COMPLEX SYSTEMS (CSYS)

Courses

CSYS 213. Systems & Synthetic Biology. 3 Credits.
Applying engineering tools to the design and analysis of biomolecular processes, gene regulatory networks, nonlinear dynamics in molecular biology, biological circuit design, biological signal processing. Prerequisite: Background required: Differential Equations, Linear Algebra, Programming. Cross-listed with: MATH 213, EE 213.

CSYS 221. Deterministic Models Oper Rsch. 3 Credits.
The linear programming problem. Simplex algorithm, dual problem, sensitivity analysis, goal programming. Dynamic programming and network problems. Prerequisites: MATH 122 or MATH 124; MATH 121 recommended. Cross-listed with: MATH 221.

CSYS 226. Civil Engineering Systems Anal. 3 Credits.
Linear programming, dynamic programming, network analysis, simulation; applications to scheduling, resource allocation routing, and a variety of civil engineering problems. Pre/co-requisites: Minimum Senior standing in CEE or Instructor permission. Cross-listed with: CE 226.

CSYS 245. Intelligent Transportation Sys. 3 Credits.
Introduction to Intelligent Transportation Systems (ITS), ITS user services, ITS applications, the National ITS architecture, ITS evaluation, and ITS standards. Pre/co-requisites: CE 140 or equivalent; Instructor permission. Cross-listed with: CE 245.

CSYS 251. Artificial Intelligence. 3 Credits.
Introduction to methods for realizing intelligent behavior in computers. Knowledge representation, planning, and learning. Selected applications such as natural language understanding and vision. Prerequisites: CS 103 or CS 123; CS 104 or CS 124; STAT 153 or equivalent. Cross-listed with: CS 251.

CSYS 253. Appl Time Series & Forecasting. 3 Credits.
Autoregressive moving average (Box-Jenkins) models, autocorrelation, partial correlation, differencing for nonstationarity, computer modeling. Forecasting, seasonal or cyclic variation, transfer function and intervention analysis, spectral analysis. Prerequisites: CE 211 or CE 225; or CE 141 or CE 143 with Instructor permission. Cross-listed with: STAT 253.

CSYS 256. Neural Computation. 3 Credits.
Introduction to artificial neural networks, their computational capabilities and limitations, and the algorithms used to train them. Statistical capacity, convergence theorems, backpropagation, reinforcement learning, generalization. Prerequisites: MATH 122 or MATH 124 or MATH 271; STAT 143 or STAT 153 or equivalent; CS 110. Cross-listed with: STAT 256, CS 256.

CSYS 266. Chaos, Fractals & Dynamical Syst. 3 Credits.
Discrete and continuous dynamical systems, Julia sets, the Mandelbrot set, period doubling, renormalization, Henon map, phase plane analysis, and Lorenz equations. Co-requisite: MATH 271 or MATH 230 or Instructor permission. Cross-listed with: MATH 266.

CSYS 268. Mathematical Biology & Ecology. 3 Credits.
Mathematical modeling in the life sciences. Topics include population modeling, dynamics of infectious diseases, reaction kinetics, wave phenomena in biology, and biological pattern formation. Prerequisites: MATH 122 or MATH 124 or MATH 230 or Instructor permission. Cross-listed with: MATH 268.

CSYS 300. Principles of Complex Systems. 3 Credits.
Introduction to fundamental concepts of complex systems. Topics include: emergence, scaling phenomena and mechanisms, multi-scale systems, failure, robustness, collective social phenomena, complex networks. Students from all disciplines welcomed. Pre/co-requisites: calculus and statistics required; Linear algebra, differential equations, and computer programming recommended but not required. Cross-listed with: MATH 300.

CSYS 302. Modeling Complex Systems. 3 Credits.

CSYS 303. Complex Networks. 3 Credits.
Detailed exploration of distribution, transportation, small-world, scale-free, social, biological, organizational networks; generative mechanisms; measurement and statistics of network properties; network dynamics; contagion processes. Students from all disciplines welcomed. Pre/co-requisites: MATH 301/CSYS 301, calculus, and statistics required. Cross-listed with: MATH 303.

CSYS 312. Adv Bioengineering Systems. 3 Credits.
Advanced bioengineering design and analysis for current biomedical problems spanning molecular, cell, tissue, organ, and whole body systems including their interactions and emergent behaviors. Cross-listed with: ME 312.

CSYS 350. Multiscale Modeling. 3 Credits.

CSYS 352. Evolutionary Computation. 3 Credits.
CSYS 355. Statistical Pattern Recognition. 3 Credits.
Analysis of algorithms used for feature selection, density estimation, and pattern classification, including Bayes classifiers, maximum likelihood, nearest neighbors, kernels, discriminants, neural networks, and clustering. Prerequisite: STAT 241 or STAT 251 or Instructor permission. Cross-listed with: STAT 355, CS 355.

CSYS 359. Applied Artificial Neural Networks. 1-3 Credits.
Introduction to artificial neural networks. A broad range of example algorithms are implemented in MATLAB. Research applications to real data are emphasized. Pre/co-requisites: STAT 223, CS 016/CE 011, or Instructor permission. Cross-listed with: CE 359.

CSYS 369. Applied Geostatistics. 3 Credits.
Introduction to the theory of regionalized variables, geostatistics (kriging techniques): special topics in multivariate analysis; Applications to real data subject to spatial variation are emphasized. Pre/co-requisites: STAT 223 or STAT 225; CS 016/CE 011 or Instructor permission. Cross-listed with: STAT 369.

Masters thesis research under the supervision of a graduate faculty member. Prerequisite: Instructor permission.

CSYS 392. Masters Project. 1-6 Credits.
Masters Project under the supervision of a graduate faculty member. Prerequisite: Instructor permission.

CSYS 395. Special Topics. 1-18 Credits.
See Schedule of Courses for specific titles.