Module DDM 4206 - Dynamics

1	Module Number	Study Programme	Semester	Offered in	Duration	Module Type	Workload (h)	ECTS Points
	4206	DDM	1	☒WS ☐SS	1 Semester	compulsory	120	4

2	Courses	Teaching and Learning Forms	Contact Time (SWS)	Contact Time (h)	Self-Study Time (h)	Language
	a) Multi Body Systems	Lecture	2	30	60	English
	b) Simulation of Multi Body Systems	Virtual Lab	2	30		

3 **Learning Outcomes and Competences**

Once the module has been successfully completed, the students can...

Knowledge and Understanding

- Explain the basic assumptions of simulating machine parts as rigid bodies.
- Explain the difference between rigid and flexible bodies.
- Model robots, automotive suspensions etc. as multi body systems (mbs).
- Describe the connections between rigid bodies by joints or force elements..
- Understand the fundamentals of rigid body dynamics.
- Understand the principles of the related software.

Use, Application and Generation of Knowledge

Use and Transfer

- Extract mbs input parameters from CAD models.
- Simulate motion and forces of mechanism.
- Create user defined force elements or joints.
- Analyse the results of multi body simulations.
- Visualise simulation results with computer animation.
- Familiarize themselves with new ideas and topics based on their basic knowledge.

Scientific Innovation

- Use methods and tools to gain new insights in the field of multi body simulation.
- Create new mathematical models for constraints between bodies.
- Optimize system topology and system parameters.
- Verify simulation results with experiments.
- Independently develop new algorithms for real time simulation of multi body systems.
- Develop concepts for integrating multi body systems into multi domain simulations.

Communication and Cooperation

- Work together with IT experts in simulation software development.
- Interpret the results of simulations and draw admissible conclusions.
- Communicate and cooperate with mechanical designers and testing engineers.

Scientific Self-Conception/ Professionalism

- Justify the solution theoretically and methodically.
- Reflect and assess one's own abilities in scientific research in that field.

4 **Contents**

a) Multi Body Systems:
Description of finite rotations, rotation matrix, speed and acceleration, forces and constraints, equations of motion, state-space equations, numerical solutions, user defined force elements.

b) Simulation of Multi Body Systems:
Introduction to Matlab Symbolic toolbox and Simcape. Modelling and Simulation of different examples with SimMechanics, e.g.: mechanical conveyor, hydraulic excavator,
Modelling and calibration of subsystems of "Esslingen Driving Simulator" and system integration in group work.

5 **Participation Requirements**

Compulsory: Fundamentals of engineering mechanics: coordinate systems kinematics, forces and torques, Newton's law of motion; Mathematics: Basic knowledge of ordinary differential equations

Recommended: Mathematical Methods in Engineering.

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6	**Examination Forms and Prerequisites for Awarding ECTS Points** Multi Body Systems: Written exam, 90 minutes, graded Simulation of Multi Body Systems: Group projects with presentations, not graded
7	**Further use of Module** Modules 4208 Design and Development 2, 4210 Vibrations and Acoustics 2
8	**Module Manager and Full-Time Lecturer** Prof. Dipl.-Ing. Mathias Oberhauser
9	**Literature** Lecture documents, Power point presentations, Tutorials for SimScape and SimMechanics Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner, Stuttgart, 1977. Schiehlen, O. W. : Multibody Systems Handbook, Springer Verlag, 1990.
10	**Last Updated** 29.04.2019