SYLLABUS
Physical Chemistry 2

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Course Goals:

This course provides the basic knowledge on chemical thermodynamics. It offers an understanding of the fundamental principals and laws of thermodynamics, thermodynamic functions and their methods of calculation.

You will first learn the basic terms and definitions. Then, you will learn the four fundamental laws of thermodynamics, thermodynamic functions, their methods of calculation and how they can be applied to pure substances and mixtures. You will develop the ability to explain the reasons behind all natural phenomena, to find relations between reason and result, to determine the optimum conditions for all chemical operations and processes, to calculate all the equilibrium properties and finally you will be able to examine all the natural, technical or even social phenomena thermodynamically.

Course Outline:

1. **Thermodynamic Terms and Definitions**
    *   Work and Heat, Expansion Work, Work of Compression, Reversible and Irreversible Transformations, Maximum and Minimum Quantities of Work.

2. **The Zeroth Law of Thermodynamics**
    *   Systems, Surroundings and Thermodynamic Operations.

3. **Molecular Motions**
    *   Degrees of freedom, translational motion, rotational motion, vibrational motion, equipartition of energy, molecular and molar energies, heat capacities.

4. **Energy and the First Law of Thermodynamics**
    *   Changes in energy in relation to changes in properties of the system, changes in state at constant volume, Joule's law, changes in state at constant pressure, the relation between Cv and Cp, Joule-Thomson experiment, adiabatic changes in state.

5. **Thermochemistry**
    *   Heat of reaction, heats of formation, Hess' Law, heats of solution, heats of reaction at constant volume, dependence of the heat of reaction on temperature, bond dissociation energies.

6. **The Second Law of Thermodynamics**
    *   Heat engines, Carnot cycle, entropy, natural directions and Clausius inequality.

7. **The Third Law of Thermodynamics**
    *   The properties of entropy, entropy changes in isothermal operations, Trouton's rule, entropy as a function of temperature and volume, entropy as a function of temperature

and pressure, entropy changes in the ideal gas, the third law of thermodynamics and its application to chemical reactions.

8. **Equilibrium and Spontaneity**
   - Equilibrium and spontaneity, driving forces for natural changes, the fundamental equations of thermodynamics, Helmholtz function, Gibbs free energy

9. **Chemical Equilibrium**
   - Chemical potential, thermodynamic properties of mixtures, chemical equilibrium in a mixture of ideal gases, equilibrium constants, temperature dependence of the equilibrium constant, Le Chatelier Principle.

Course Materials:

- **Textbook**
  P.W. ATKINS "Physical Chemistry", Oxford University Press, 7th , N.Y., 2002.

- **Additional References**
  G.W. Castellan, "Physical Chemistry", Addison-Wesley Pub. Com. Inc., USA, 1983.

  W. J. Moore, "Basic Physical Chemistry", Prentice Hall Inc., USA, 1983

Grading Scheme:

Midterms:	There will be 2 midterm exams.
Quizzes:	There will be at least 3 10-15 minutes quizzes.
Homeworks:	Homeworks to be handed in will be assigned in order to encourage collaboration with the classmates, to give the students the practice that they need to feel confident with the material.
Questions:	Questions will be directed during the lectures in order to give the students the opportunity to explain ideas and listen to each other. The best answer will be awarded by an extra quiz grade.

	Number	Effective Proportion %
Midterm Exams	2	42
Quizzes	5	12
Homeworks	5	6
Final Exam	1	40

Letter Grades

90-100	AA	50-59	CC
80-89	BA	40-49	DC
70-79	BB	30-39	DD
60-69	CB	…-29	FF