

## CHEMISTRY DEPARTMENT, PORTLAND STATE UNIVERSITY

**CHEMISTRY 440/540, PHYSICAL CHEMISTRY.**

FALL, 2007

Venue: SB1 304; 12:45 – 13:50 PM

Instructor: R. H. Simoyi (SB2 372)

### **Syllabus:**

The chapters and page numbers referred to in this syllabus are from *Physical Chemistry*, by McQuarrie and Simon

<b>Lecture No.</b>	<b>Date</b>	<b>Topic</b>	<b>Pages</b>
1	Mon, 9/24	Organization, Introduction, Numerical Methods	627 - 635
		Partial Differentials	683 - 693
2	Wed, 9/26	Partial differentials	683 - 693
		Pressure, Gas Laws (Boyle, Charles, Avogadro) Ideal gas law.	637 - 674
3	Fri, 9/28	Real gases, compressibility factor, Two parameter equations of state	642 – 648
		Cubic equation of state; law of corresponding states	648 - 658
4	Mon, 10/1	Virial coefficients, Boyle temperature, L-Jones potentials	658 – 674
		First law of thermodynamics	765 - 800
5	Wed, 10/3	First law, State Functions, adiabatic expansion	769 – 780
6	Fri, 10/5	Adiabatic processes, cont'd, Enthalpy, Heat capacity	780 – 786
		Thermochemistry	787 – 796
7	Mon, 10/8	Hess Law	789 – 796
		Kirchoff's Law, Joule-Thompson Experiment/Coefficient/Inversion temperature	797- 800

8	Wed, 10/10	Statistical Mechanics: Boltzmann Factor, Probability Ensembles, Ensemble Averages	693 – 716 696 – 700
9	Fri, 10/12	Translational Partition Function for monatomic gas Heat capacity at $C_v$ ; distinguishable molecules	700 – 702 702 – 710
10	Mon, 10/15	Molecular partition functions	713 – 716
11	Wed, 10/17	Stirling's approximation, Entropy Second Law of thermodynamics, $Q_{rev}$ , State Functions	809 – 820 820 – 822
12	Fri, 10/20	Spontaneity, $S = k_B \ln W$ , Clausius Inequality Entropy as a state function	824 – 830 831 - 834
13	Mon, 10/22	Make-up class	
	<b>Mon, 10/22</b>	<b>First in-course exam [covers lectures 1 – 12]</b>	
14	Wed, 10/24	Third law of thermodynamics, third law entropies, heat capacity Absolute entropies	853 – 860 861 - 864
15	Fri, 10/26	Standard molar entropies Helmholtz and Gibbs energies	865 – 870 881 – 910
16	Mon, 10/29	Helmholtz energy and spontaneity Examples, calculations, Maxwell relations	884 – 887 888 - 904
17	Wed, 10/31	Maxwell relations, cont'd, Fundamental Equation	893 – 901

		Gibbs-Helmholtz equation, Fugacity	901 - 910
18	Fri, 11/2	Phase Equilibria	925 – 952
		Water, carbon dioxide, benzene phase diagrams, critical point	929 - 933
19	Mon, 11/5	Chemical potential and phase changes	933 – 940
		The Clausius-Clayperon equation	941 - 949
20	Wed, 11/7	Liquid-liquid solutions	963 – 998
		Partial molar quantities, Gibbs-Duhem equation, Raoult's law	966 - 972
21	Fri, 11/9	Make-up lecture	
	Mon, 11/12	Veterans' Day, No university exercises	
22	Wed, 11/14	Distillation, Raoult's and Henry's laws	972 – 980
		Temperature-composition diagrams	981 – 986
	<b>Wed, 11/14</b>	<b>Second in-course exam [covers lectures 1 – 21]</b>	
23	Fri, 11/16	Activities, activity coefficients, non-ideal mixtures	987 – 993
		Standard states	993 - 998
24	Mon, 11/19	Solid-liquid solutions, colligative properties	1011-1047
		Activity of non-volatile solute	1015 - 1020
25	Wed, 11/21	Freezing point depression, evaluation of	1020 - 1022
		Osmotic pressure; mean activity coefficients	1023 - 1030
	<b>Fri, 11/23</b>	<b>The day after Thanksgiving, no university exercises</b>	

26	Mon, 11/26	The Debye-Huckel Theory	1031 - 1037
		The spherical approximation to D-Huckel theory	1035 - 1037
27	Wed, 11/28	Chemical equilibrium	1049 – 1082
		Equilibrium constant, Le Chatelier's principle	1053 - 1057
28	Fri, 12/1	Effect of extent of reaction on Gibbs energy, Gibbs and spontaneity	1058 - 1066
		Basic revision of course content	
<b>30</b>	<b>Mon, 12/03</b>	<b>Final Exam, 12:30 PM – 2:20 PM, SB1 304.</b>	

*Note: Depending upon the rate at which topics will be covered; Chapter 26 on Chemical Equilibrium may be set aside and handled in the winter quarter in Chem 441/541.*

*Also Note: Veterans' Day is going to be celebrated on Monday; 11/21/07; which would have been the day set aside for in-course exam 2. The class will have to search for an alternative time for the exam.*