WVU Department of Civil & Environmental Engineering

CE 543: Water Quality Modeling-Analysis

Three (3) Semester Credit Hours

ESB-E 501, 12:00 PM-12:50 PM, Monday, Wednesday, and Friday, Spring 2018

Objectives: This is as an "introductory to advanced" level course for graduate students to gain basic understanding and applied skills on the fundamental concepts, theories and methods of water quality modeling and analysis for stream, river, lake and estuarine environments. Water quality distributions, trends, and compliance with regulatory standards would also be discussed. Emphasis will be given to the development of ***user-friendly, robust models as ecological engineering tools*** to predict surface water quality for achieving sustainability under a changing climate, land use/cover, and environment.

Method of Instructions: As opposed to a traditional one-way lecturing by the instructor, we will adopt an "***inductive learning***" approach for this class. Inductive learning can be defined as a platform to incorporate a range of instructional methods, including *case studies*, inquiry learning, problem-based learning, project-based learning, team-based learning and collaborative learning. Students will be grouped into several teams. Each team will lecture on assigned topics, while others will participate with in-class discussion. ***Please note that each student will present his/her part of each chapter/project; everyone will prepare for an entire chapter so that s/he can present any part decided by the instructor during the class.*** Students will work in groups to identify open-ended, poorly structured real-life environmental problems and propose their own solutions following ecological-water resources engineering principles. All teams will interactively work and collaborate on different components of a single term-project, preparing a single presentation and a report (journal manuscript format). Instructor will mainly act as a facilitator and mentor.

Prerequisite: Permission of the instructor**. Corequisite:** None.

Instructor: Omar I. Abdul-Aziz, Ph.D.; Office: ESB 313; Tel: 304-293-9926; Email: oiabdulaziz@mail.wvu.edu. Office hours: 3:30 PM-4:30 PM, Tuesday/Thursday.

TA: N/A; Email: N/A.

Text book: *Surface Water-Quality Modeling.* Authors: Steven C. Chapra. Waveland Press Inc., Long Grove, IL. ISBN 10: 1-57766-605-4; 844 pages.

Reference book: *Principles of Surface Water Quality Modeling and Control.* Author: Robert V. Thomann, and John A. Mueller. HarperCollins *Publishers* Inc., NY. ISBN 0-06-350728-5; 644 pages.

Supplemental Materials: Peer-reviewed journal papers; (ii) Handouts.

Procedures: Students are expected to read the text and/or other assignments thoroughly.

Evaluations: The learning objectives/outcomes will be achieved/evaluated through assignments, exams, and a collaborative term project; invoking profound learning, analyses, syntheses, and stimulating discussions. The term project will involve interactive and coordinated team-learning based ***case study developments***. Based on the comfort level of the class with the inductive-learning methods (as obtained from the students' feedback from the initial weeks of class), topic for the term project can be open to selection by the students; the instructor will provide guidance, as needed for each student. Report for the term project should be submitted in the form of a journal manuscript. Grades would vary based on individual student contributions to the scientific merit and quality of reports and presentations.

Assignments and ppt presentations: 30%; Exams: 40%; Term-project: 30%.

Instructor reserves the right to modify any evaluation criteria. Here is a tentative grading policy: 93.3 ≤ A ≤ 100.0; 90.0 ≤ A- < 93.3; 86.7 ≤ B+ < 90.0; 83.3 ≤ B < 86.7; 80.0 ≤ B- < 83.3; 76.7 ≤ C+ < 80.0; 73.3 ≤ C < 76.7; 70.0 ≤ C- < 73.3; 66.7 ≤ D+ < 70.0; 63.3 ≤ D < 66.7; 60.0 ≤ D- < 63.3; F < 60.0.

