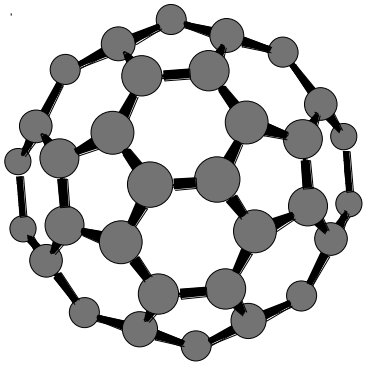

KASKASKIA COLLEGE
CHEM 112 (Physical and Analytical) Course Syllabus

Instructor: Dr. Niranjan Goswami
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Text Book : The Principles of General Chemistry (2nd Edn) by Silberberg
Lab: Basic Laboratory Studies in General Chemistry with Semimicro Qualitative Analysis(10th Edn) by Grace R. Hered

Weekly Schedule:
MWF: 9:00A-9:50A
TR : 1:00P-2:50P

OFFICE HOURS	
MWF **MW**	**8:30A-9:00A** **10:00A-3:30P** **6:00P-6:30P(Breese)**
T **R**	**10:A-10:30A** **10:30A-11:A**

Or by appointment

(Notes: This is a web-enhanced class. Some activities and assignments must be completed via the Internet as well as traditional classroom instruction)

Course Outline: Factors that influence reaction rates. Rate laws, calculation of the rate constants and activation energies. Relationships between reaction rate and equilibrium constant, mechanisms of reactions. The equilibrium constant, reaction quotient, Kc and Kp relationships and calculation of the equilibrium concentrations with ICE tables, Le Chatelier's Principle. Acid-Base equilibia, Calculations of pH and pOH. Calculations of Acid-Base equilibria. Ionic equilibria and Buffer systems, Acid-Base titrations and solubility product constant calculations. The laws of thermodynamics. The second law and the spontaneity of chemical reactions interms of entropy and free energy changes. Calculations of these themodynamic functions. Oxidation-Reduction reactions in their different media solutions. Voltaic cells and electrolytic cells and their

applications including the pH meter. Naming coordination complex compounds, Valency Bond and the Crystal Field Theory of the transition metal complexes. Magnetic properties of the complex compounds. Radiochemistry, Nuclear chemistry and the calculations of the binding energy. Applications of Nuclear chemistry in Nuclear Medicine.

Exams: There will be 4 hour exams and the final Exam(**5** exams total). The lowest score of the hour exams should be dropped..The Final exam will be **comprehensive**.

quizes: There are two different types of quizzes:

Lecture Comprehension Quiz: Each lecture should be completed with a quiz. This quiz should be multiple choice and should be easy if a student pay attention to the lecture.

Weekly Quiz: This quiz will be done on blackboard.

Attendance Policy: The students are required to attend every class unless any emergency reason. Proper documents needed to prove the emergency occurrence. 3 regular absences in the whole semester will be accepted. Points will be taken off for each absence(30 points) after 3 regular absences if no proper documentation is submitted for emergency. Students coming to the class 10 minutes(or higher) late or leave the class earlier will be considered as late(**L**) in the grade book and each 3 lates will be equal to 1 full absence(**a**). Also, the student will miss the lecture comprehension quiz for making every absence

Inside the Class Room policy:

(1) Not talking in the class except class materials
(2) Not sleeping during the class time
(3) Seriously working in the class and in the lab
(4) Regular Note-keeping
(5) No cell phones, CD players, or other listening or recording or cameras are allowed in the class room. The violators might loose points from the total points.
(6) No eating food inside the class
(7) Must bring scientific calculators and books.
(8) The students must be seated separately enough during the quiz or exam period.

Assignments: The assignments will be assigned every week. You cannot copy anybody's homework. You will have to do it by yourself.

Objectives of the course*: The core objective of this course is to learn fundamentals of physical and analytical chemistry. This course includes chemical kinetics in which we will learn about the principles of chemical kinetics. We will understand why and how the rates of chemical reactions are affected. We will learn about the dynamics or chemical equilibrium and reversibility of chemical reactions. Also, we will be learning how chemical equilibrium will be related and affected by thermodynamic functions. We will be learning about the ionic equilibrium and also electrochemical principles and calculations. We will understand how the oxidation-reduction reactions are related to electrochemistry. We will also concentrate on the qualitative analysis of the cations and anions*

even by doing experiments in the laboratories. We will also understand the radioanlytical techniques, nuclear reactions and their applications

Course syllabus:

