Engineering Faculty Document No. 36-24
October 30, 2023

TO: The Faculty of the College of Engineering
FROM: The Division of Environmental and Ecological Engineering
SUBJECT: New undergraduate Course, EEE 36001

The Faculty of the Division of Environmental and Ecological Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

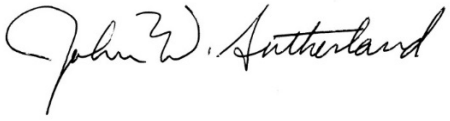
EEE 36001: Water Quality and Treatment Laboratory
Sem. 1, Lecture 2, Laboratory 2, Credits 3
Prerequisite: (Undergraduate level CE 35000 Minimum Grade of D- or Undergraduate level EEE 35000 Minimum Grade of D-) and (Undergraduate level CHM 11200 Minimum Grade of D- or Undergraduate level CHM 11600 Minimum Grade of D- or Undergraduate level CHM 13600 Minimum Grade of D- or Undergraduate level CHM 12600 Minimum Grade of D- or Undergraduate level CHM 12400 Minimum Grade of D- or Undergraduate level CHM 12901 Minimum Grade of D-) or (Undergraduate level CHEM C1220 Minimum Grade of D- and Undergraduate level CHEM C1020 Minimum Grade of D-) or (Undergraduate level CHEM C1060 Minimum Grade of D- and Undergraduate level CHEM C1260 Minimum Grade of D-)

Course description:
Laboratory procedures are described and performed that examine chemical, physical, and biological properties and constituent concentrations of natural waters. In addition, water treatment process experiments are performed to show how constituent concentrations can be altered during water treatment processes. Procedures include the analytical determination of several chemical and biological constituents in water by titrimetric, colorimetric, or chromatographic methods, whereas treatment processes include reactor design, pH adjustment, ion exchange, lime softening, coagulation, and disinfection. The learning outcomes for this course are:

1. Apply physical, chemical, and biological principles to each experimental procedure or measurement technique.
2. Conduct laboratory experiments, making quantitative measurements to assess water quality and water treatment process performance.
3. Organize, report, and graphically display experimental data in common software packages.
4. Analyze and evaluate experimental data on its quality and significance (i.e., usefulness).
5. Identify issues (i.e., problems) with data collection and data uses.

This course has been taught under the permanent course EEE 36000, which is a variable title, variable credit course in the Fall semester for approximately ten years. The new course, EEE 36001 is a permanent title, three credit course.

Reasons: As the EEE program has grown it has become necessary to clearly differentiate between the Fall and Spring versions of EEE 36000. In addition, the Registrar will not permit students to repeat and replace failing grades of a variable title, variable credit course.



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John W. Sutherland, Professor and Fehsenfeld Family Head
Division of Environmental and Ecological Engineering

Enrollment for the last five years has been
2023 – 60
2022 – 58
2021 – 60
2020 – 39
2019 – 48

Syllabus for Fall 2023 follows.

Syllabus, Fall 2023
EEE 36000 (005,008,009,010)
Environmental and Ecological Engineering Laboratory

Schedule: Lectures: Monday and Friday at 11:30 a.m. to 12:20 p.m. in HAMP 1144
Labs: (Sections 010 008 009) scheduled for Tuesday 11:30, 1:30, 3:20, respectively in HAMP 2146
Information for the class will be posted on Brightspace – download and print each lab write-up prior to the Monday Lecture

Instructors: Prof. Chad Jafvert
Office 3145D HAMP
Office hrs: **email me anytime** at jafvert@purdue.edu
and we will arrange a time to talk through Webex or in person

Description: Lecture 2 hr, Laboratory 2 hrs, credits 3. Prerequisites: none
Laboratory procedures are described and performed that examine chemical, physical, and biological properties and constituent concentrations of natural waters. In addition, water treatment process experiments are performed to show how constituent concentrations can be altered during water treatment processes. Procedures include the analytical determination of several chemical and biological constituents in water by titrimetric, colorimetric, or chromatographic methods, whereas treatment processes include reactor design, pH adjustment, ion exchange, lime softening, coagulation, and disinfection.

