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| Course Title | Modelling and Analysis of Dynamic Systems | | | | |
| Course Code | **MME 524** | | | | |
| Course Type | COMPULSORY | | | | |
| Level | MASTER/PHD | | | | |
| Year / Semester | Spring Semester | | | | |
| Teacher's Name | Loucas Louca | | | | |
| ECTS | 8 | Lectures / week | 2 x 1,5 hours | Laboratories / week | None |
| Course Purpose and Objectives | The purpose of the course is the teaching of a unified approach for modeling real systems with mechanical, fluid and electrical components and the understanding of the basic principles of modeling multi-energy domain dynamic systems, the derivation and simulation of bond graph models and calculate the behavior of dynamic systems through time and frequency responses. | | | | |
| Learning Outcomes | The students will be able to:<br>• perform systematic selection of ideal energy elements for modeling real dynamic systems,<br>• represent, lump parameter and multi-energy, dynamic systems with appropriate bond graph models,<br>• use causality and develop state variable differential equations describing the behavior of a dynamic system that its model is developed using bond graphs,<br>• calculate the time response through computer simulation of a system with mechanical, fluid and electrical components,<br>• identify the parameters of a system using the time response and the physical description of a system,<br>• analyze the correctness of the initial modeling assumptions through analysis and<br>• select the complexity of dynamic systems using systematic modeling methodologies such as deduction and reduction. | | | | |
| Prerequisites | No | Required | No | | |
| Course Content | The course is using a unified approach for abstracting real mechanical, fluid, and electrical systems into appropriate models in bond graph and state equation form to meet engineering design and control system objectives. The emphasis is not on the mechanics of deriving equations but rather on understanding how the engineering task defines the modelling objectives that determine what modelling assumptions are appropriate. The bond graph language, which is a graphical power topology of a dynamic system, is taught to help students easily represent models of multi-energy domain systems. This allows causality, as well as system analysis tools, to be used to determine the correctness of the modelling assumptions. In addition, model complexity is studied using systematic modeling methodologies (deduction and reduction). Problems in the form of homework are required to reinforce the theoretical concepts presented in the lecture. A final project on a topic of | | | | |

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| | the student's research area will reinforce the concepts taught in this course. At the end of the course, students will be able to develop models of dynamic systems for a specific application and given accuracy. |
| Teaching Methodology | Lectures 3 hours per week / Tutorials 1 hour per week<br>The teaching methodology includes lectures using the white/black board, demos of 20-SIM software, solving sample problems during lectures.<br>There is continuous communication with the instructor and active participation of the students in the class.<br>During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours. |
| Bibliography | Karnopp, D.C., D.L. Margolis, and R.C. Rosenberg, *System Dynamics: Modeling and Simulation of Mechatronic Systems*, 5th Edition, Wiley, 2012, ISBN 978-0470889084. |
| Assessment | Homework assignments (20%), individual Project (15%), midterm exam (30%), final exam (35%) |
| Language | GREEK OR ENGLISH |