**Spring 2023 – CIV_ENV 395 PROJECTS PRACTICUM IN ENVIRONMENTAL ENGINEERING**
Mondays and Wednesdays: 9:30-10:50 am, M120

Prof. Ludmilla Aristilde
ludmilla.aristilde@northwestern.edu

*Office hours*: Wednesdays 3:30 pm to 4:30 pm

*Teaching Assistant*
Jade Basinski, jadebasinski@u.northwestern.edu

*Office hours:* To be determined

| | | | |
|---|---|---|---|
| *Course Grading:* | Case Study 1 | 150 | (15%) |
| | Case Study 2 | 200 | (20%) |
| | Case Study 3 | 200 | (20%) |
| | Quizzes (5) | 400 | (40%) |
| | Participation/Attendance | 50 | (5%) |
| | Total | 1000 | |

***Course Description and Objectives:***
This course will focus on the application of environmental engineering fundamentals to evaluate, model, and develop engineering solutions for different environmental contamination scenarios. Students will work in groups of "environmental consulting engineers" to address each problem scenario by designing engineering approaches to the problems, deriving mass balances of problem contaminants, applying differential equations to model biological and chemical transformations, evaluate cost-benefit analyses or implementation challenges of solutions.

Course Objectives:
1. Derive and apply equations to describe mass balances and reactions in environmental systems.
2. Solve environmental problems in different natural and engineered settings.
3. Develop and evaluate alternative engineering solutions.
4. Evaluate the complexity of problems and challenges faced by environmental scientists and engineers.

**COURSE OUTLINE:**
Week 1: 3/28; 3/29
Video: PCBs-a toxic legacy in the Hudson River
Course Overview
Review of Material Bass Balance
Environmental News
***Case Study 1 out 3/29***
Review Reactor Types
Review Deriving Material Mass Balance in Batch and continuously-mixed flow reactor (CMFR)

Week 2: 4/3; 4/5
Review Deriving Material Mass Balance in CMFR
*Engineering Problems*: Steady-state contaminated lake conditions
*Engineering Problems*: Transient contaminated lake conditions
Introducing Plug Flow Reactors (PFR)
Review Deriving Material Balance in Plug Flow Reactors (PFR)
*Engineering Reactor Performance*: Contaminant treatment using CMFR *versus* PFR

Week 3: 4/10; 4/12
**QUIZ #1 on 4/10 (Covers CMFR and Lake Pollution)**
Pollutant Categories; Clean Water Act (Video)
Reviewing Clean Water Act

Reviewing Clean Air Act
Clean Air Act (Video)
Air Pollutants and Emissions; Primary versus Secondary Air pollutants
*Engineering Problem:* Intermittent Air Pollution from smoking
*Engineering Problem:* Indoor air pollution from household item
***Case Study 1 due Friday 4/14,* 4:30 pm**

Week 4: 4/17; 4/19
**5-min flash presentation of environmental news on 4/17**
Introduction to Biochemical Oxygen Demand (BOD) and $BOD_5$
*Engineering Problem*: Estimating $BOD_5$
**QUIZ #2 on 4/19 (Covers CMFR and Air pollution)**
Interpreting BOD as a first-order decay of oxygen consumption.
Interpreting and modeling biochemical oxygen demand (BOD)
*Engineering Problem*: Interpreting a BOD experiment

Week 5: 4/24; 4/26
***Case Study 2 out 4/30***
*Engineering Problem*: River contaminant with Interfacial gas-liquid or sediment-liquid pollution dynamics
Modeling River Pollution with Interfacial Mass Transfer
River Pollution and Modeling downstream BOD
Introduction to deriving dissolved oxygen (DO) sag curve
**QUIZ #3 on 4/26 (Covers PFR)**
*Documentary video: Poisoned Water (1 of 5)*
Deriving DO Sag curve

Week 6: 5/1; 5/3
Deriving DO Sag Curve (continued)
*Engineering Problem*: City permit and meeting DO criterion.
*Engineering Problem*: River quality downstream of an Industry.
*Documentary video: Poisoned Water (2 of 5)*
Aquifers and Darcy's Law
Hydraulic Gradient

Week 7: 5/8; 5/10
**QUIZ #4 on 5/8 (Covers BOD and DO Sag Curve)**
*Documentary video: Poisoned Water (3 of 5)*
Case study 2 workshop on 5/8 (half of lecture)
Modeling flow through an aquifer
*Engineering Problems:* Groundwater contaminant transport
Deriving Contaminant transport through porous media
*Engineering Problem:* Lake Sediment Transport with different boundary conditions

Week 8: 5/15; 5/17
**20-min PowerPoint Presentation of Case Study 2 on 5/15**
Deriving Contaminant transport through porous media (continued)
*Engineering Problem:* Lake Sediment Transport with different boundary conditions
Wastewater treatment systems, Waste to energy
**Case Study 2 due Monday 5/16, 12 pm**
***Case Study 3 out 5/17***
*Documentary video: Poisoned Water (4 of 5)*
Review Deriving Material Bass Balance of Bioreactors
Modeling bioreactors

Week 9: 5/22; 5/24

**QUIZ #5 on 5/22 (Covers Contaminant Flow through Porous Medium)**
*Engineering Problem:* Modeling biological reactor design
*Documentary: Poisoned Water (5 of 5)*
Case study 3 workshop 5/24

Week 10: 5/29- *Memorial Day*; 5/31

**20-min PowerPoint Presentation of Case Study 3 on 5/31**
**QUIZ #6 on 5/31 (Covers Bioreactors)**
Environmental Pollution and Environmental Law (Video)
Overview of CIV-ENG 395
***Case Study 3 due Friday 6/2, 4:30 pm***

**Text:**
No textbook is required for this course. If needed, supplementary handouts will be provided.

**Assignments:**
Homework assignments and case studies and will be posted online. There will be three case studies and six quizzes, as indicated on the detailed course outline. Quizzes count for **80 points each**. The Quiz with the lowest score will be dropped.
Case study assignments will be due online (on Canvas) by the time indicated on the syllabus. You will be given about two weeks to complete each case study. Case studies count for **150 or 200 points each**.
*Penalty*: a 10-point penalty for each day a case study is late (A case study turned in at 4:31 pm is considered one-day late).

**Please note:** Each student in this course is expected to abide by the Northwestern University Code of Academic Integrity
*Quiz*: Cheating or absence during a quiz will result in an automatic zero for the quiz grade.
*Case study*: You will be working in pre-arranged groups of 2 or 3 (except for Case study 1).
**Grade Disputes:** If there is a dispute over the grading of a quiz or case study, I reserve the right to re-evaluate the entire work. A written explanation of the dispute will have to be turned in and the appropriate changes will be made and explained to the student. Any grade dispute should be turned in by the next class period after the assignment/ exam is returned to you.
**Special Needs**: Please notify me if you have or develop any documented disabilities or special circumstances that require attention. Appropriate accommodations will be made as soon as possible. Communication is key here. I am only able to help if you communicate to me your special needs.

**Emergencies:** To receive extensions on case-study assignments, documented medical or family emergencies are required. Extensions are not given for either professional or athletic trips. No extensions will be given after the graded solutions are posted a week later.
Your grade will be re-calculated to account for missed quizzes or case-studies due to emergencies.

**Class Participation:**
Active class participation is an integral part of the learning process and I encourage you to participate and ask questions in class.
*Attendance*: One-minute assignments will be given in class during each lecture throughout the quarter and will count towards your class participation grade (**30 points**). Additional **20 points** for in-class participation during lecture discussion.