Academic Guidance in the Event a Student is Quarantined: Email Prof. Jafvert and he will accommodate as necessary. (This is true for other health related issues and for other personal reasons.)

Learning Resources: Handouts and notes will be provided for each laboratory exercise on Brightspace. Some additional and necessary information will be provided during MF lectures.

Assignments: Students will be evaluated based on the completeness and accuracy of laboratory reports and other assignments. Laboratory reports will be due at 9:30 am on the next Friday after the "lab week" (one week after data analysis for that lab is discussed). Each assignment will be delivered to the instructor during the Friday class period. Some late assignments may be approved if you contact Prof. Jafvert ahead of time.

Grading and Attendance Policy:

Participation - 12% - attendance in MF class (0.5% for each period)
If you will not be present during a lecture, email Prof. Jafvert ahead of time for an excused absence (no points will be deducted). Attendance in labs: Documented health related issues are excusable, but you will still need to write up a lab with data provided to you.
Lab Reports - 88%

Final Grades will be assigned based on: A > 90%, B > 80%, C > 70%, D > 60%, F – Less than 60%. Prof. Jafvert reserves the right to decrease the percentages, however, they will not be raised (i.e., a 90 is always an A, an 88 might or might not be an A).

Guidance in the Event of Necessary Quarantine/Isolation of Student

Contact the instructors and your TA by email, and (obviously) do not attend class or lab until you are out of quarantine. We will make arrangements for you to make-up any missed labs.

Academic Integrity: Remember: *"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."* Students are expected to abide by the University's Honor Code. Every assignment that you turn in under your own name must be completed by you personally. If you turn in homework or lab reports copied from someone else (or their files) or allow others to copy your work, this will be considered automatic grounds for failing the course.

Emergency Preparation -In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course Brightspace page or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Learning Outcomes (Course Objectives): After this course, the student will be able to:

1. Understand the physical, chemical, and biological principles behind each experimental procedure or measurement technique.
2. Conduct laboratory experiments, making quantitative measurements to assess water quality and water treatment process performance.
3. Organize, report, and graphically display experimental data in common software packages.
4. Analyze and evaluate experimental data on its quality and significance (i.e., usefulness).
5. List issues (i.e., problems) with data collection and data uses.

ABET Outcomes: The following ABET Outcome (number 6) will be assessed in this course:
An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

***Tentative* Course Schedule:**

Week of		Topic
Aug	21	Attend Lab period to be sized for lab-coats (15 min) attend lectures (Monday and Friday)
	28	1) pH Measurement, Acid-Base Titrations, Alkalinity
Sept	4	2) UV/Vis Spectroscopy, Buffer Design, pK_a Determination (**no class on Monday 9/4**)
	11	3) Completely Mixed Systems in Series, First Order Decay
	18	4) Ca, Mg measurement by EDTA Chelation/Titration, Lime softening
	25	5) Alum Coagulation, Turbidity
Oct	2	6) Ion Exchange (Cu^{2+} – Na^{+}), **no class on Friday 10/7** to give you a start to the Break.
	9	9-10 is October Break (**no class on Monday and no Lab, but attend class on Friday**)
	16	7) Dissolved Oxygen, Henry's Law (O_2 probe and Winkler)
	23	8) Chlorine analysis by DPD Titration
	30	9) *E. Coli* Measurement and Disinfection
Nov	6	10) Biochemical Oxygen Demand (BOD)
	13	11) Chemical Oxygen Demand (COD)
	20	23-25 is Thanksgiving break – **no class on Monday or Friday, no lab this week**.
	27	12) Ion Selective electrodes Ca^{2+}-humic acid complexation
Dec	4	DEAD WEEK - Last lab report is due (**no lab this week**)
	11	FINAL EXAM WEEK – No exam

In Labs 1, 2, 4, 7, and 12, major ions and molecules in natural fresh waters are measured. In Labs 3, 4, 5, 6, and 9, environmental engineering processes are examined. In Labs 1-8, 11 and 12, the chemistry and/or physics underlying each analytical method is discussed. Design issues related to drinking water treatment are covered in Labs 1 and 2 (pH adjustment), 3 (reactor design), 4 (lime softening), 5 (coagulation and flocculation), 6 (ion exchange softening), and 8-9 (disinfection).

