

Course Title	<b>Modeling and Analysis of Dynamic Systems</b>				
Course Code	<b>MME 325</b>				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3 <sup>rd</sup> Year / 5 <sup>th</sup> Semester				
Teacher's Name	Loucas Louca				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	10 hours total
Course Purpose and Objectives	To teach a unified approach for the modeling of real systems with mechanical, thermal, fluid, and electrical elements. Models of dynamic systems are represented using suitable graphical form models and state space equations. Time and frequency response are calculated, and system parameters are identified. By the end of the course students will be able to model and analyze multi-energy domain dynamic systems in order to understand the dynamic interaction between different physical phenomena.				
Learning Outcomes	<ul style="list-style-type: none"> <li>• Perform systematic choices of ideal elements for modeling a real dynamic system with mechanical, thermal, fluid and electrical elements and their interactions.</li> <li>• Develop the differential equations that describe the input/output behavior of a dynamic system.</li> <li>• Compute the input/output transfer function of a dynamic system.</li> <li>• Compute the response using the Laplace transform of a linear system with an input that is a combination of simple functions.</li> <li>• Define the stability of a real system.</li> <li>• Compute the frequency response of high order linear systems.</li> <li>• Identify the parameters of a system using the time response and a dynamic model of the system.</li> <li>• Find the time and frequency response using computer simulation of a dynamic system.</li> </ul>				
Prerequisites	MAS 027, MME 225	Required	None		
Course Content	The course introduces a unified approach for modeling real dynamic systems. Modeling is accomplished using appropriate graphical or state-space equation models, in order to meet the requirements during the use of the models in design and automatic control. System analysis is used to calculate behavioral characteristics and to evaluate the accuracy of modeling assumptions. Topics taught include lumped parameter models; models with electric, fluid and thermal elements; interfaces; state-space equations; block diagrams; Laplace transforms – transfer functions; time and frequency domain response; stability. Students use Matlab/Simulink as a computational analysis tool. Laboratory exercises are used to identify parameters and demonstrate the interaction between different physical phenomena.				

	<p><b>Laboratory Exercises</b></p> <ul style="list-style-type: none"> <li>• Low-frequency electromechanical system</li> <li>• Fluid-Mechanical component interaction</li> <li>• Two-tank fluid system</li> </ul>
Teaching Methodology	<ul style="list-style-type: none"> <li>• Lectures using whiteboard</li> <li>• Recitation for solving sample problems</li> <li>• Laboratory exercises</li> <li>• Homework</li> <li>• Demos/exercises using Matlab/Simulink</li> <li>• Office hours</li> <li>• During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.</li> </ul>
Bibliography	<ul style="list-style-type: none"> <li>• Palm, W.J. III, <i>System Dynamics (2<sup>nd</sup> Edition – International Edition)</i>. McGraw-Hill, ISBN 978-0071267793.</li> <li>• Shearer, J.L., B.T. Kulakowski and J.F. Gardner, <i>Dynamic Modeling &amp; Control of Engineering Systems</i>. Prentice Hall, ISBN 13-356403-7.</li> <li>• Ogata, K., <i>System Dynamics</i>. Prentice Hall, ISBN 013-124714-X.</li> <li>• Karnopp, D.C., D.L. Margolis and R.C. Rosenberg, <i>System dynamics: Modeling and Simulation of Mechatronic Systems</i>. Wiley, ISBN 0471333018.</li> <li>• Doebelin, E., <i>System Dynamics: Modeling, Analysis, Simulation, Design</i>. Published by Marcel Dekker, ISBN 9780824701260.</li> </ul>
Assessment	<ul style="list-style-type: none"> <li>• Laboratory 15%</li> <li>• Midterm Exam 40%</li> <li>• Final Exam 45%</li> </ul>
Language	Greek/English