Title: **Fundamentals of Vibration Engineering**

Lecturer: Prof. Dr.-Ing. habil. Dipl.-Math. Carsten Behn

Content & Aim: This course is an introduction to the dynamics and vibrations of lumped-parameter models of mechanical systems, i.e., mechanical vibration systems with finite degrees of freedom. Starting with several descriptions to govern the equations of motion for systems of particles and rigid bodies in planar motion, students will become familiar with the Lagrangian Equations of the 2nd kind, with the D'Alembert's principle, and Newton-Euler mechanics (Principles of Linear and Angular Momentum). Having these tools at hand, the following topics cover several vibration systems with a single degree of freedom, their analytical treatment and the development of substitution models for complex (nonlinear) systems. The lecture proceeds in introducing free undamped and damped systems, forced undamped and damped systems (from the general case to the harmonic one). After this course, students are able to evaluate free and forced vibration of linear/linearized mechanical systems and to determine the main characteristics of such systems in context to their vibration behavior.

Course outline:

1. Introduction
2. Modeling Aspects
3. Fundamental Laws from Dynamics
   (Newton-Euler, D'Alembert, Lagrange)
4. Classification of Vibration Systems and Modeling
5. Free undamped Vibrations with *DoF=1*
6. Free damped Vibrations with *DoF=1*
7. Forced undamped Vibrations with *DoF=1*
   (general case to harmonic one)
8. Forced damped Vibrations with *DoF=1*
9. Outlook to subsequent systems: *DoF=n*, *DoF=∞*

Level:	Bachelor: Mechanical Engineer (B.Eng.)
Language:	English
Necessary basics:	Kinematics, Dynamics
Teaching methods:	2 lectures (90 min.) per week, incorporated exercises
Workload:	150 hours (present time: 60h + self-study 90h)
Optional Add-On:	- Practical courses including setting up a report - Programming in Maple / MatLab
Credits:	5 ECTS-Credits
Course degree:	graded, written exam (120 minutes)
Recommended literature:	- R.C. Hibbeler: *Engineering Mechanics: Dynamics*, 12th edtion, Pearson - K. Zimmermann, I. Zeidis, C. Behn: *Mechanics of Terrestrial Locomotion*, Springer - J.P. Den Hartog: *Mechanical Vibrations*, Dover