You are not alone: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

You are valued (nondiscrimination Statement/Accessibility): Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue's nondiscrimination policy can be found at: http://www.purdue.edu/purdue/ea_eou_statement.html. If you anticipate or experience physical or academic barriers based on disability, let the instructor know so that you can be accommodated.

See next page for lab report content and format

Lab Report Requirements

Laboratory report format (points may be taken off for illegible appearance or pages out of order!)

a) Always, give your name and e-mail address, lab partner(s) names, date, and Lab Report Title (including lab number). The length will generally be between 3 to 10 pages (depending on the lab) and can be a mix of hand-written information, Excel spreadsheet printouts, and Word documents. Neatness and organization count! While data are collected in the lab by a group of 2 or 3 students, or shared with the class, reports are composed individually. And student that hands in a report that contains a duplicate of a write-up in another student's report will be given a zero grade. The data will be the same, but not the files or write-ups.

b) The content of each report will dependent on the lab (all reports will not be the same). You may include an Introduction Section (Objectives, Purpose, Significance), Theory Section (Reactions, Equations), Methods Section (experimental and/or analytical methods, sample calculations), Results Section with Discussion (tables, graphs, and text that includes an explanation of the results and any experimental difficulties or explanation of unusual/erroneous results), and Answers to Assigned Questions. **The Introduction, Theory, and Methods sections must be hand-written. Label each section.**

c) The most important material to include in each report is a table or tables of the original data (i.e., volume of titrant), a description of the methods used to transform these data (i.e., sample calculations to convert volume of titrant to concentration), and any final numbers that have been calculated from the original data (i.e., concentrations of ions or species in samples). You may use spreadsheets to perform any basic calculations on original (raw) data, but you always need to include documentation on the formula's that the spreadsheet uses to convert numbers. If a printout of an Excel spreadsheet or Word document is part of your report, your name and the file name should be written in the spreadsheet or Word file directly (not by hand), and it should be formatted to print nicely on a page or two.

d) Any number in any cell in a spreadsheet must include a label with units. This could be a header on a column of numbers, or a cell to the left of the number that includes the label (i.e., Absorbance, Concentration (M), wavelength (nm), Sample Vol. (mL)). If abbreviations are used, a Text Box should be included on the spreadsheet that defines all abbreviations or in the Word file or hand-written notes where the abbreviations are used.

e) To facilitate writing your report, process the data first, and then compose the Results and Discussion Sections. This will give you an idea regarding the necessary material to include in the earlier sections (e.g., what information is required to explain data collection and experimental procedures). Most of the information in the early sections will be provided to you directly in the handouts. In your reports, you do not need to repeat all of this information. For example, you may list the reagent solutions with key concentration information (i.e., 0.1106 g / L ferrous ammonium sulfate (FAS) titrant), but do not need to list the entire composition of each solutions.

f) All tables and figures are numbered (i.e., Table 1. Absorbance values for Bromocresol Green) and the captions of tables are above the table, and the captions of Figures are under the Figures. Below are examples of good Tables and Figures. NOTE: If data are discrete, then use symbols (points) to represent them, models are always continuous, so use lines to represent them. Also "Data" are plural, so never write: "the data shows . ." Place all figures directly on a spreadsheet or in a Word file, unless they are hand-written. X-Y graphs should be as close to square as possible. Never use exponents (i.e., e-5) on axis units – report numbers using appropriate prefixes (i.e, µL, mL, m^3, etc.) so that the numbers on axes are between 0.01 and 100.

