

**Approval: 9<sup>th</sup> Senate Meeting**

**Course Number:** EN 605

**Course Name:** Modeling and Simulation of Energy Systems

**Credits:** 2-0-2-3

**Prerequisites:** None

**Intended for:** UG/PG.

**Distribution:** Compulsory for M. Tech in Energy Engineering and elective for others

**Semester:** Odd/Even

**Preamble:** The course is aimed to provide the students with general tools of modelling and simulation as applied to energy systems.

**Course Modules:**

1. Physical Modelling – Dimensional analysis and dimensionless groups, Similarity criteria, development of physical models based on similarity and dimensionless group. Application of physical modelling to energy systems (6 contact hours)
2. Mathematical modelling – Continuous time dynamic modelling through differential equation, lumped parameter and distributed parameter models, Input-output models, transfer function, state space models and their transfer functions, models for control, transient and steady state response, stability; Simulation of models by MATLAB, applications of dynamic modelling and simulation to energy management in ships and PV systems. (8 contact hours)
3. Fuzzy logic Modelling – Fuzzy sets, membership function, operations with fuzzy sets, Fuzzy knowledge, Fuzzy inference systems, fuzzy approach to identify power transformer criticality, data clustering to evolve fuzzy models, design of fuzzy logic controller for optimal control of boiler-turbine system. (5 contact hours)
4. Artificial neural network (ANN) modelling – Neuron, Neural network and its architecture, training, validation and test of the back propagation network (BPN), modelling of solar distillation system, ANFIS models. (6 contact hours)
5. Non-traditional techniques of optimization - simulated annealing and genetic algorithm. (3 contact hours)

**Text Books:**

1. Similarity and Modeliling in Science and Engineering by Josef Kunes, Cambridge International Science Publishing, 2012.
2. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall India,
3. Fuzzy logic with eEngineering Applications by Timothy J. Ross, John Wiley & Sons, 2010
4. Neural Networks by Simon Haykin, Pearson Education,Inc,1999
5. Optimization for Engineering Design by K. Deb, Prentice Hall India Pvt. Ltd.,1991