SYLLABUS

ENE 806: ENVIRONMENTAL ENGINEERING PROCESS LAB

Spring Semester 2022

Time: Monday, Wednesday: 1:50 PM to 4:40 PM

Location: Room 3578, Engineering Building (Environmental Engineering Teaching Lab)

Until Jan 31, 2022, please connect via Zoom (link provided below) at the class time. When we are able to meet in person, please come to Room 3578, Engineering Building (Environmental Engineering Teaching Lab).

https://msu.zoom.us/j/97963487779 Passcode: ENE806

OBJECTIVE

At the end of this environmental engineering process lab course you will be able to formulate hypotheses related to environmental engineering processes of medium complexity, plan and design experiments, collect and analyze data to test the formulated hypotheses, use/validate mathematical models capable of describing the processes, and draw conclusions with due attention to statistical power and quality of data. You will also gain considerable experience in making presentations and writing technical reports.

EXPERIMENTS AND ENVIRONMENTAL PROCESSES

We plan to complete three experiments focusing on three different environmental engineering processes. All three experiments (and especially the third experiment) are somewhat open-ended meaning you may take the same general approach and propose tasks that go beyond the basic elements.

Experiment 1: **Disinfection Kinetics in Drinking Water Treatment: Online, completed individually; Experiment focused on modeling of disinfection kinetics using MATLAB.** 3-4 weeks

Parameters and Elements of Interest for this experiment include Models (Chick-Watson log-linear model, Hom model, Intrinsic Quenching model, Others); Pathogens (Microbial species, Protozoa, Viruses), Genes, Temperature, Contact Time, pH, Disinfectants Type and Dosage, etc. More details will be provided during the lecture on Jan 10.

Experiment 2: **In-person, completed as a two-person team; Experiment to be selected from the list below;** 4-6 weeks

At the start of Experiment 2, we will form teams (2 students per group; your choice is fine which will remain the same for Experiment 3 as well). Each team will select an experiment from the list of experiments given below. Additional consideration e.g., availability of probes, reagents, and set-up may be necessary before making the final selection. We will omit those experiments that involve handling of activated sludge, manure, or digested sludge due to SARS-CoV-2.

1. Granular Activated Carbon (GAC) Column for Removal of Emerging Contaminants
2. Oxygen Transfer Efficiency (K_{La})
3. Performance of Plug Flow Reactor and CSTRs in Series
4. Measurement of Indoor/Outdoor Airborne Particulate and Bacterial Density
5. Water Softening and Color Removal by Coagulation/Flocculation
6. Membrane Filtration
7. Head Loss during Sand Filter Backwashing
8. Anaerobic Digestion of Food Waste
9. Oxygen Uptake Rate in Activated Sludge Process
10. Nitrification Inhibition in Activated Sludge Process
11. Disinfection Kinetics in Plug Flow Reactors
12. Synthesis and SEM-based characterization of Silica Nanoparticles
13. Biosensors using Quartz Crystal Microbalance
14. Phosphorus Removal using Fluidized Bed Reactor
15. Kinetics of Biofilms Development using Continuous Microscopy
16. Bacterial Removal Efficiency in Home Water Filtration Units
17. Antibiotic Susceptibility Testing (AST)
18. Toxicity of Single Wall Nanotubes to *Escherichia coli*
19. Fabrication of a Low Flow Gas Sensor for Lab-scale Anaerobic Digester Monitoring
20. Catalytic Conversion of Chlorinated Solvents
21. Polymerase Chain Reaction-based Monitoring of Waterborne Pathogens

Experiment 3: **In-person, completed as a two-person team; Experiment to be designed by you as a team;** 4-6 weeks
For the third experiment, you have the option to design your own experiment in consultation with me. For a completely new third experiment, you should starts your discussions early on so ordering and receiving of materials and reagents can be completed while you are working on the previous experiment(s). Significant discussion is necessary for this option but the rewards are also substantial (experience of designing/creating something new is always more fun!).

APPROACH

In general, the approach for each experiment will involve Steps A through F:

A. Formulate a hypothesis based on literature review conducted by you for a given process/experiment,
B. Specify the parameters to be measured/data to be collected to test the hypothesis,
C. Extract the needed experimental data from literature or collect it experimentally in the lab,
D. Analyze the collected data to test the formulated hypothesis with due attention given to statistics,
E. Present the overall results documenting the hypothesis, parameters measured, and the outcome, and
F. Prepare and submit a final technical report.

GRADING POLICY

All experimental work is individually graded based on the points accumulated for each experiment as follows:

Experiment 1:	
Presentation for Exp 1 (15-min per person)	15%
Final Technical Report for Exp 1	15%
Experiment 2:	
Presentation for Exp 2 (15-min per team)	15%
Final Technical Report for Exp 2	15%
Experiment 3:	
Presentation for Exp 3 (15-min per team)	15%
Final Technical Report for Exp 3	15%
Student-initiated discussions, interim report/lab record, team etiquette, quizzes	10%
Total	100%

ATTENDANCE

Your attendance and work on the experiments is expected during lab hours for in-person classes.

- Until Jan 31, 2022, this meeting will be by Zoom. When we meet in person (based on the MSU directives we receive closer to that date), it will be in Room 3578 Engineering Building.
- If you plan to spend additional time outside the class hour when Joseph is not present in the lab, please arrange at least one additional team/lab member to be present. At the start of class time (1:50 PM on Mon and Wed), we will meet for 15- to 30-min (initially this may take more time) for planning/Q&A/discussion of progress. The remaining time will be used for conducting the experiments.

TEXTBOOK

There is no textbook for this course. Peer reviewed journal articles and other suitable material will be identified or provided as needed throughout the course. Conducting professional quality literature search is an expected component of this course. If you are unfamiliar with the tools available to conduct literature search, please consult me.

INSTRUCTOR

Syed A. Hashsham, Professor | 1449, Engineering Research Ct. Room A126
Phone 402 2692 | Email: hashsham@egr.msu.edu

INSTRUCTIONAL TECHNICIAN/LAB MANAGER

Joseph Nguyen, Office: 3578A Engineering Building | Phone: 353-0688 | Email: nguyenj@egr.msu.edu

ENVIRONMENTAL HEALTH AND SAFETY TRAINING

All lab experiments will be conducted in accordance with the rules implemented by the Environmental Health and Safety at MSU. Training modules are available at https://ehs.msu.edu/

When the face-to-face lab begins, Joseph Nguyen will show you the laboratory, provide the basic laboratory safety training, and get you a key to the laboratory (which must be returned at the end of this course). If you have already completed these as part of your graduate research lab work, the safety training may be waived but site-specific training will still be necessary. For your own safety and the safety of others, please also make sure that you do not work alone in the lab during evenings. Joseph will also help you get supplies and equipment that are available for use in all your experiments and help you with any issues related to finding lab equipment, components, and setting up the experiments.

CALENDAR

Holiday: Monday, 1/17
Spring Break: Monday 3/7 to Friday 3/11
Classes End: Friday, 4/29
Final Exams: Monday, 5/2 - Friday, 5/6
Commencements: Friday, 5/6 - Sunday, 5/8