SYLLABUS

ENE 806: ENVIRONMENTAL ENGINEERING PROCESS LAB

Spring Semester 2024

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

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

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 have a total of 14 weeks during which we have planned two experiments, each ranging from 4 to 8 weeks. The first set of experiments listed under Experiment I below (you are expected to choose only one from this set of experiments) is focused on physico-chemical processes important to environmental engineers. The second experiment, although constrained with respect to the setup and analytical techniques used, is open-ended. Using the experimental set-up and analytical techniques, you are expected to propose a hypothesis, carry out the required experiment to test it, collect data and analyze it, and based on the results, either prove or disprove the proposed hypothesis.

Experiment 1: **Experiment to be selected from the list below;** 4-6 weeks

At the start of Experiment 1, we will form teams of 2 students per group. Your choice is fine which will remain the same for subsequent experiment(s). Each team will select an experiment from the list of experiments below. Additional consideration e.g., availability of experimental set-ups, equipment, and probes may be necessary before making the final selection.

1. Oxygen Transfer Efficiency (K_{La}): (*Column with spargers and N_2/Air supply and O_2 probes*)
2. Performance of Plug Flow Reactor and CSTRs in Series (*Jar Tests Base and stirrer + CSTR*)
3. Water Softening and Color Removal by Coagulation/Flocculation (*Jar Tests Apparatus*)
4. Membrane Filtration (*Membranes and Pressure Vessel*)

Experiment 2: **An experiment designed by you involving anaerobic digestion in microcosms;** 6-8 weeks

For the second experiment, you have the option to design your own experiment in consultation with me focusing on the anaerobic digestion process studied in microcosms. You should start your discussions early so that if new chemicals are needed, they can be ordered and received while you are preparing the report of the previous experiment. Critical aspects of this experiment are proposing a hypothesis, setting up the experiment, and testing the hypothesis to prove/disprove it. Besides the routine set of equipment (pH meter, HACH COD digestion apparatus and spectrophotometer, Turbidimeter, etc.), this experiment will also provide you with an opportunity to learn one or more of the following analytical techniques:

1) Gas Chromatography (GC; *for measuring methane*)
2) High Performance Liquid Chromatography (HPLC; *for measuring volatile fatty acids*)
3) Quantitative Polymerase Chain Reaction (qPCR; *for measuring functions and organisms*)

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.

ATTENDANCE

- Your attendance and work on the experiments is expected during lab hours.
- 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.
- 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.

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

GRADING POLICY

Technical Report for Exp 1 (Graded as a group):	25%
Technical Report for Exp 2 (Graded as a group):	25%
Presentation (Graded as a group)	25%
Final Exam (Graded individually)	25%
Total	100%

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/

On the first day of classes in Spring 2024 (**Monday, Jan 8, 2024**), 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, 1/15
Spring Break: Monday 2/26 to Friday 3/01
Classes End: Friday, 4/21
***Final Exam*: Monday, April 22, 2024, 3:00 PM - 5:00 PM**
Commencements: Friday, 4/26 - Sunday, 4/28