

**ENVE 615**  
**ENVIRONMENTAL CHEMISTRY**  
**FALL, 2007**

**INSTRUCTOR:** Dr. Richard F. McCormick

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**OFFICE HOURS:** 10 – 12 MWF; other hours as posted or by appointment

**TEXT:** *Chemistry for Environmental Engineering and Science*, Sawyer, McCarty, & Parkin, 5<sup>th</sup> Edition, McGraw-Hill, 2003.

**COURSE OBJECTIVE:** To continue the education of the environmental engineering/science student in the area of environmental chemistry including laboratory techniques.

**COURSE OUTCOMES:** With the successful completion of the course, the student should be able to:

1. Understand the use of the terms *turbidity, color, pH, acidity, alkalinity, hardness, dissolved oxygen, BOD, COD, nitrogen, iron, manganese, solids, sulfates, and phosphates* as they apply to the field of environmental engineering.
2. Understand the use of principles of stoichiometry, ionization, and bonding.
3. Understand the use of principles of oxidation and reduction in environmental engineering relationships.
4. Understand the principles of acid/base reactions, buffers, and solubility product.
5. Be familiar with the principles of chemical thermodynamics, electrochemistry, and chemical kinetics in environmental applications.
6. Understand chlorine chemistry as it applies to disinfection.

<b>GRADING BASIS:</b>	2 Hourly Exams	@	20% each	40%
	Homework			20%
	Lab			20%
	Final exam			<u>20%</u>
	Total			100%

The lab grade will consist of	Weekly exercises/reports	60%
	Lab mid-term exam	20%
	Lab final exam	<u>20%</u>
	Total	100%

NOTE: A lab schedule, with safety instructions, will be distributed next week.

<b>TEST SCHEDULE:</b>	Hourly exam #1	October 1, 2007
	Hourly exam #2	November 5, 2007
	Final exam	December 10, 2007
	Lab mid-term exam	October 15, 2007
	Lab final exam	December 10, 2007

**NOTE:** Because this course meets only one night per week, an entire period cannot be devoted to testing. Therefore, we will either have some lecture or a lab exercise on days that we have tests scheduled, with the exception of December 10, when we will have both the course final and the lab final.

For the last several years, this course has been taught in Dow Building 701, where Marshall had leased lab facilities. That lease terminated on June 30, 2007, and our environmental lab has been moved to Huntington. We will discuss how the lab will be handled on the first night of class.

### **COURSE TOPICS:**

1. Basic chemical definitions, stoichiometry, and ionization
2. Periodic table and bonding
3. Turbidity, color, and pH
4. Acidity and alkalinity
5. Hardness and dissolved oxygen
6. BOD and COD
7. Nitrogen, iron, and manganese
8. Solids
9. Sulfates and phosphates
10. Oxidation/reduction reactions
11. Law of mass action
12. Acids and bases
13. Buffers
14. Solubility product
15. Chemical thermodynamics
16. Electrochemistry
17. Chemical kinetics
18. Chlorine chemistry and disinfection

### **INITIAL HOMEWORK ASSIGNMENTS:**

#	Assignment/Problems	Due Date
1	Work Stoichiometry Handout	August 27
2	Read Chapters 13 – 16 Work problems 13-2, 13-3, 14-1, 14-3, 15-1, 16-3	September 10
3	Read Chapters 17 – 19 Work problems 17-7, 17-11, 18-10, 18-11, 19-8	September 17
4	Read Chapters 22 – 24 Work problems 22-1, 22-7, 22-9, 23-2, 23-3, 24-1, 24-2	September 24
5	Read Chapters 25 – 27 Work problems 25-1, 25-4, 26-2, 27-1, 27-3	October 1
6	Read Chapters 29 - 30 Work problems 29-1, 29-6, 29-8, 30-2, 30-3, 30-5	October 8

### **Instructions for Lab/Reports**

1. Final lab reports will be due at the beginning of the next lab period or when otherwise stated by the lab instructor. They may be formal or informal. **Informal** lab reports must be done neatly on 8 1/2 by 11 engineering grid paper or on typing paper. They will consist of one page containing the data recorded during the experiment and any calculated results appropriate for the given experiment. To accompany this page will be the answers to several questions attached to the lab handout material. Each data sheet will be worth 40 points, and each question will be worth 10 points. A **formal** lab report will be typewritten, will contain a

purpose, discussion of theory, procedure, sample calculations, results, discussion of results, conclusions, and finally, an appendix containing the raw experimental data. Formal lab reports will be graded on the basis of the quality of the experimental results (raw data, calculations, and interpretation of results), report content and organization, spelling, grammar, neatness, and other pertinent factors. Each report should have a cover sheet giving the class number and name, experiment name and date, and the student's name and signature. Formal lab reports will be worth 100 points each. For both formal and informal lab reports, when possible, data should be analyzed statistically. At the very least, the mean of the data along with the standard deviation should be calculated. Final lab reports will not be accepted late.

