IHE 7712 – Advanced Model-Based Approaches for Systems Analysis

Course Description
Introduction into the use of advanced model-based computer simulations for analysis of various industrial engineering-related analyses. Topics include three basic types of simulation: Systems Dynamics, Discrete Event, and Agent-Based, with the emphasis on the last. The course will outline the basic steps of a simulation-based analysis, beginning with the formulation of an appropriate problem statement, developing use cases/scenario vignettes, adapting a simulation to instantiate those cases, defining and implementing a simulation experimental design. The course will be heavily hands-on; students will learn by performing their own simulation-based analysis project.

Offered both face-to-face and online
Graduate level – 3 credit hours

Course Learning Objectives
Students enrolled in this course will learn to:

• Understand and implement the three basic simulation methodologies
• Understand and implement multi-modal methodologies
• Understand and apply the principles and procedures of simulation-based analysis
• Identify and formulate a problem for simulation-based analysis
• Identify and formulate appropriate use cases/scenario vignettes
• Identify and document critical assumptions, constraints, factors, and factor interactions
• Develop an appropriate mathematical model
• Implement that model by adapting/developing an appropriate simulation using the software platform and example models provided
• Develop and execute an appropriate simulation design of experiments for that problem
• Analyze the results, develop appropriate conclusions and recommendations
• Clearly and concisely present the model, simulation design, and the insights obtained from the analysis

Course Learning Outcomes
Upon successful completion of this course, students can:

• Understand and implement the three basic simulation methodologies
• Understand and implement multi-modal methodologies
• Understand and apply the principles and procedures of simulation-based analysis
• Identify and formulate a problem for simulation-based analysis
• Identify and formulate appropriate use cases/scenario vignettes
- Identify and document critical assumptions, constraints, factors, and factor interactions
- Develop an appropriate mathematical model
- Implement that model by adapting/developing an appropriate simulation using the software platform and example models provided
- Develop and execute an appropriate simulation design of experiments for that problem
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**Tentative Weekly Schedule**

**Week 1**
- Introduction to Simulation-Based Analysis
- Introduction to Anylogic

**Week 2**
- Sim Modeling Methods
- Sim Modeling Methods

**Week 3**
- Systems Models and Simulation Modeling
- Discrete Event Simulation

**Week 4**
- Modeling Complex Systems
- Discrete Event Modeling and the Enterprise Library

**Week 5**
- Systems Dynamics Modeling
- Stocks and Flows, Eqn.s
- Systems Dynamics Modeling
- Example Models

**Week 6**
- Agent Based Modeling
- Agent Basics
- Agent Based Modeling
- Networks & Communications

**Week 7**
- Agent-Based Modeling
- Example Project
- Exam 1

**Week 8**
- Introduction to State Charts
- State Chart Elements
- Introduction to State Charts
- Transitions

**Week 9**
- Events
- Java: Classes, Variables, Functions

**Week 10**
- Java: Expressions, Statements, Collections
- Any logic
- Presentation and Animation

**Week 11**
- Project Reviews
- Design of Simulation Experiments

**Week 12**
- Randomness in AnyLogic
- Any logic Data Input/Output

**Week 13**
- Exam 2
- Verification and Validation

**Week 14**
- Project Reviews
- Project Reviews

**Week 15**
- Final Exam