

## Drive Train Optimization

**Code:** MFHAT31G04-EN

**ECTS Credit Points:** 4

**Evaluation:** ESE

Year, Semester: 3<sup>rd</sup> year/2<sup>nd</sup> semester

Number of teaching hours/week:

Lecture: 2

Practice: 2

**Prerequisites:** Machine Elements II. MFGEP32G05-EN,  
Manufacturing Processes III. MFGYT33G03-EN

### Topics:

This series of lectures is based on the topics of technical mechanics and machine elements. The course is aimed at designing a drive train that runs smooth at a moderate vibration. It comprises: ascertaining the excitation effects that act on the drive train, ensuring stable operation of the engine and the coupled machine, deriving the equation of motion of the drive train and modeling its torsion and banding vibrations. In particular, the course focuses on the application of dynamic models using a computer simulation program based on the frequency equations, how to calculate the natural frequencies, and how to tune or detune the natural frequencies from the excitation frequency. In the laboratory, vibration measuring is introduced along with testing pieces of equipment like amplifiers (Spider 8), transducers, and the application of measuring software (Catman).

### Literature:

1. Zsolt Tiba: Dynamic driveline modeling, ISBN 978-963-318-044-0, Kiadó: Debrecen University Press 2010., 109 pages
2. Zsolt TIBA, Géza HUSI: Mechanical Design of a Mechatronics System: Laboratory Handbook, Debrecen: [University of Debrecen Faculty of Engineering], 2012, ISBN: 978 963 473 525 0, 152 pages

### Schedule

<b>1<sup>st</sup> week:</b> <b>Lecture:</b> Prerequisite of performing the planned service life of a drive train. <b>Practice:</b> Load situations acting on a drive train.	<b>2<sup>nd</sup> week:</b> <b>Lecture:</b> Excitation effects, resonance phenomenon. <b>Practice:</b> Electric motors and internal combustion engine characteristics.
<b>3<sup>rd</sup> week:</b> <b>Lecture:</b> Prerequisite of smooth running of a drive train. <b>Practice:</b> Machinery characteristics.	<b>4<sup>th</sup> week:</b> <b>Lecture:</b> Motion equation of a drive train. <b>Practice:</b> Features of the equation of motion of a chain type drive train.
<b>5<sup>th</sup> week:</b> <b>Lecture:</b> Features of the equation of motion of a transmission type drive train. <b>Practice:</b> A gear drive transmission system. A belt drive transmission system.	<b>6<sup>th</sup> week:</b> <b>Lecture:</b> Features of the equation of motion of a forked type drive train. <b>Practice:</b> Forked transmission systems.
<b>7<sup>th</sup> week:</b> <b>Lecture:</b> Determination of the bearing stiffness. <b>Practice:</b> Calculation of the bearing stiffness of different type of rolling bearings.	<b>8<sup>th</sup> week:</b> <b>Mid-term test</b> <b>Lecture:</b> Operation characteristics of a cardan joint. <b>Practice:</b> Quasi homokinetic joints, homokinetic joints.
<b>9<sup>th</sup> week:</b> <b>Lecture:</b> The dynamic model of torsion vibration. Motion equation of torsion vibration. <b>Practice:</b> Frequency equation, determination of the natural frequencies of torsion vibration.	<b>10<sup>th</sup> week:</b> <b>Lecture:</b> The dynamic model of bending vibration. Motion equation of bending vibration. <b>Practice:</b> Matrix of motion parameters
<b>11<sup>th</sup> week:</b>	<b>12<sup>th</sup> week:</b>

<p><b>Lecture:</b> Derivation of the Transform matrix.</p> <p><b>Practice:</b> Considering the cardan joint in the drive, connecting matrix for a cardan joint.</p>	<p><b>Lecture:</b> Considering the flexible suspension in the drive, connecting matrix for flexible suspension.</p> <p><b>Practice:</b> Connecting matrix for excitation effects and for general situations.</p>
<p><b>13<sup>th</sup> week:</b></p> <p><b>Lecture:</b> Application of a dynamic model for general drive train cases.</p> <p><b>Practice:</b> A dynamic simulation computer programs and its application.</p>	<p><b>14<sup>th</sup> week:</b></p> <p><b>Lecture:</b> A dynamic simulation computer program and its application.</p> <p><b>Practice:</b> A dynamic simulation computer program and its application.</p>
<p><b>15<sup>th</sup> week:</b></p> <p><b>End-term test</b></p>	

### Requirements

#### A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. The attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the mid-term test in the 8<sup>th</sup> week and the end-term test in the 15<sup>th</sup> week. Students have to sit for the tests.

#### B, for a grade:

The course ends in an **examination (ESE)**.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**An offered grade:** It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.