2. At the end of each lab, waste material will not be poured down the drain. All waste liquids, including excess titrants, will be placed in the designated disposal container.

### **Laboratory Safety Rules**

1. **SAFETY GLASSES SHALL BE WORN AT ALL TIMES.** Personal eyeglasses (with shock resistant lenses and side safety shields) may be substituted for lab safety glasses.
2. There will be no smoking, eating, or drinking allowed in the lab.
3. Horseplay will not be tolerated. Running, except in an emergency, is not allowed.
4. Shirts and shoes (NOT SANDALS) will be worn at all times in the lab.
5. Appropriate gloves (surgical latex or nitrile, rubber, leather, or heat resistant) must be worn when handling chemicals, hot material, etc. Gloves will be provided by the lab instructor.
6. Operating equipment will not be left unattended.
7. Each student is expected to know the location of the nearest fire extinguisher, first aid station, safety shower, eye-wash station, and telephone. The location of these items will be pointed out at the beginning of each semester.
8. All warning signs and posters must be followed.
9. All accidents and/or unsafe conditions in the laboratory must be reported to the lab instructor immediately.
10. Barrels, boxes, chairs, stools, etc are not to be substituted for ladders. Ask the lab instructor for assistance when objects are out of reach.
11. When lifting, keep your back straight and lift with your legs. Obtain help when needed. Carts and dollies are available for transporting heavy objects.
12. All aisles, passageways, and hallways should be kept clear of debris, surplus equipment, furniture, etc so that people may move freely and safely about the lab.
13. At the end of each laboratory experiment, waste material will not be poured down the drain. All waste liquids, including excess titrants, will be placed in a container designated "Waste Liquids" for proper disposal.
14. **DO NOT DRINK OR EAT ANY CHEMICALS USED IN ANY EXPERIMENT!**
15. Upon completion of the laboratory experiment, you should wash your hands thoroughly.

16. Use common sense.

**NOTE: Violations of safety regulations are sufficient cause for assigning a failing grade for a particular experiment. Serious or repeated violations may result in failure of the course.**

**Tentative Lecture/Lab schedule  
Fall, 2007**

<b>Date</b>	<b>Lecture/Lab #</b>	<b>Topic</b>	<b>Turn in</b>
8/20	<b>Introduction Lecture #8</b>	<b>Basic chemical fundamentals</b>	
8/27	<b>Lecture #9 Lecture #1</b>	<b>Periodic table, chemical bonding Turbidity, color, pH</b>	<b>HW #1</b>
9/10	<b>Lecture #2 Lecture #3 Lecture #4</b>	<b>Acidity, alkalinity Hardness, dissolved oxygen BOD, COD</b>	<b>HW #2</b>
9/17	<i>Lab #1 Lab #2 Lab #3</i>	<i>Standards Acidity/Alkalinity Turbidity/Color</i>	<b>HW #3</b>
9/24	<b>Lecture #5 Lecture #6 Lecture #7</b>	<b>Nitrogen, iron, manganese Solids Sulfates, Phosphates</b>	<b>Lab #1 HW #4</b>
10/1	<b>Exam #1 Lecture #10</b>	<b>Oxidation, reduction</b>	<b>Lab #2 HW #5</b>
10/8	<i>Lab #4 Lab #5 Lab #6</i>	<i>Hardness/Solids Residual Cl<sub>2</sub> Dissolved Oxygen</i>	<b>Lab #3 HW #6</b>
10/15	<b>Lecture #11 Lecture #12 Lecture #13</b>	<b>Redox, chemical equilibrium Acids, bases Buffers</b>	<b>Lab #4</b>
10/22	<b>Lecture #14 Lecture #15 Lecture #16</b>	<b>Solubility product Disinfection, chlorine chemistry Chemical thermodynamics</b>	<b>Lab #5</b>
10/29	<i>Lab #7 Lab #8 Lab #9</i>	<i>Phosphates Sulfates Jar Test</i>	<b>Lab #6</b>
11/5	<b>Exam #2 Lab Mid-term</b>		<b>Lab #7</b>
11/12	<b>Lecture #17 Lecture #18 Lecture #19</b>	<b>Chemical thermodynamics Electrochemistry Chemical kinetics</b>	<b>Lab #8</b>
11/26	<b>Lecture #20 Lecture #21</b>	<b>Colloid chemistry Coagulation summary</b>	<b>Lab #9</b>
12/3	<b>Review</b>		