CARNEGIE MELLON UNIVERSITY

Department of Chemistry

09-106: Modern Chemistry II

Syllabus **Spring Semester, 2001**

Lectures: Monday, Wednesday and Friday 11:30 -12:20 p.m., Doherty Hall 2315

Web site: http://ir.chem.cmu.edu/chem106

All course handouts are available on the web site, along with a list of assignments and upcoming due dates.

Instructors:

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Office Hours: To be announced and posted on web site.

Textbook: David W. Oxtoby and Norman H. Nachtrieb, "Principles of Modern Chemistry", Fourth edition, Saunders College Publishing (1996). Reading assignments will be announced in lecture and posted on the web site.

In addition to the textbook you are required to purchase a copy of lecture note outlines, which will be distributed in lectures. A charge of $7.00 will be debited to your university account to pay for this material.

Workload: It is assumed that you will spend at least 10 hours per week on this course: 5 in lecture and recitation, and at least 5 outside the classroom.

Supplemental Instruction: Supplemental instruction will be available for this course. Information will be announced in class and posted on the web site.

Laboratories: Up to five of the recitation periods will involve laboratory experiments.

All students must perform a safety check-in to the laboratory on Tuesday, January 16, as part of the regularly scheduled recitation period. (This will count as the first quiz of the semester.)

Group work: You are encouraged to work in groups on the graded homework assignments. This means you can work together on the problem, but you must write your own solution.

On your homework, you must list the members of your work group.

Note: Every member of the group must be involved in finding the solution. Group work does not mean copying the answers of other members in your group.

Grading: The final grade will be based on the following point distribution.

Quizzes: 100pts

A 5-10 min quiz will be given once a week in recitation (except for weeks following an hour exam). The lowest two grades will be dropped.

The topics covered in the quizzes will be announced in lecture and listed on the web site. In weeks containing a lab, the quiz will be related to the laboratory.

Homework: 100pts

There will be about 11 homework assignments, and the lowest grade will be dropped.

Exams: 400pts

There will be 3 one-hour exams.

Tentative Dates: Friday, February 16
Thursday, March 22
Friday, April 27

and a comprehensive final exam.

All exams will be graded on a 100pt scale. The 400pts used in determining the final grade will be obtained by writing down the scores for each of the hour exams once, and the score for the final exam three times:

exam1 exam2 exam3 final final final

The lowest two scores in the above list will then be dropped. If your final is your highest score, it will count for 75% of your exam grade. If you do not do well on the final it will count for only 25% of your exam grade.

Bonus Points

On some of the homework problems, there will be questions for bonus points. There will be a total of 30 points throughout the semester. These will be added on to your grade, after the course grading curve has been established.

The course will be curved, based on the 600 non-bonus points listed above, such that the grade point average for the class is between 2.8 and 3.0. It is at this stage that the range for A,B… grades will be established. Then, the bonus points will be added to student scores.

Makeup exams and quizzes: *NOTE:* No make-up exams or quizzes will be given. Since the grading scheme is designed to allow low scores to be dropped, a missed exam or quiz will not be counted in the final average.

List of topics (tentative)

Thermo I
Chapter 7: Thermochemistry

1. Work and heat
2. The first law of thermodynamics
3. Enthalpy and heat capacity
4. Hess' law and bond energies (enthalpies)
5. State functions

Thermo II
Chapter 8: Second Law of Thermodynamics

6. Spontaneity, reversibility, and equilibrium
7. Second law of thermodynamics
8. Entropy and disorder
9. Third law of thermodynamics, third law entropies
10. Free energy and spontaneity

Equilibrium
Chapter 9: Chemical Equilibrium

11. Chemical Reactions and Equilibrium
12. Law of Mass Action
13. Relationships Among Equilibrium Expressions
14. Calculation of equilibrium constants from ΔG
15. The Reaction Quotient

Exam 1 (Friday, February 16)

16. LeChatelier's Principle

Acids and Bases
Chapter 10: Acid-Base Equilibria

17. Bronsted Acids and Bases.
18. pH, pOH, pK.
19. Strengths of Acids and Bases.
20. Strong Acids/Strong Bases.
21. Weak Acids and Bases
22. Hydrolysis
23. Buffers
24. Polyprotic acids
25. Acid-base titrations

Solubility
Chapter 11: Heterogeneous Equilibria

26. Solubility equilibria
27. Slightly soluble salts
28. Precipitation and the solubility product
29. Complex ion formation and solubility
30. Effects of pH on solubility

Exam 2 (Thursday, March 22)

Kinetics
Chapter 11: Chemical Kinetics

31. Rate equations, order of kinetics
32. Molecularity
33. Method of initial slopes
34. Mechanisms
35. Activation Energies

Electrochemistry
Chapter 10: Electrochemistry

36. Redox Reactions
37. Electrochemical Cells and Electrolysis
38. Faraday's Laws
39. Galvanic Cells
40. Free Energy and Cell Voltage
41. Standard Electrode Potentials
42. Nernst Equation
43. Equilibrium Constants from Electrochemistry

Exam 3 (Friday, April 27)

Phase Transitions:
Chapters 5/6: Condensed Phases and Solutions

44. Melting, evaporation, and sublimation
45. The critical point
46. Vapor pressure and equilibrium
47. Phase diagrams.
48. Ideal Solutions and Raoult's Law.
49. Fractional distillation.
50. Boiling pt. elevation and freezing pt. depression.
51. Osmotic pressure.

Tentative Schedule

January

M	T	W	T	F	S
1	2	3	4	5	6
8	9	10	11	12	13
15	16	17	18	19	20
Thermo I					
22	23	24	25	26	27
Thermo I			Thermo II		

February

S	M	T	W	T	F	S
28	29	30	31	1	2	3
	Thermo II					
4	5	6	7	8	9	10
	Thermo II		Chemical Equilibrium			
11	12	13	14	15	16	17
	Chemical Equilibrium				Exam 1	
18	19	20	21	22	23	24
	Chemical Equilibrium			Acid-Base		

March

S	M	T	W	T	F	S
25	26	27	28	1	2	3
	Acid-Base					
4	5	6	7	8	9	10
	Acid-Base			Break		
11	12	13	14	15	16	17
	Acid-Base			Solubility		
18	19	20	21	22	23	24
	Solubility			Exam 2		
25	26	27	28	29	30	31
	Spring Break					

April

S	M	T	W	T	F	S
1	2	3	4	5	6	7
	Kinetics					
8	9	10	11	12	13	14
	Kinetics					
15	16	17	18	19	20	21
	Electrochemistry				Carnival	
22	23	24	25	26	27	28
	Electrochem				Exam 3	

May

S	M	T	W	T	F	S
29	30	1	2	3	4	5
	Phase eq/Colligative Prop					