Table 1. Filter C Data

	Vol (L)	Abs	C (µM)
1	0.25	0.005	0.128205
2	0.5	0.004	0.102564
3	0.75	0.005	0.128205
4	1	0.006	0.153846
5	1.25	0.009	0.230769
6	1.5	0.009	0.230769
7	1.75	0.009	0.230769
8	2	0.01	0.25641
9	2.25	0.01	0.25641
10	2.5	0.01	0.25641
11	2.75	0.011	0.282051
12	3	0.01	0.25641
13	3.25	0.01	0.25641
14	3.5	0.011	0.282051
15	3.75	0.013	0.333333
16	4	0.021	0.538462
17	4.25	0.044	1.128205
18	4.5	0.102	2.615385
19	4.75	0.188	4.820513
20	5	0.294	7.538462
21	5.25	0.415	10.64103
22	5.5	0.528	13.53846
23	5.75	0.623	15.97436
24	6	0.701	17.97436
25	6.25	0.758	19.4359
26	6.5	0.798	20.46154
27	6.75	0.821	21.05128
28	7	0.844	21.64103
29	7.25	0.866	22.20513
30	7.5	0.884	22.66667
31	7.75	0.883	22.64103
32	8	0.885	22.69231
33	8.25	0.904	23.17949
34	8.5	0.909	23.30769
35	8.75	0.913	23.41026
36	9	0.922	23.64103

Chad Jafvert
filename: Example_Spreadsheet.xlsx
Date: July, 31, 2013

Experimental Conditions		
Fluids=	BCG solution and DI Water	
Duration =	49	minutes
Total Volume added =	22	liters
Ave flow rate=	0.44898	L/min
wavelength monitored	616	nm
cell pathlength	1	cm
Chemical Information		
BCG = Bromocresol Green		
Molecular weight	698.01	g/mol
Molar Absorptivity	39000	$M^{-1}cm^{-1}$
Concentration	0.02	g/L
Concentration	2.87E-05	M
Concentration	28.6529	µM
Stock Solution Abs	1.028	

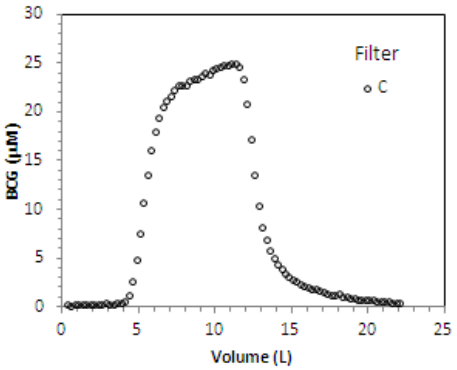

Figure 1. BCG Concentration versus volume of

I. Laboratory Safety

a) Glasses and lab coats must be worn at all times in the lab. Glasses can be safety or polycarbonate prescription. Note the location of the eyewash and safety shower. Do not start working on any new lab, until the instructor has provided the class with initial instructions.

b) Label all beakers/flasks with a sharpie on the glass. Do not write on the white "label area" of any glassware, as this leaves a permanent mark. When you are finished with each lab, the TA will tell you where you should return all materials (beakers, etc.). Do not leave the lab until the TA has checked your work area and dismissed your group.

c) Most (but not all) chemicals that we will use are not toxic, and we generally will be working at low aqueous concentrations. Use caution especially when pipetting strong acids and bases - for the sake of your lungs, skin and clothes. Concentrated sulfuric acid, in particular, will leave a hole in your clothes.

d) No food or drink in the lab (personal water bottles must remain closed, you may go in the hallway to drink).

e) For economic and safety reasons, please use caution when using glassware. pH probes are especially delicate (and costly), and burette tips are easy to break.

f) You may enter the lab alone during unscheduled hours only to check on ongoing experiments (i.e., count colonies on Petri dishes), but not to perform experiments. If you need to perform an experiment during unscheduled hours, you will need a lab partner and permission from the TA.