SYLLABUS

A. Course Description

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Language*
CHM	**241**	**Physical Chemistry (1)**	**4**	**2**	**2**	**2**	**6**	**CHM 102**	**3**	**English**

Topics covered in the course include the properties of ideal gas and some laws related to them and the real gas properties. First, second and third laws of thermodynamics, the equilibrium states, Application of the Gibbs function and the Planck function to some phase changes.At the end of this course the student will be able to:

- define the concept of standard state and thermodynamic functions of pure substances due to change of temperature.
- list the thermodynamic concept of phase equilibrium, chemical equilibrium, entropy, and Gibb's free energy.
- estimate the heat of reaction from tabulated bond energy values.
- evaluate the elevation in boiling point and depression in freezing point of solutions due to salt addition.
- analyze data and results through analytical thinking, with evaluation of the gained information.
- diagram and illustrate experimentally obtained data.

B. References: Required Textbook & Internal Website

I shall use

Physical Chemistry, K. J. Laidler, J. H. Meiser, B. C. Sanctuary, (4th Ed.), Houghton Mifflin Company, 2003, [ISBN: 0618123415].

Students are required to purchase the textbook/materials (it is an obligation). The book contains the lecture notes as well as activities for the students to take part in; the book serves as a workbook. Other references:

- ***Chemical Thermodynamics Basic Concepts and Methods***, Irving M. Klotz, Robert M. Rosenberg, (7th Ed.), Wiley, 2008, ISBN-10: 471780154
- ***Physical Chemistry***, P.W Atkins, and J. de Paula, (8th Ed.), New York, NY: W.H. Freeman and Company, 2001, (ISBN: 9780716735397)
- ***Physical Chemistry***, R.Silbey, R. Alberty, and M. Bawendi. (4th Ed.), New York, NY: John Wiley & Sons, 2004, ISBN: 9780471215042.

Google Classroom Webpage: http://www.imamm.org/

C. Topics Outline

Disclaimer: this is a very fast-paced course. There will be little time—if any—for review. What follows is an approximate outline of the pace of the course. We may go faster or slower, contingent on the class response. The tentative list of topics to cover:

a. Theory:

1. **Nature of physical chemistry**. Classical mechanics and Properties of Gases, The Perfect Gas – States of gases , Gas laws, Individual Gases, Boyle's Law, Charles's and Gay-Lussac's law, Avogadro's Principle, Graham's law, Perfect (Ideal) Gas Equation, Mixtures of Gases.Dalton's Law, Mole Fractions, Real Gases, Virial coefficients, Molecular Interactions, Compression factor Boyle's Temperature, CO_2 Phase Diagram, Condensation, Critical Constants, van der Waals Equations, Principle of Corresponding States, Kinetic Model of Gases.
2. **Introduction to Thermodynamics**, Basic Concepts (Work, Heat and Energy), ZEROth Law. The First Law of Thermodynamics - Conservation of Energy, Systems and Surroundings. Expansion Work, General Expression for Work, Free Expansion, Expansion Against Constant Pressure, Reversible Expansion, Isothermal Reversible Expansion, Heat Transactions, Calorimetry, Heat Capacity. Enthalpy, Definition of Enthalpy, Measurement of Enthalpy, Variation of Enthalpy with Temperature, Relation Between Heat Capacities, Adiabatic Change, Work of Adiabatic Change, Heat Capacity and Adiabats. Standard Enthalpy Changes, Enthalpies of Physical Change, Enthalpies of Chemical Change, Hess' Law, Standard Enthalpies of Formation Changes, Reaction Enthalpy & Enthalpy of Formation, Group Contributions, Temperature Dependence of Reaction Enthalpies.
3. **State Functions, Exact and inexact differentials**, Changes in internal energy, The Joule experiment, Changes in internal energy at constant p. Temperature Dependence of Enthalpy, Changes in enthalpy at constant volume, Isothermal compressibility, Joule-Thomson effect, CV vs. Cp.
4. **The second law of thermodynamics**. Carnot Cycle and entropy: The Concepts, Direction of Spontaneous Change, Dispersal of Energy, Entropy, Thermodynamic definition, Entropy as a State Function, The Clausius Inequality. Entropy of Phase Transition at the Transition Temperature, Expansion of the Perfect Gas, Variation of Entropy with Temperature, Measurement of Entropy. Third Law of Thermodynamics, Nernst Heat Theorem, Third-Law Entropies, Reaching Very Low Temperatures, Helmholtz and Gibbs Energies, Helmholtz Energy, Maximum Work, Gibbs Energy, Maximum Non-Expansion Work, Standard Molar Gibbs Energies.
5. **Simple Mixtures**, Thermodynamic Description of Mixtures, Partial Molar Quantities, Partial Molar Volume, Partial Molar Gibbs Energies, Significance of Chemical Potential, Gibbs-Duhem Equation, Thermodynamics of Mixing, Gibbs Energy of Mixing, Other Thermodynamic Mixing Functions, Chemical Potentials of Liquids, Ideal Solutions, Ideal Dilute Solutions. The Properties of Solutions, Liquid Mixtures, Colligative Properties, Boiling point elevation, Freezing point depression, Solubility, osmotic Pressure, Activities, Solvent Activity, Solute Activity, Regular Solutions.

b. Practical:

Safety and Laboratory equipments and measurements and reports, Boyle and Mariette's law (P, V), Amontons' law (P,T), Gay-Lussac's law (V, T), Avogadro' s law (V, n), Charles's law, Determination the molar heat of solution and dilution, Determination the molar heat of

reactions, Boiling point elevation, Freezing Point Depression, Molecular weight determination by boiling point elevation, Molecular weight determination by freezing point depression

D. Exams & Grading System

The semi-official dates of the exams for this course, with all the caveats, that the word "semi-official" entails, can be found here:

- **Midterm 1:** 6th or 7th week &**Midterm 2:**11th or 12th week
- **Quizzes**: **2 Quizzes**
- **Homework: 4 Homework**
- **Final Exam:** 16th weak

	Teaching/learning activities	Contact Hours	Frequency	Total Contact hours	Self-study hours (hrs)	Total self-study hours	Student Learning Time
1	Lecture	2	15	30	1.5	22.5	52.5
2	Tutorial	2	15	30	1.5	22.5	52.5
3	Lab\Practical	2	14	28	0	0	28
4	Lab report	0	14	0	1	14	14
5	Homework	0	4	0	2	8	8
6	Lab Exam	2	1	2	4	4	6
7	Quiz	0.25	2	0.5	1	2.5	2.5
8	Test (Midterm)	1.5	2	3	4	8	11
9	Final Exam	2	1	2	8	8	10
Total				95		89	184.5

Independent self-study = 87/15 ≅ 6 hrs per week (as average**)**

Your course grade will be based on Final Exam, Midterms, Homework, Quizzes, Participation, Attendance and Project.

Midterm 1: 10 %	**Midterm 2:** 10 %	**Final Exam:** 40 %
Laboratory: 30 %	**Quizzes; Homework & Attendance & Participation:** 10 %	

Grading distribution:

A^+: [95, 100], A:[90, 95), B^+: [85, 90), B: [80, 85), C^+: [75, 80), C: [70, 75), D^+: [65, 70), D: [60, 65), F: [0, 60).

E. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Examsgoo.gl/ykm7t3

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