**THE UNIVERSITY OF ZAMBIA**

**SCHOOL OF NATURAL SCIENCES**

**DEPARTMENT OF CHEMISTRY**

**CHE2615: Basic Physical Chemistry**

**Pre-requisites**: CHE1000, M1100

**Rationale**

The course is intended to broaden students' understanding of the basic concepts of physical chemistry by developing fundamental mathematical concepts. Thus, the course is designed to impact simple computation skills and to an understanding of general phenomena as described by the kinetic theory, electrochemistry, and treatment of involving energy changes essential for beginners.

**Course Objectives**

*On completion of the course, students should be able to;*

*(i)* compute simple relation involving kinetic theory of gases, free energy and entropy.
*(ii)* relate electrochemistry to everyday situations
(iii) relate chemistry to other scien-based disciplineds and thus realize the importance of Chemistry in everyday life.
*(iv)* use knowledge on chemical equilibria, buffers, reaction rates to everyday circumstances.

**Course Content:**

**Kinetic theory of gases**

Brief review of gas laws (Boyle's Charle's Gay-Lussacs, Dalton's Graham's laws), Postulates of Kinetic theory. Mathematical treatment of Kinetic theory, Deduction of all the gas laws from $PV = \frac{1}{3} mnu^2$.

Molecular velocity of gases (root-mean-square velocity). Distribution of molecular velocity.
Thermodynamics - introduction and scope of thermodynamics
System, surrounding and universe. State and non-state functions. Thermodynamic variables. Definition of internal energy, work and heat. Statement of the first law and its mathematical formulation. Application of first law to an ideal gas, isothermal and adiabatic conditions. Heat capacities of gases. Hess' law and Kirchoff equation. Bond energies. Introduction to the second law. Qualitative prediction of direction of reaction based on encropy.
Simple treatment of $\Delta G^o = \Delta H^o - T\Delta S^o$, $\Delta G^o = -nFE^o$ and $\Delta G^o = -RT\ln K$.

**Chemical and Ionic Equilibria**

Reversible reactions. Law of Mass action. Equilibrium constant, $K_c$ and $K_p$ and the relationship, $K_p = K_c(RT)^{\Delta n}$. Factors affecting equilibria (qualitative and quantitative treatment). Heterogeneous equilibria. Ionic equailibria - definition of acids and bases acid conjugate and base pair. Acidity - alkalinity-pH.pKa. Self-ionization of water, $K_w$ .pH of weak acids and bases. Hydrolysis constant, $K_h$. Buffer solutions-Henderson-Hasselbatch equation. Solubility products.

**Chemical Kinetics**

Introduction to Rate and rate law. Molecularity and order of reaction. Concentration and rate equations. The integrated rate laws - zero, first and second order reactions. Radioactive decay and carbon dating. Pseudo-order reactions. Factors affecting the rate of reactions.

**Electrochemistry**

Ohm's law, electrolysis-mechanism of electrolysis. Faraday's laws and calculations. Galvanic cell, Daniel cell and standard cell. Cell convention. Difference between chemical and electrolytic cells. Reduction potential and electrochemical series. Nernst equation. Dry cell and lead accumulator cell. Strong and weak electrolytes. Theories of electrolytic conductance and conductance ratio. Kohlrausch's law of independent migration of ions. Variation of molar conductance with concentration.

Mode of delivery

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| Lectures: | 3 hours per week. |
| Tutorials: | 1 hour per week. |
| Laboratory: | 3- hour-session per week. |

**Assessment:**

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| **Continuous assessment(CA)** | | **40%** |
| Theory Test : | 20% | |
| Assignments: | 5% | |
| Laboratory practical: | 15% | |
| **Final Theory Examinations** | | **60%** |
| **Total** | | **100%** |

**Recommended Textbook:**

P.W. Atkins, Physical Chemistry, W. Freeman and Company, New York, 1986.

**Supplementary Readings:**


1. G. barrow, Physical Chemistry, 6th edition, McGraw-Hill, 1988.
2. G.W. Castellan, Physical Chemistry, Addison-Wesley Inc., 1983.
3. P. Harwood, General Chemistry: Principles and Modern Applications, Prentice-Hall Int. Inc., 1987.