

CE475 – WATER QUALITY ANALYSIS
SPRING 2009

Lecture: 2:30 – 3:20 pm MWF
 120 Sackett Building

CE 497D Laboratory: 3:35 – 6:35 pm M (some W)
 124 Sackett Building

Instructor: Dr. Bill Burgos
 115 Sackett Building

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Office hours: 11am-12:30pm TTh, 3:30-5:00pm F, other times by appointment

Assistant: Ching DeSa, Graduate Teaching Assistant, 5-C Sackett Building, tcd5005@psu.edu

Prerequisites: CE 370, CHEM 012, CHEM 014

Course Objectives: Apply basic chemical principles to better understand water quality, drinking water treatment and wastewater treatment. Apply basic analytical chemistry principles to understand how to measure common water and wastewater constituents.

Textbook: Chemistry For Environmental Engineering and Science 5th Ed. (2003) C.N. Sawyer, P.L. McCarty and G.F. Parkin, McGraw Hill (required), ISBN 0-07-248066-1, International Edition ISBN 0-07-119888-1.

Laboratory Manual: Available at Engineering Copy Center, 101 Engineering Unit A (required)

Course Web Page: The ANGEL course management system will be used to communicate with students, to post lecture material to post homework assignments (and solutions), and as a link to other relevant reference material.

Grading:	3 In-Class Examinations @ 100 pts each	300	46	93-100%	A
	4 Homework Assignments @ 50 pts each	200	31	90-92%	A-
	Final Examination	<u>150</u>	<u>23</u>	87-89%	B+
	Total	650	100%	83-86%	B
				80-82%	B-
			77-79%	C+	

In-Class Examinations: Each exam will cover roughly one-quarter of the course. Exams will be 50-min, in-class, closed-book tests where students are allowed to bring one 8-½”×11” sheet of notes.

Homework Assignments: A relatively large number of “suggested” homework problems will be listed for each chapter or major topic and students are encouraged to try all of them. A subset of these problems will be collected on the dates listed in the syllabus below. The majority of these assignments will be completing problems in the textbook, however, additional assignments could include conducting literature reviews to supplement lecture topics. Four homework assignments will be assigned during the semester. Solutions will be made available on the course web page on the due date for each assignment. No credit will be given for late problem sets. Collaboration is encouraged; however, be sure that you fully understand the concepts and problem-solving approaches to succeed on the exams.

Final Examination: This will be a cumulative exam, however, the major focus will be on the last one-half of the course. This exam will be a ~2-hr, in-class, closed-book test where students are allowed to bring one 8-½”×11” sheet of notes. This exam will be given on the appointed date/time of finals week.

CE 475 COURSE SYLLABUS, SPRING 2009:

Date	Lecture Number, Topic (<i>lab topic</i>)	Reading	HW/Lab
12-Jan	L1: Introduction	Ch 1	
14-Jan	L2: Key concepts	Ch 9	
16-Jan	L3: Analytical techniques	Ch 11	
21-Jan	L4: Spectrophotometry	Ch 12.1-12.3	Lab safety
23-Jan	L5: General Chemistry	Ch 2.1-2.7	
26-Jan	L6: General Chemistry (<i>dilutions</i>)	Ch 2.10-13	Volumetric transfers – Ch 11
28-Jan	L7: Statistical Analyses	Ch 10.1-5	
30-Jan	L8: Statistical Analyses	Ch 10.6-10	HW #1 due
2-Feb	L9: Physical Chemistry (<i>colorimetry</i>)	Ch 3.1-2	Solids, turbidity – Ch 11, 26
4-Feb	L10: Physical Chemistry	Ch 3.9-10	
6-Feb	L11:		In-Class Examination #1
9-Feb	L12: Equilibrium Chemistry (<i>HACH spec</i>)	Ch 4.1-2	Sulfate, standards – Ch 15, 29
11-Feb	L13: Equilibrium Chemistry	Ch 4.3-4	
13-Feb	L14: Acid-Base Chemistry	Ch 4.5	
16-Feb	L15: Acid-Base Chemistry (<i>pH meter</i>)	Ch 4.6-7	Alkalinity – Ch 16 – 18
18-Feb	L16: Acid-Base Chemistry		
20-Feb	L17: Alkalinity	Ch 16 – 18	
23-Feb	L18: Alkalinity (<i>DO meter</i>)		BOD, COD – Ch 22 – 24
25-Feb	L19: Carbonate System		
27-Feb	L20: Carbonate System		HW #2 due
2-Mar	L21: Carbonate System		Nutrients – Ch 25, Ch 30
4-Mar	L22: Catch-up & Review		
6-Mar	L23:		In-Class Examination #2
16-Mar	L24: (<i>Flow and load calculations</i>)	Ch 2.15, 4.9	Field methods
18-Mar	L25: Metal solubility – carbonates		
20-Mar	L26: Metal solubility – carbonates		
	metal solubility homework set		
30-Mar	L27: Acid Mine/Acid Rock Drainage - I-99		
1-Apr	L28: Metal solubility – hydroxides		
3-Apr	L29: Metal solubility – hydroxides		HW #3 due
6-Apr	L30: Applications to AMD/ARD		
8-Apr	L31: Applications to AMD/ARD		
10-Apr	L32:		In-Class Examination #3
13-Apr	L33: Applications to coagulation	Ch 7, 13	
15-Apr	L34: Applications to coagulation		
17-Apr	L35: Applications to coagulation		
20-Apr	L36: Applications to water softening	Ch 19	
22-Apr	L37: Applications to water softening		
24-Apr	L38: Applications to water softening		HW #4 due
27-Apr	L39: Trace contaminants	Ch 34, 12.4	Research presentation
29-Apr	L40: Trace contaminants		
1-May	L41: Trace contaminants		
?-May			Final Exam

