EE 501: Simulation Modeling and Analysis

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| **Lecture Schedule** | | See Time Table | **Course Type,**  **Semester** | Elective, Mandatory for Computer Stream, Spring | | |
| **Credit Hours** | | Three | **Pre-requisite** | Linear Algebra, Signals and Systems, undergraduate course in probability, Basic Programming skills (C/C++, Matlab, Java, etc.) | | |
| **Instructor** | | Dr. Fahim Gohar Awan | **Contact** | [fawan@uet.edu.pk](mailto:fawan@uet.edu.pk) | | |
| **Office** | | 1st Floor,  Room # 1, Research Center  EE Department | **Office Hours** | Tuesday 04:00 pm to 06:00 am  Thursday 04:00 pm to 06:00 pm | | |
| **Teaching Assistant** | | None | **Lab Schedule** | None | | |
| **Course Description** | | This is a graduate level course in simulation, modeling and analysis with applications in Electrical Engineering. One of the ways of studying complex systems is through modeling and simulation, which are used as tools to represent these systems in a virtual environment. Current advances in computing performance (which has been a major constraint in this field for some time) allow for the simulation these kinds of systems within reasonable time horizons. | | | | |
| **Measurable Learning Outcomes** | **CLOs** | **Description** | | | **PLOs,**  **Levels** | **Taxonomy Domain & Level** |
| CLO1 | Understand the fundamental features and basic building blocks and features of Complex Systems. Familiarize with Agent Systems and Analyze its various Models | | | PLO 1  Medium | Cognitive 2 |
| CLO2 | Analyze relationships using Mutual information, coefficient-of-determination, correlation and other statistical measures | | | PLO 2  Medium | Cognitive 4 |
| CLO3 | Understand System Dynamics, Discrete Event Modeling | | | PLO 1  Medium | Cognitive 2 |
| CLO4 | Apply Multi-Approach Modelling, Systems-of-Systems, Complex System Modeling in Energy and implement the performance of Complex Systems Via C/C++ or MATLAB | | | PLO 3,5,9,10  High | Cognitive 3 |
| **Textbooks** | | **REQUIRED**:  Enrique Kremers. *Modelling and Simulation of Electrical Energy Systems through a Complex Systems Approach using Agent-Based Models*. KIT Scientific Publishing, 2013.  **OPTIONAL**:  Axelrod R. The complexity of cooperation: agent-based models of competition and collaboration. Princeton University Press, 1997. | | | | |
| **Grading Policy vis-à-vis CLO Mapping** | | * Class Participation (Not Attendance) 20% CLO7 * Quizzes (~6 to 8) 10% CLO1 to CLO2 * Midterm 30% CLO 1 to CLO2 * Final 40% CLO 3 to CLO4 | | | | |

**Lecture Plan**

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| **Weeks** | Topics | **Readings & CLOs** |
| **1\*** | Introduction to Simulation Modeling and Analysis with applications to Electrical Engineering | **Notes**  **CLO1** |
| **1\*** | Properties and Features of Complex Systems | **Ch. 2, Book 1**  **CLO1** |
| **2\*** | Electrical Energy Systems: A Complex Systems Approach | **Ch. 2, Book 1**  **CLO1** |
| **1\*** | Representation of Simulation Models | **Ch. 3, Book 1**  **CLO1, CLO2** |
| **2\*** | Agent Systems, Models and Simulations | **Ch. 3, Book 1**  **CLO1** |
| **3\*** | System Dynamics, Discrete Event Modelling, Multi-Approach Modelling, Systems-of-Systems, Complex System Modelling in Energy | **Ch. 3, Book 1**  **CLO3, CLO4** |
| **2\*** | Agent-Based Models for Energy Systems | **Ch. 4, Book 1**  **CLO1** |
| **2\*** | Challenges of the Electrical System, Simulation and Modelling Tools, Storage and Smart Grid measures, | **Ch. 4, Book 1**  **CLO2, CLO3** |
| **2\*** | Wind Farm Case Study, Wind Simulator Implementation, Demand Side Management Implementation through UFLS, Implementation of the Systemic Model | **Ch. 5, Book 1**  **CLO4** |
| **3\*,+** | Simulation Results and Discussion, Low/High Wind Speed Day, Heterogeneous Parameterization of the Agents **Discussion on Research Papers** | **Ch. 6, Book 1**  **CLO4** |

**\* -** Tentative, + - Time Permitting

**Note**: All simulations need to be developed using C/C++ or MATLAB