# 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.

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| 5 | **Participation Requirements**<br>Compulsory: Fundamentals of engineering mechanics: coordinate systems kinematics, forces and torques, Newton's law of motion; Mathematics: Basic knowledge of ordinary differential equations<br>Recommended: Mathematical Methods in Engineering. |
| 6 | **Examination Forms and Prerequisites for Awarding ECTS Points**<br>Multi Body Systems: Written exam, 90 minutes, graded<br>Simulation of Multi Body Systems: Group projects with presentations, not graded |
| 7 | **Further use of Module**<br>Modules 4208 Design and Development 2, 4210 Vibrations and Acoustics 2 |
| 8 | **Module Manager and Full-Time Lecturer**<br>Prof. Dipl.-Ing. Mathias Oberhauser |
| 9 | **Literature**<br>Lecture documents, Power point presentations, Tutorials for SimScape and SimMechanics<br>Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner, Stuttgart, 1977.<br>Schiehlen, O. W. : Multibody Systems Handbook, Springer Verlag, 1990. |
| 10 | **Last Updated**<br>29.04.2019 |