INTRODUCTION TO ENVIRON. ENG. **DR. LANCE LIN**
CE 347 (CRN: 83952, 83953, 83954**)** **FALL 2018**

LECTURE DAY/TIME/ROOM	TR/11:00 – 12:15/801 ESB
LABORATORY SESSIONS	TW/14:00 – 16:50/G35 ESB
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OFFICE HOURS	Wed. 10AM-12PM or by appointment

TEACHING ASSISTANTS

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COURSE DESCRIPTION

Students in the class will be introduced to topics relevant to environmental engineering. Topics to be covered in this class include characterization of pollution in air, water, and solid wastes, environmental regulations, and engineering approaches for treatment and remediation of the pollution to meet the regulatory requirements. The students will learn to apply mass balance principles and reaction kinetics in engineering calculations and design of treatment systems. Contemporary issues such as water-energy-food nexus, climate changes, emerging contaminants (e.g., engineered nanomaterials, pharmaceuticals and personal care products) and potential solutions for addressing these issues will also be discussed. In laboratory sessions, the students will conduct experiments, collect and analyze data, and interpret the results.

EXPECTED LEARNING OUTCOMES

Course Outcome	Targeted ABET Program Outcomes
Be familiar with environmental laws, pollution, and engineering approaches to mitigate pollution	h, j
Apply mass balance and reaction kinetics in designing treatment and pollution control systems	b, h
Learn and present contemporary environmental issues	g, J
Conduct experiments; collect and analyze data; and interpret the results	b, g

b = Design, conduct experiments/ analyze and interpret data
g = Communicate effectively in oral, written, and electronic formats
h = Impact of engineering solutions in a global and societal context

j = Knowledge of contemporary issues

TEXTBOOK

1. Davis M.L, DA Cornwell, 2013, Introduction to Environmental Engineering, 5th Edition, McGraw Hill, New York, NY. ISBN 978-0-07-340114-0

CLASS POLICIES

Lecture

Students are expected to have basic knowledge of mathematics, sciences, and engineering. Attendance will be formally monitored during lecture periods. Attendance and class participation will be considered in the evaluation of a student's desire to learn.

Assignments

Homework/laboratory assignments will be given during the semester. Assignments are due at the beginning class. Late assignments **will not be accepted** without prior written approval from the instructor. In case of emergency, students are required to provide a proof of the emergent event to get an extension of the deadline.

Exams

Two exams will be given during the regular semester and a comprehensive final exam will be given at the end of the semester.

FIELD TRIPS

We plan to have a trip to the water treatment plant in Morgantown. The plant is operated by Morgantown Utility Board (MUB). You have a chance to see various treatment processes for drinking water. Attendance is required for the field trip. Additionally, we will try to arrange for a trip to the wastewater treatment plant in Star City. More details will be announced later.

GRADE

Grades will be calculated according to the weighting factors listed in the following table.

Lecture attendance	5%
Homework assignments	24%
Contemporary issues assignments	5%
Lab. assignments	30%
Exam #1	12%
Exam #2	12%
Final Exam	12%

Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts

considered to fall under academic dishonest and possible ensuing sanctions, please see the policies at https://provost.wvu.edu/governance/academic-standards-resources.

TOPIC OBJECTIVES

Units of Measurements

1. Understand the concepts of mass, moles, concentrations, flow rate, and loading rate.
2. Know how to use and convert between units of measurements.

Watersheds and Water Quality

1. Understand the watershed concept.
2. Be able to identify sources of major pollutants.
3. Be able to name and describe water quality measurement methods.
4. Be able to name major pollutants in WV waters.
5. Be able to describe what a 303d list is.
6. Be able to describe assimilative capacity.
7. Be able to define TMDL and calculate major components that contribute to TMDL.

Mass Balance

1. Know how to select control volume.
2. Understand mass and molar flow rates.
3. Understand the meaning of steady state, accumulation, and conservative and non-conservative materials.
4. Be able to write general mass balance equation.

Reactions

1. Know how to balance chemical reactions.
2. Know how to determine the amount of product formed and/or reactants used based on stoichiometry.
3. Be able to write equilibrium expressions for chemical reactions and to use the results to calculate the equilibrium distribution of chemical species.
4. Be able to compare and discuss the magnitude of the equilibrium constant.
5. Be able to distinguish between equilibrium and kinetics.
6. Be able to write rate expressions from reactions.
7. Be able to write zero, first and second order rate law reactions.
8. Be able to solve zero, first and second order rate law expressions.

Risk Assessment

1. Learn risk-based assessment for human health.
2. Be able to describe potential exposure routes of pollutants to human.
3. Be able to identify important factors relevant to exposure paths and risk.
4. Be able to calculate dose and risk associated toxic pollutants.

Drinking Water

1. Be able to identify and describe various pollutants that are of concern in drinking water.
2. Be able to distinguish primary and secondary standards and MCLs and MCLGs.
3. Be able to describe a typical flow train through a water treatment plant and the objectives of various stages of treatment.

4. Be able to calculate overflow rates and detention times for different unit operations and to size the various unit operations.
5. Be able to describe disinfection-by-products and how they are formed.
6. Be able to calculate treatment efficiency of a treatment unit given the influent and effluent quality.

Wastewater

1. Be able to name and describe major constituents of concern in domestic wastewater.
2. Be able to describe how quality of wastewater effluent is regulated.
3. Be able to name and describe water quality parameters used as indictors of treatment.
4. Be able to describe a typical flow train through a wastewater treatment plant and the objectives of various stages of treatment.
5. Be able to describe different secondary wastewater treatment processes.
6. Be able to name different types of biological treatment processes.
7. Understand the concept of sludge and the generation of solids in wastewater treatment facilities.

