Course Descriptions CiE

Course code:

MFM12 (FK06)

Course title :

Multibody Dynamics

Hours per week:

4

Semester:

8 (graduate students)

Number of ECTS Credits allocated/work load:

5

Course contents:

Part I - Rigid Body Dynamics

1 Introduction to Flexible Multibody Dynamics

1.1 Introduction

1.2 Multibody System Characterization

1.3 Overview of Multibody System Programs

1.4 Multibody System Applications

1.5 Notations

1.6 Standard Tables

1.7 Notations of the Script and MBS-Programs such as SIMPACK

1.8 References

2 First Usage of Multibody Programs

2.1 Introduction

2.2 A First Model - The Pendulum

3 Kinematics of Rigid Multibody Systems

3.1 Basic Kinematics

3.1.1 Coordinate Systems or Reference Frames

3.1.2 A Vector in Frames K1 and K2 - Rotation Matrix

3.1.3 Spatial Rotations

3.1.4 Properties of Rotation Matrices

3.1.5 Computation of angles from a given rotation matrix

3.1.6 Using three reference frames

3.1.7 Homogeneous Transformation Matrices
3.2 Velocity and Acceleration of a Rigid Body
3.2.1 Angular velocity of the body fixed frame
3.2.2 Angular acceleration of the body fixed frame
3.2.3 Linear velocity of the body fixed frame
3.2.4 Linear acceleration of the body fixed frame
3.3 Velocity and Acceleration of an Additional Body Frame
3.4 Kinematics of a Rigid Body Using the MBS Notation
3.5 State Variables of a Rigid Body
3.6 Relative Kinematics of Body Interaction Elements
4 Dynamics of Rigid Multibody Systems
4.1 Linear and Angular Momentum, Rigid Body Data
4.2 Dynamical Equations of Motion of a Rigid Body
4.2.1 Newton and Euler Equations
4.2.2 Jourdain's Principle
4.3 Constraint Equations of Joints
4.3.1 Implicit Constraint Equations
4.3.2 Explicit Constraint Equations
4.4 Multibody System Equations of Motion
4.4.1 The DAE-System
4.4.2 The ODE-System
4.4.3 Summary about constraint equations and their formalisms
4.5 Solution Methods
4.6 Consideration of Force Elements
4.7 Applications II on Rigid MBS
4.7.1 Slider-Crank mechanism of an engine
4.7.2 Satellite with kinematical driven rigid arms

Part II - Flexible Body Dynamics

5 Introduction to Mechanics of Elastic Bodies
6 Introduction to Finite Element Method
7 Elastic Body Modelling in Multibody Dynamics

Prerequisites:

Mechanics I and II, Mathematics I and II, Computer mathematics, Modelling u. Simulation, matrix calculus.

Objective of the course/learning outcome:

Students will be able to

- understand the motion of rigid and flexible multibody systems attached by mechatronic components
- setup small multibody models using Math programs and MBS programs
- interpret the results of multibody dynamics and mechatronic systems.

Recommended Reading:

Wallrapp, O. (2008) Flexible Multibody Dynamics, Manuscript HM.
Schabana, A. (1998) Dynamics of Multibody Systems, Cambridge Univ Press
Schwertassek,R. and Wallrapp,0., (1999) Mehrkörperdynamik, Vieweg

Teaching methods:

Lecture, exercises in groups, homework and practical work by computer programs like Maple, Matlab, Simpack, projects.

Assessment methods:

Class Projects, Written Examination

Language of instruction:

English

Name of lecturer:

Oskar Wallrapp

Email:

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Link:

http://www.fh-muenchen.de/fb06/professoren/wallrapp/e_course_fmbd.html