Florida International University
Department of Civil and Environmental Engineering

Optimization in Water Resources Engineering (CGN 5930)
Spring 2020

Credit Units: 3

Catalog Description: This course will present the fundamentals of optimization techniques such as non-linear methods, pattern search and genetic algorithms and their applications to various water resources engineering problems. The applications will include optimal operation of multi-objective and multi-reservoir systems, flood control, optimal design of hydraulic structures, optimal design and operation of water distribution systems and pumping stations. The course will primarily use MATLAB along various freely available water resources engineering simulation models.

Instructor: Arturo S. Leon, Ph.D., P.E., D.WRE
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Office hours: by appointment (please send me an e-mail)

Date and Time of Class: Wednesday **5:00PM - 7:40PM**
Classroom: Engineering Center (EC) 3278

Pre-requisite: CWR3540 Water Resources Engineering or permission of instructor

Course Learning Outcomes:
At the end of the course, students should be able to:
1) understand optimization concepts
2) formulate, design and solve optimization models of water resources engineering
3) integrate systems outputs into decision making

Textbook/Reading: Online free textbooks, listed below, will be used. Handouts and notes will be provided by the instructors through Canvas.

1. Managing Water Resources: Methods and Tools for a Systems Approach by Slobodan P. Simonović (http://www.slobodansimonovic.com/waterbook.pdf)
2. Introduction to Optimization Analysis in Hydrosystem Engineering by Ehsan Goodarzi, Mina Ziaei, Edward Zia (https://link.springer.com/book/10.1007%2F978-3-319-04400-2)
3. Water Resources Systems Planning and management. By Daniel P. Loucks and Eelco Van Beek (http://unesdoc.unesco.org/images/0014/001434/143430e.pdf)
4. Practical Optimization: A Gentle Introduction. By Chinneck. Free online at: http://www.sce.carleton.ca/faculty/chinneck/po.html

Websites of interest:
1. http://www.frontsys.com. This is the Frontline Systems website. Frontline and Lasdon jointly developed the Excel Solver, and Frontline markets enhanced solvers for Excel.
2. http://www.ece.nwu.edu/OTC/. This is the website of the Optimization Technology Center at Argonne National Laboratories. It contains relevant information and software. It also allows you to submit an optimization problem to them and get a solution.
3. www.gams.com. This is the GAMS Development Corporation website. GAMS is a widely used algebraic modeling language for optimization.
4. http://www.iitk.ac.in/kangal/codes.shtml. This is the website of Prof. Kalyanmoy Deb. This page contains the source code of the multi-objective genetic algorithm NSGA-II that will be used in this course.

Academic Misconduct:
Academic or scholarly dishonesty is an act of deception in which a student seeks to claim credit for the work or effort of another person, or uses unauthorized materials or fabricated information in any academic work or research, either through the student's own efforts or the efforts of another. FIU Students are expected to uphold the standards of academic integrity and the policies of the University regarding conduct. Cheating and plagiarism will not be tolerated; these offenses could result in failing the course, and suspension or expulsion from the University. Refer to the FIU Student Code of Conduct for full details on what constitutes academic dishonesty and misconduct, as well as the procedures for resolution of pertaining matters within the University judiciary procedures - https://studentaffairs.fiu.edu/get-support/student-conduct-and-conflict-resolution/

Course material:
Course material (lecture notes, homeworks), etc will be made available through Canvas (https://canvas.fiu.edu/). **Old** course material and software is posted in the course website at http://web.eng.fiu.edu/arleon/Teaching_Optimization.html

Student Attendance:
Attendance is mandatory and up to one unjustified absence will not affect your Assistance/ Participation score. Eight absences or more will result in a course grade of "F". For a number of absences between 2 and 8, points will be deducted depending on the number of absences up to a maximum of 10 points.

FIU Policies:
The instructor will comply and enforce all applicable FIU's Policies. Students are responsible for knowing all applicable academic policies and their requirements. Students should also refer, for details, to the *FIU Student Handbook* (which includes the Student Code of Conduct) at https://studentaffairs.fiu.edu/about/student-handbook/index.php

Homeworks (HW):
Four homeworks will be assigned. Homeworks are due at the **beginning of the class** on the due date (see course schedule below). Late homeworks **will not** be accepted. If you will be out of town, make arrangements to have a friend turn in your homework for you. Feel free to discuss your solutions with your classmates. However, **you need to submit an individual** homework. **Group submissions will not be accepted.**

Final Exam:
The final exam will be comprehensive and will test general understanding of the course.

Grading:
The course grade is based on the following components:

Homework: 30%
Final Exam: 25%
Course Project: 35%
Oral Presentation 10% (8%- Content, 2%-Delivery),
Written Report 25% (20% - Content, 5% - Composition)
Class attendance/In-class problem solving (up to 10%)

Letter grades will be assigned as follows:

92.0 or higher	A
90.0 – 91.99	A-
88.0 – 89.99	B+
82.0 - 87.99	B
80.0 – 81.99	B-
78.0 – 79.99	C+
65.0 - 77.99	C
45.0 - 64.99	D
44.99 or lower	F

Course Schedule (Tentative)

Week	Date	Topics	Homework	Out date	Due date
1	8-Jan	Overview of optimization in Water Resources Engineering			
2	15-Jan	Introduction to Classical Optimization	**HW #1**	15-Jan	29-Jan
3	22-Jan	Introduction to Global Search			
4	29-Jan	Multi-objective and hybrid optimization	**HW #2**	29-Jan	12-Feb
5	5-Feb	Simplified Applications in Water Resources Engineering			
6	12-Feb	Simplified Applications in Water Resources Engineering	**HW #3**	12-Feb	4-Mar
7	19-Feb	Genetic Algorithms			
8	26-Feb	Spring Break (No Classes)			
9	4-Mar	Application of optimization techniques to hydropower operation, **Project assignment**	**HW #4**	4-Mar	18-Mar
10	11-Mar	Application of optimization techniques to hydropower operation			
11	18-Mar	Application of optimization techniques to hydropower operation			
12	25-Mar	Application of optimization techniques to flood control			
13	1-Apr	Application of optimization techniques to flood control			
14	8-Apr	Application of optimization techniques to flood control			
15	15-Apr	Project Presentations			
16		Final Exam (date and time of final exam is set by the University)			