# COEN 4860: Introduction to Neural Networks and Fuzzy Systems

**Class Schedule:** 3 Credit course meeting the equivalent of two 75-minute class periods per week.

**Course Coordinator**: Dr. Richard J. Povinelli

**Course Materials:**

## **Required:** "Neural Network Design" by Martin Hagan, Howard Demuth, and Mark Heale, PWS Publishing, 1996.

**Course Description:**

Concepts of artificial neural network architectures and training algorithms, supervised and unsupervised learning, linear and non-linear neural networks, feedback neural networks, applications in scientific and engineering areas, fundamentals of fuzzy sets and fuzzy logic, fuzzy rules and inference systems, fuzzy pattern classification and clustering analysis and fuzzy control systems.

**Prerequisites**: COSC 2010 and MATH 1451

**Selected Elective** in ELEN Computer Hardware & Software area, COEN Intelligent Systems area (breadth and depth)

**Contribution to Professional Component**:

Engineering Science 50 %

Engineering Design 50 %

**Course Goals:**

This course will provide students with the principle of artificial neural networks and fuzzy logic systems, with the emphasis of engineering applications. Students will also learn how to apply them to solve real-world problems.

**Course Objectives:**

*By the end of this course, students should be able to*

1. identify problems in various scientific and engineering areas that are suitable for neural network and fuzzy logic solutions.
2. effectively perform acquisition and preprocessing of data from the operational environments.
3. select appropriate neural network models and architectures for the identified problems.
4. choose either supervised or unsupervised training algorithms for the selected neural network models and architectures.
5. be proficient to derive mathematical formula for the neural network training algorithms.
6. develop fuzzy logic inference systems for the selected problems.
7. implement fuzzy inference system to solve scientific and engineering problems.

**Contribution to Program Objectives**: partial fulfillment of Criterion 3 objectives A, C, E, F, G, I, K

**Course Topics:**

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| Topic | Weeks |
| Introduction and Fuzzy Set Theory | wk1 |
| Fuzzy Set Relations | wk2 |
| Fuzzy Logic and Inference Systems | wk3 |
| Fuzzy Control | wk4 |
| Fuzzy Control and System Applications  Test One | wk5 |
| Intro to ANN | wk6 |
| Single and Multiple layer Perception Learning Rule | wk7 |
| Review of Vector Space and Widraw-Hoff learning | wk8 |
| Introduction to Optimization Theory | wk9-10 |
| Test Two | wk10 |
| Back-propagation Learning ANN | wk11 |
| Associate Learning ANN | wk12 |
| Competitive Learning and Kohonan Feature Maps | wk13 |
| Hopfield ANN | wk14 |
| Final Project Presentation | wk15 |

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