SUGGESTED HOMEWORK PROBLEMS (by chapter)

Chapter	Problem Number
2	2.1, 5, 6, 9, 11, 12, 14, 15, 16, 27, 30, 47, 48, 50
3	3.5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 33, 34, 35
4	4.3, 4, 7, 11, 12, 13, 20, 24, 36, 48, 64, 73, 74, 84, 85, 86, 90, 93
6	6.10, 11, 13, 16, 17
9	9.4, 6, 14
10	10.2, 3, 4, 5, 13, 24
11	11.1, 4, 9, 14, 21
12	12.1, 4, 6, 13, 16
13	13.1, 2, 3, 6
15	15.3, 7, 10
16	16.1, 3, 5, 9
17	17.2, 7, 9, 10
18	18.1, 7, 9, 14
19	19.1, 8, 9
22	22.6, 7, 13, 14
23	23.18, 20, 22
24	24.2, 4, 7, 12
25	25.5, 6, 10, 19, 20
26	26.1, 4, 5
29	29.1, 6, 10
34	34.2, 6, 9, 10, 13

SUGGESTED HOMEWORK PROBLEMS (by problem set)

HW Set	Lecture topics	Lab topics	problems
1	Analytical chem. General chem. Thermodynamics Statistical analyses	<i>Dilutions</i> <i>Solids/turbidity</i>	2.1, 6, 9, 11, 12, 14, 27 3.5, 6, 7, 8, 9 9.4, 6, 14 10.2, 3, 4, 5, 13, 24 11.1, 4, 9, 14 12.1, 4, 6 15.3, 7, 10 26.1, 4, 5
2	Equilibrium chem. Redox/electrochem. Acid-base chem. Alkalinity/carbonate system	<i>Sulfate</i> <i>Standard Solns</i> <i>Alkalinity</i> <i>pH meter</i> <i>HACH spec</i>	2.15, 16, 30 3.11, 15, 16, 17 4.3, 4, 7, 11, 12, 13, 20, 24, 36, 48 6.11, 6.13 11.21 12.13, 16 16.1, 3, 5, 9 17.2, 7, 9, 10 18.1, 7, 9, 14
3	Carbonate solubility Hydroxide solubility AMD treatment	<i>BOD, COD</i> <i>DO probe</i> <i>Nutrients</i>	2.48, 50 3.13, 14, 33, 34, 35 4.64, 73, 74, 84, 85, 86, 90, 93 6.10 22.6, 7, 13, 14 23.18, 20, 22 24.2, 4, 7, 12 25.5, 6, 10, 19, 20 Supplemental problems
4	Coagulation Water softening Trace contaminants	<i>Field methods</i> <i>Independent research</i>	2.5, 47 3.6 6.16, 17 13.1, 2, 3, 6 19.1, 8, 9 34.2, 6, 9, 10, 13 Supplemental problems