Principles of Surface Water Quality Modeling, CE 585, Spring 2024

Department of Civil, Construction, and Environmental Engineering, NC State University

Meets:	Tuesdays and Thursdays 11:45-1:00 EB3 2220
Instructor:	Dan Obenour, Ph.D., P.E.; Fitts-Woolard Hall 3205, drobenour@ncsu.edu
	Office Hours*: Tuesdays and Thursdays 4:20-4:50 (all students) Tuesdays 4:50-5:10 (EOL students only)
Teaching Assistant:	Smitom Borah, sborah@ncsu.edu.
	Office Hours*: Mondays 4:20-4:50 (all students) Mondays 4:50-5:25 (EOL students only) Thursdays: 9:45-10:15 (all students)
	*Please sign up 24 hours in advance using spreadsheet on Moodle.
Webpage:	https://wolfware.ncsu.edu/ (Moodle)
Prerequisites:	Courses in environmental processes (e.g., CE 373) and quantitative calculus-based hydrology (e.g., CE 383) or permission of instructor.
Text:	*Surface Water-quality Modeling.* 2008. S. Chapra. Waveland Press.

Course Overview: This course addresses how human inputs affect natural and engineered aquatic systems, through mathematical modeling of system dynamics. Course topics integrate physical, chemical, and biologic processes related to pollutants and lower food-web dynamics. Lectures and assignments cover both theory and application. Applications are relevant to informing management, protection, and restoration of inland and coastal waters.

Course Objectives: This class will teach students to develop, apply, and critically evaluate surface water quality models. Modeling problems will typically address how natural and engineered aquatic systems respond to pollutant loads and other environmental factors. The course will first teach students to model generic substances within different settings (rivers, lakes, etc.), subject to reaction, settling, diffusion, dispersion, volatilization, and advection. The course will then cover the more complex and interrelated dynamics associated with specific water quality constituents of common management interest (e.g., dissolved oxygen, nutrients, temperature, algae). While it is impossible to cover all potentially relevant water quality constituents within a single course, the course will provide students with the structure and fundamental principles to expand models to other potentially relevant substances.

Student Learning Outcomes:

1. Mathematically represent the fate and transport of conservative and non-conservative substances in streams, lakes, and other surface water bodies.
2. Based on first principles, develop analytical and numerical solutions to water quality modeling problems.
3. Identify and explain the bio-physical processes controlling dissolved oxygen, nutrients, phytoplankton, pathogenic bacteria, and other water quality constituents, and apply these processes within the modeling environment.
4. Identify and explain the bio-physical processes controlling important sediment-water fluxes within a water body, and apply these processes within the modeling environment.
5. Identify and explain the physical processes controlling temperature and heat within surface water systems and apply these processes within the modeling environment.
6. Explain and apply calibration, validation, sensitivity, and uncertainty analyses within the modeling environment.
7. Apply models to evaluate scenarios relevant to pollution control, engineering interventions, and hydro-climatological variability.

Grading Structure:

Homework and Participation	25%
Test 1	25%
Test 2	25%
Project and Presentation	25%

Course grades will be based on the standard grading scale (i.e., 97-100%=A+, 93-97=A, 90-93=A-, 87-90=B+, … , 60-63=D-, <60=F). Note that any course averages reported by Moodle are simple averages that do not reflect the weighting and policies outlined in this syllabus.

If you believe that the grading of an assignment was improper, please submit a brief written explanation within one week after the assignment is returned. After that time, revisions to grades will only be considered under extenuating circumstances.

Note that provisions will be made for students who miss an assignment with a valid, documented excuse (see below). The validity of an excuse is evaluated by the instructor. Examples of potentially valid excuses are illnesses and family emergencies. Documentation should include contact information for a responsible party (e.g., a doctor). Inform the instructor as soon as possible (before the absence, if possible) for full consideration.

