Catalog Description: EEC 443 Modeling and Simulation of Mechatronic Systems (3 credit(s))
Pre or co-requisite: EEC 440.
Unified approach to modeling of dynamic systems using bond graphs, with emphasis in electromechanical systems; object-oriented and automated modeling concepts; computer simulation.


Coordinator: Hanz Richter, Associate Professor, Mechanical Engineering

Course Objectives: This course is designed to:
Introduce students to modern approaches to modeling and simulation of engineering dynamic systems. Provide skills enabling students to carry the modeling-simulation-model validation cycle required in mechatronic system design. Introduce object-oriented and automated modeling concepts with the use of bond graph-based software for automatic equation generation.

Expected Outcomes: Upon completion of this course, students should be able to:
1. Identify the most appropriate route to model generation.
2. Construct dynamic models of electrical, mechanical and mixed systems.
3. Perform computer simulations for model validation.
4. Use a validated model as a tool for design.

Fulfills the Following Electrical Engineering Program Objectives and Outcomes:

Objectives: 1. Practice mechanical engineering in Fluid Thermal/Energy Conversion and/or Machine System stems of the discipline in private, government or industrial organizations.
2. Practice mechanical engineering in environments that require a variety of roles including engineering problem definitions, application of advanced methods of analysis, problem diagnosing, solution of real-world engineering design problems that are subject to realistic constraints such as cost, safety, etc.
3. Take the role of a team member or team leader in the engineering profession of their employment, in professional organizations.
4. Enhance their knowledge beyond BS level, a life long learner, and keep current with the advancements in engineering and technology.

Outcomes: Ability to apply math, science, and engineering knowledge.
(c) Engineering design of mechanical systems, units and processes.
(e) Identification, formulation and solution of engineering problems.
Prerequisites by Topics:

1. Vibrations
2. Differential Equations
3. Electrical Circuits
4. Computer Programming

Topics:

1. Course introduction. Definition and relevance of mechatronics 2
2. Introduction to modelling concepts and approaches 4
3. Ported systems and bond graphs 4
4. Basic component modelling 10
5. State Space models and linear response 8
6. Object-oriented and automated modelling 6
7. Guided project work: model generation 3
8. Midterm examination 2
9. Final group presentations 4
10. Holidays 2

Total lecture/laboratory hours 45

Computer Usage: Matlab will be used for numerical simulation. Other specialized software will be introduced and provided for automatic modeling tasks.

Design Projects: Students are expected to design an op-amp signal conditioning circuit for a temperature sensor and an audio amplifier circuit.