FACULTY OF ENGINEERING

CIVIL ENGINEERING DEPARTMENT

COURSE OUTLINE

***Soft Computing in Civil Eng.***

Course Information:

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| **Course Unit Title** | Introduction to soft computing |
| **Course Unit Code** |  |
| **Type of Course Unit** | Ph.D. and Master's |
| **Level of Course Unit** | Graduate and Post-Graduate |
| **Number of Credits** | 3 |
| **Number of ECTS Credits** | - |
| **Theoretical (hour/week)** | - |
| **Practice (hour/week)** | - |
| **Year of Study** | 1 or 2 |
| **Semester** | 2 |
| **Course Coordinator** | Prof. Dr. Vahid Nourani https://scholar.google.com/citations?user=rGeDVgkAAAAJ&hl=en |
| **Name of Lecturer** | Prof. Dr. Vahid Nourani |
| **Name of Assistant(s)** | - |
| **Mode of Delivery** | Face to Face and Distance Learning |
| **Language of Instruction** | English |
| **Prerequisites** | B.Sc. in Engineering or Sciences |
| **Optional Program** | - |

Course Audiences:

Not only water resources students but also students of other fields of Civil Engineering, Agricultural and Earth Sciences can select and use this course. In addition to water resources problems, geotechnical, structural and environmental applications of soft computing tools will be presented.

Objectives of the Course:

The purpose of this course is to give an introduction to soft computing and basic understanding of tools in the emerging field of hydroinformatics for the practicing engineer. It also offers gaining practical experience in using these tools within other fields of Civil engineering (e.g, environmental, Structural and geotechnical engineering fields).

General overview of the input data and simulation models in water management.

Acquisition of individual experience in the use of hydroinformatics through execution of a term project.

Learning Outcomes:

Upon completion of the course, the student will be able to:

a) be able to make appropriate and critical use of soft computing tools in civil engineering in general and in water resources engineering in particular;

b) be able to identify suitable methods and tools for solving allocation problems;

c) be able to critically assess research results;

d) improve skills for independent learning, reporting and presentation; improve IT skills;

e) to perform time series modeling and forecasting;

f) to parameter estimation of conceptual models;

g) multi-resolution analysis of climatic parameters

h) work with related toolbox of MATLAB

Texts:

Required readings will be posted on the class website or distributed in class.

Some potential references, but not required:

Kumar, P., (2005), Hydroinformatics: Data Integrative Approaches in Computation, Analysis, and Modeling, CRC Press, 552

Abbott, 1991, Hydroinformatics- Information Technology and the Aquatic Environment, Avebury Technical, Aldershot, U.K

Nielsen, 2016, Neural Networks and Deep Learning, Web-book. <http://neuralnetworksanddeeplearning.com/index.html>

Tayfur, G., 2012, Soft Computing in Water Resources Engineering, WIT press, UK

Assessment:Attendance & Assignment 10%

Mid-term Exam (Written) 20%

Final Exam (Written) 30%Term Paper-Project 40%

Course Schedule and Contents

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| Third Week of March | Day | Time  First 90 min. Second 90 min. | |
| Day 1 | Hydroinformatics:  Introduction and concepts | Data Pre-processing |
| Day 2 | An overview of MATLAB | Commands and functions of MATLAB |
| Day 3 | MATLAB toolboxes | Statistical analysis by MATLAB |

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| Fourth Week of March | Day | Time  First 90 min. Second 90 min. | |
| Day 1 | Introduction to ANN | Ann Concepts |
| Day 2 | MATLAB NNTOOL | Applications, hydrological time series forecasting |
| Day 3 | Applications, concrete strength estimation | Mid-term Exam |

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| Third Week of June | Day | Time  First 90 min. Second 90 min. | |
| Day 1 | Fuzzy theory and sets | Fuzzy logic |
| Day 2 | ANFIS Modeling | ANFIS toolbox of MATLAB |
| Day 3 | ANFIS for rainfall-runoff , seepage and contaminant transport modeling | Methaheuristic Optimization Method, GA |

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| Fourth Week of June | Day | Time  First 90 min. Second 90 min. | |
| Day 1 | GA Concepts | GA toolbox of MATLAB |
| Day 2 | GA, application for calibration of hydrological models | GA application for optimization of structures (Dam, truss, Channel) |
| Day 3 | Basics of GP | GP, applications |