines - the energy released during combustion is converted into mechanical energy by the crank mechanism. The components involved in the transformation are all part of a complex stress system, from which the crankshaftCloseCurlyQuotes loads are elaborated. After defining tasks and require-ments, we can gain insight into the possibilities of mass optimization, the importance of balancing the free mass forces, and the steps of geometry formation.

4. Valve control

The function of the valve control mechanism is to regulate the processes of the air charge of internal combustion engines. Setting the control times basically determines the performance and torque characteristics of the internal combustion engines, so it is important to know the parameters of the settings, the influencing factors, and the limitations of the system. In addition, designing example of various elements of valve control is also presented.

5. Turbocharging

One of the most frequently used tool of boosting performance in an internal combus-tion engine is the charging process. In this presentation, we can gain insight into the construction of the turbocharger from among the chargers working on different prin-ciples. You can learn about the components that make up the turbocharger, their ma-terial and manufacturing technology, and the control strategy of the charger unit. Finally, a detailed derivation can be used to observe the steps of coordinating turbo-chargers with the engine. This is the so-called matching procedure.

6. ECUs and engine calibration

One of the key to the operation and use of internal combustion engines is the engine control unit and its proper functioning. This presentation introduces the principles of engine control, calibration and thermodynamic optimization. After discovering the application on the testbench, processes such as the implementation of traction cont-rol or the detection and control of knocking combustion are also shown.

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

Rating

This project work is conditional on the presentation of actual workflows on a weekly basis and the preparation of project documentation for these workflows. The professional level and formal criteria of the documentation are the same as those described in the thesis requ-irements. The rules of the MSc thesis template on the bmt.sze.hu website apply to the structure of the thesis. The full scope of the document must be a work of its own. In the case of plagiarism, the dissertation is inadequate. Content references are governed by the rules of the thesis template. The team's work must meet the engineering standards of an MSc thesis.

During the semester the teams present their own works twice (mid-term and end-of-term). During these presentations, students can use their previously mentioned lecture skills within the frame of the course.

The course also requires the execution and documentation of the work done at the engineer-ing level. With the preparation of this and its consultative feedbacks, the course aims to pro-vide assistance in the creation of thesises, TDK documents, and other engineering publications.

Students are awarded the mark for their semester project work in the following divisions:

40% The professional content of the documentation.
40% Level of the presentations.
20% Formal requirements of the documentation.
The min. 60% of the points from each section is required

The individual marks are based on individual performance allocation and the feedbacks of the consultant.

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

Literatures

1, Michael Trzesniowski: Rennwagentechnik [Wiessbaden 2008]

2, Gál Péter, Csizmazia József: Gépjárműmotorok II-III [Nemzeti Tankönyv kiadó]

3, Dezsényi György, Emőd István, Finichiu Liviu: Belsőégésű motorok tervezése és vizsgálata, [Nemzetközi Tankönyvkiadó Rt, Budapest 1999]

4, Bosch kézikönyvek: Motorelektronika

5, Frank Tibor, Kovács Miklós: Befecskendező és motorirányító rendszerek [Maróti könyvkereskedés]

6, Hermann Hiereth, Peter Prenninger: Charging the internal combustion engine [Springer-Verlag, Wien 2003]

7, Michael Costin, David Phipps: Racing and sports car chassis design, B.T. Batsford LTD London

8, Alan Staniforth, Competition car suspension, 2006 Haynes Publishing

9, Carroll Smith, Engineer to win understanding car dynamics, Motorbooks Workshop

10, Prof. Dr.-Ing. Mario Theissen, Dipl.-Ing. Markus Duesmann, Dipl.-Ing. Jan Hartmann, Dipl.-Ing. Matthias Klietz, Dipl.-Ing., 10 Years of BMW F1 engines, Ulrich Schulz , BMW Group, Munich

11, C.H.A. Criens, T. ten Dam, H.J.C. Luijten, T. Rutjes, Building a MATLAB based Formula Student simulator

12, Anthony M OCloseCurlyQuoteNeill, Chassis design for SAE racer, University of Southern Queensland 2005

13, Bradley John Moody, Control and instrumentation for the USQ Formula SAE-A race car, University of Southern Queensland 2005

14, Cristopher Scott Baker, FoES Formula SAE-A space frame chassis design, University of Southern Queensland 2004

15, Cristina Elena Popa, Steering system and suspension design for 2005 Formula SAE-A racer car, University of Southern Queensland 2005

16, Jeremy Little, Developement of the drivetrain including brakes and wheels for the Formula SAE-A vehicle, University of Southern Queensland 2004

17, Matthew Harber, Developement of a drivetrain system for a Formula SAE-A race car, University of Southern Queensland 2005

18, Travis William Mauger, Selection of an engine and design of the fuelling system for a Formula SAE car, University of Southern Queensland