Additional Class Policies:

Homework Assignments: Homework should be prepared and presented in a neat and orderly format to receive full credit. Include a brief problem statement and the background information required to solve the problem. In preparing your work, please consider the following aspects: (1) the overall approach was appropriate for the problem; (2) the assumptions you made for parameter values were appropriate; and (3) you accurately completed the calculations and provided answers in appropriate units. You are encouraged to discuss your assignments with other students, faculty, and professionals inside and outside of class. However, the actual writing and calculations should be your own, unless otherwise instructed. Many problems will benefit greatly from use of an electronic spreadsheet (e.g., MS Excel) or coding (e.g., Python). Do not print lengthy tables of data unless specified in the homework instructions. Most quantitative problems will be graded based on a demonstration of effort (80-90%) and providing the correct solution (10-20%). Selected problems may be graded in greater detail. Answer keys will be provided upon return of homework. One homework assignment may be due in the last week of class. The lowest homework grade will be dropped.

Class Discussion Forum: We are going to try to make use of the Moodle discussion forum this year. Please post any homework or lecture questions to this forum. All students are encouraged to read questions and consider responding. The TA and instructor will respond to questions within 24 hours (M-F), if appropriate. If you have not received a satisfactory answer within 24 hours, feel free to reach out to the TA and instructor by email. In general, do not post last-minute homework questions and expect an immediate response. I suggest starting your homework early to avoid such situations.

Participation: Students are expected to participate in in-class problem-solving sessions. To receive full participation credit, students should attend and participate in at least 75% of these sessions (allowances may be made for extenuating circumstances on a case-by-case basis). Participation is worth 5% of the class grade. EOL students may receive this credit by regularly participating in the Discussion Forum, or they may replace this portion of their class grade with their homework score.

Tests: Tests will be completed individually within the class period. If a test is missed with an approved excuse (see above), then a makeup test can be provided up to ~3 days after the original test date. Otherwise, the missed test will be replaced based on the student's performance on the other test.

Projects: Students may develop water quality modeling projects based on their research or professional interests (submit a brief project proposal to the instructor) or they may complete a project assigned by the instructor. Projects are typically completed in groups of 2-3. The project Memo and Final Report will typically be around 6 and 12 pages, respectively. Deliverables will be graded based on factors including

(but not limited to): organization, clarity, soundness of assumptions and logic, quality of results, efficient use of page space, appropriate citation, and quality of writing and graphics. Additional instructions will be provided later in the semester. The project Memo and Final Report are worth 4% and 15% of the class grade, respectively.

Presentation: Students engaged in the instructor-assigned project will present a research article or textbook chapter related to water quality modeling. Students who have developed their own projects may instead present their project, related literature, and preliminary results. Presentations will be graded based on content, organization, delivery, and graphical quality. Additional instructions will be provided later in the semester. The presentation is worth 6% of the class grade.

Late submission: Homework assignments and project reports are due at 11:00 pm on the due date (via Moodle). Late work will be penalized 25% if submitted up to 24 hours late and 50% if submitted from 24-48 hours late. After 48 hours, no credit will be received.

Pre-recorded lectures: Pre-recorded lectures will sometimes be posted on Moodle. They should be viewed before the relevant class date to ensure more time for problem solving, questions, and discussion in class.

General Policies:

N.C. State University Polices, Regulations, and Rules (PRR): Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus: http://policies.ncsu.edu/policy/pol-04-25-05 (Equal Opportunity and Non-Discrimination Policy Statement), https://diversity.ncsu.edu/policies/ (OIED policies), http://policies.ncsu.edu/policy/pol-11-35-01 (Code of Student Conduct), https://studentconduct.dasa.ncsu.edu/academic-integrity-overview/ (Academic Integrity) and http://policies.ncsu.edu/regulation/reg-02-50-03 (Grades and Grade Point Average). Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02).

Statement for students with disabilities: Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office (DRO) at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (NCSU REG 02.20.01).

Supporting Fellow Students in Distress: As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remains a healthy and safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you, either for the classmate's well-being or yours. When this is the case, I would encourage you to report this behavior to the NC State's Students of Concern website: https://prevention.dasa.ncsu.edu/nc-state-cares/about/. Although you can report anonymously, it is preferred that you share your contact information so they can follow-up with you personally.

Please also note services available at the Counseling Center: https://counseling.dasa.ncsu.edu/.