Course Outline

Date	Topics	Text Reference Chapter(s)
1/8	Course overview, objectives, expected outcomes, and evaluations	
1/10	Introduction	Lecture 1 (Chapra)
1/12	Introduction	Lecture 1 (Chapra)
1/15	*University Closed: Martin Luther King Day*	
1/17	Reaction Kinetics	Lecture 2 (Chapra)
1/19	Pollutant Mass Balance: Steady-State Solutions	Lecture 3 (Chapra)
1/22	Pollutant Mass Balance: Steady-State Solutions	Lecture 3 (Chapra)
1/24	Pollutant Mass Balance: Particular Solutions	Lecture 4 (Chapra)
1/26	Pollutant Mass Balance: Particular Solutions	Lecture 4 (Chapra)
1/29	Feedforward Systems of Reactors	Lecture 5 (Chapra)
1/31	Feedforward Systems of Reactors	Lecture 5 (Chapra)
2/2	Feedback Systems of Reactors	Lecture 6 (Chapra)
2/5	Feedback Systems of Reactors	Lecture 6 (Chapra)
2/7	Basic Computational Methods: Well-Mixed Reactors	Lecture 7 (Chapra)
2/9	Basic Computational Methods: Well-Mixed Reactors	Lecture 7 (Chapra)
2/12	Contaminant Diffusion	Lecture 8 (Chapra)
2/14	Contaminant Diffusion	Lecture 8 (Chapra)
2/16	Distributed Systems in Steady-State	Lecture 9 (Chapra)
2/19	Distributed Systems in Steady-State	Lecture 9 (Chapra)
2/21	Time-Variant Distributed Systems	Lecture 10 (Chapra)
2/23	Time-Variant Distributed Systems	Lecture 10 (Chapra)
2/26	Control-Volume Approach: Steady-State Solutions	Lecture 11 (Chapra)
2/28	Control-Volume Approach: Steady-State Solutions	Lecture 11 (Chapra)
3/2	Simple Time-Variable Solutions	Lecture 12 (Chapra)
3/5	Simple Time-Variable Solutions	Lecture 12 (Chapra)
3/7	Advanced Time-Variable Solutions	Lecture 13 (Chapra)
3/9	Modeling and Analysis of Stream/River Water Quality	Lecture 14 (Chapra)
3/12	*Spring Recess; no class*	
3/14	*Spring Recess; no class*	
3/16	*Spring Recess; no class*	
3/19	***Exam-1 (on Lectures 1-13)***	
3/21	Modeling and Analysis of Stream/River Water Quality	Lecture 14 (Chapra)
3/23	Modeling and Analysis of Estuarine Water Quality	Lecture 15 (Chapra)
3/26	Modeling and Analysis of Estuarine Water Quality	Lecture 15 (Chapra)
3/28	Modeling and Analysis of Water Quality in Lakes and Impoundments	Lecture 16 (Chapra)
3/30	*University Closed*	
4/2	Modeling and Analysis of Water Quality in Lakes and Impoundments	Lecture 16 (Chapra)
4/4	Modeling and Analysis of Sediment Transport in Streams/Rivers	Lecture 17 (Chapra)
4/6	Modeling and Analysis of Sediment Transport in Streams/Rivers	Lecture 17 (Chapra)
4/9	Evaluations of Model Sensitivity and Predictions	Lecture 18 (Chapra)

4/11	BOD and Oxygen Saturation in Aquatic Environments	Lecture 19 (Chapra)
4/13	BOD and Oxygen Saturation in Aquatic Environments	Lecture 19 (Chapra)
4/16	Streeter-Phelps' Model for Stream Dissolved Oxygen (DO)	Lecture 21 (Chapra)
4/18	Streeter-Phelps' Model for Stream Dissolved Oxygen (DO)	Lecture 21 (Chapra)
4/20	Streeter-Phelps' Model for Stream DO: Distributed Sources	Lecture 22 (Chapra)
4/23	Streeter-Phelps' Model for Stream DO: Distributed Sources	Lecture 22 (Chapra)
4/25	***Term-Project Presentation***	
4/27	***Term-Project Presentation***	
TBD	***Exam-2 (on Lectures 14-19, 21-22)***	
5/5	***Term-Project Report Due***	

Important Notes:

This is a course "outline", which can be revised by the instructor to implement the concepts of "dynamic curriculum" based on the continuing progress and response of the class. You will be informed if changes are made. Assignments, project reports and presentations must be emailed to the instructor and members of all teams prior to the class. Attendance is critical for a successful completion of this inductive learning-based class. Therefore, each student needs to be present in every class unless subject to some extraneous circumstances; the presentations and participations will be graded. Delayed entry interrupts the lecture; please come on time.

Absence at tests: **N/A.**