Air Pollution

1. Understand how the Clean Air Act regulates air pollutants.
2. Be able to identify the major sources and effects of the air pollutants.
3. Be able to describe the major pathways for ozone formation. Be able to discuss how NO_x and hydrocarbons contribute to ozone formation.
4. Understand the general nature of the earth's atmosphere and its important layers.
5. Be able to identify greenhouse gases and understand the theory behind the greenhouse effect.
6. Be able to use the point-source Gaussian plume model to determine downwind contaminant concentrations.
7. Be able to identify sources of indoor air pollution and to calculate the concentration of pollutants in indoor environments.

Solid and Hazardous Waste

1. Understand the definition of solid and hazardous waste.
2. Be able to distinguish reuse, recycle, and recovery.
3. Be able to name and describe different disposal options and landfill types.
4. Be able to describe what pollution prevention and waste minimization are.

Green Engineering

IN-CLASS DISCUSSION OF CONTEMPORARY ISSUES

During the semester, we will discuss contaminants and issues that are of concerns to the environment and human health. We will focus on contemporary issues and have the discussion in class. You will surf the web and summarize the information on at least two web sites that discuss the issues. The information along the web site information should submitted by the specified deadline. The discussion in class will focus on:

1. Basic physical, chemical, biological properties of the contaminants
2. Potential concerns
3. Sources of contamination
4. Major locations of contamination
5. Fate of the contaminant in the environment
6. Routes of exposure
7. Major incidents of exposure
8. Treatment processes or remediation techniques
9. Regulations and legislation pertaining the contaminant

In your research, you do not have to report on each of the nine items above, however, the class discussion will attempt to cover all of them. Bonus points for the most interesting websites will be given. Some potential contaminants to be studied:

- Energy-water nexus
- Shale gas development and related issues
- Pharmaceuticals and personal care products
- Engineered nanomaterials
- Climate change
- Selenium
- Mercury emission from coal-fired plants

LABORATORY SESSIONS (G35, ESB)

Session #1: Laboratory safety and overview of laboratory sessions
- Introduction of laboratory materials, seating, rules, and safety.
- Overview of laboratory sessions.

Session #2: Water Quality Solids

Session #3: Water Quality Alkalinity/Hardness/Conductivity

Session #4: Water Quality COD/BOD/TOC

Session #5: Water Treatment Chlorine

Session #6: Water Treatment Jar Test and Filtration

Session #7: Water/wastewater Treatment Coliforms and Disinfection

TENTATIVE LECTURE & LABORATORY SCHEDULE FALL 2017

Date	Lecture	Date	Laboratory Session	Reading assignments
8/16	Introduction/Units & Applications	8/15	---	Chap. 1 Chap. 5.1-5.2
8/21	Watersheds & Water Quality	8/21	Lab 1 Safety & lab intro.	Chap. 7.1-7.4
8/23	Watersheds & Water Quality Contemporary 1 due (8/23)	8/22	Lab 1 Safety & lab intro.	Chap. 7.1-7.4
8/28	Watersheds & Water Quality	8/28	Lab. 2 WQ - Solids	Chap. 7.1-7.4
8/30	Material Balance HW 1 due (8/30)	8/29	Lab. 2 WQ – Solids	Chap. 2.1-2.2
9/4	Reactions	9/4	Lab. 3 WQ-Alk./Hard./Cond.	Chap. 5.3
9/6	Reactions	9/5	Lab. 3 WQ-Alk./Hard./Cond.	Chap. 5.3
9/11	Reactor Theory HW 2 due (9/11)	9/11	Contemporary issues discussions	Chap. 2.3
9/13	Reactor Theory ***Help Session for Exam #1***	9/12	Contemporary issues discussions	Chap. 2.3
9/18	***Exam #1***	9/18	Lab. 4 WQ – COD/BOD/TOC	
9/20	***Guest Lecture (WVDEP)***	9/19	Lab. 4 WQ – COD/BOD/TOC	
9/25	Water Supply & Treatment	9/25	Lab 5. – Chlorine	Chap. 6
9/27	Water Supply & Treatment	9/26	Lab 5. – Chlorine	Chap. 6
10/2	Water Supply & Treatment Contemporary 2 due (10/2)	10/2	Lab.6 - Jar test & filtration	Chap. 6
10/4	Wastewater Treatment	10/3	Lab.6 - Jar test & filtration	Chap. 8
10/9	Wastewater Treatment HW 3 due (10/9)	10/9		Chap. 8
10/11	Wastewater Treatment ***Help Session for Exam #2***	10/10	Field Trip	
10/16	***Guest Lecture (Tim Ball, MUB)***	10/16	Field Trip	Chap. 8
10/18	***Exam #2***	10/17		
10/23	Risk Assessment	10/23	Contemporary issues discussions	
10/25	Risk Assessment	10/24	Contemporary issues discussions	
10/30	***Guest Lecture*** ***(Stephen Sites, WVDOH)*** Contemporary 3 due (10/31)	10/30	---	Chap. 3
11/1	Risk Assessment	10/31	---	Chap. 3
11/6	Election Day (no class)	11/6	---	Chap. 3
11/8	Air Quality & Pollution	11/7	---	Chap. 9
11/13	Air Quality & Pollution Homework 4 due (11/13)	11/13	Contemporary issues discussions	Chap. 9

11/15	Air Quality & Pollution	11/14	Contemporary issues discussions	Chap. 9
11/20	Thanksgiving Break (Fall Recess)			
11/22				
11/27	Solid & Hazardous Waste	11/27	---	Chap. 11-12
11/29	Solid & Hazardous Wastes	11/28	---	Chap. 11-12
12/4	Green Engineering & Sustainability			Chap. 13
12/13	**Final Exam (8 – 10 AM)**			