Chapter 16: Rate of reaction and mathematical expression of reaction rate. Factors affceting the reaction rates. First order, second order and 3rd order reactions and their rates. Half-life of reactions. Integrated Rate Laws, Collision and Transition state of reaction rates and Activation Energy calculations. Reaction mechanisms and catalysis.
Homework:16.11, 16.12, 16.18, 16.27, 16.28, 16.38, 16.59, 16.60, 16.64

Chapter 17: Mathematical expression of chemical equilibrium. Equilibrium constant and reaction quotients. Le Chatelier's Principle and factors affecting equilibrium constants. Relationships between equilibrium constant and reaction rates.Techniques for solving equilibrium problems.
Homework: 17.14, 17.21, 17.22, 17.24, 17.30, 17.33, 17.34, 17.61, 17.62

EXAM I: Feb 4, Fri

Chapter 18: Concepts of acids and bases. Strengths of acids and bases. Ionic equilibria and pH calculations. Ionic equilibria calculations of Weak Electrolytes. Henderson-Hasselbalch Equations.Polyprotic acids.Lewis Acid-Base Model.
Homework: 18.5, 18.6, 18.7, 18.15, 18.18, 18.34, 18.43, 18.60, 18.67, 18.90

Chapter 19: The Common Ion Effect and Buffer Solutions.Acid-base Titrations and Indicators. Solubility- Product constant and Principle and Precipitations. Solubility and Common-ion effects. Solubility Product Principles, Precipitation and Qualitative Analysis. Equilibria involving complex ions.
Homework: 19.3, 19.8, 19.10, 19.12, 19.10, 19.11, 19.12, 19.14, 19.15, 19.40, 19.44, 19.52

EXAM II: March 4, Fri

Chapter 20: Chemical Thermodynamics. Thrmodynamic functions, the first law of thermodynamics and the second law of thermodynamics. Spontaneous processses. Calculations of enthalpy anf entropy changes. The third law of thermodynamics.Free energy changes and relationships between free energy changes and equilibrium constants.
Homework: 20.13, 20.14, 20.15, 20.28, 20.45, 20.50, 20.51, 20.60, 20.64

Chapter 21: Electrochemistry. Galvanic cells and cell potentials. Standard elctrode potentials and calculations. Relationships between cell potential and the equilibrium constant. Primary and secondary cells. Electrolytic cells and applications.Faraday's laws of electrolysis. Balancing oxidation-reduction reactions.
Homework: 21.5, 21.6, 21.7, 21.8, 21.20, 21.21, 21.23, 21.31, 21.35, 21.36, 21.49, 21.54, 21.80, 21.81

EXAM III: March 25, Fri

Chapter 22: The Chemistry of Transition elements: Valence Bond and Molecular Orbital Method of Chemical Bonding. Quantum mechanical concept and Bond Order calculations. Hybridization concept and complex compounds of metal ions including naming complex compounds.
Homework: 22.10, 22.11, 22.24, 22.25, 22.29, 22.30, 22.31, 22.38, 22.47, 22.62

Chapter 18: Laws of radioactive decay. Radioactive dating. Binding energy calculations Nuclear reactions and applications
Homework: 23.6, 23.7, 23.10, 23.12, 23.20, 23.24, 23.27, 23.48, 23.49

EXAM IV: April 29, Fri
FINAL EXAM: Comprehensive

THE LEARNING OUTCOMES OF CHEM 112

The students should be able to understand
(1) what is the definition of reaction rate?
(2) how to express mathematically the reaction rate laws of various reactions
and how to define the reaction orders(Ist order, 2nd order, and 3rd order reactions)
(3) how to determine the rate laws?
(4) what is the Integrated Rate Law and the methods how to determine the reaction orders?(For example, graphical methods)
(5)the mechanisms of reactions
(6) how to calculate the Activation Energy by graphical method
(7)the different types of catalysis
(8) how to calculate the equilibrium constant
(9) how to relate the K_c to K_p
(10)what is the difference between the reaction quotient and the equilibrium constant
(11) how the equilibrium is shifted by the various factors like temperature, pressure, and concentration and catalyst based on the Le Chateliers Principle
(12)how to calculate the equilibrium concentrations
(13) what is the various concept of acids and bases
(14) calculate the pH and pOH of of various solutions
(15)how to calculate the equilibrium concentrations of weak acids
(16) how to calculate the pH and pOH of buffered solutions.
(17) how to calculate the buffer capacity and how to make a buffer solution
(18) how to determine the equilivalence points and pKa by acid-base titrations and the application of Henderson-Hasselbalch equation
(19) what is the application of solubility constant principle in identifying the presence of cations(qualitative analysis) and anaions
(20) What are the significances of thermodynamic functions (Entropy, Internal energy, Enthalpy, and Free energy and spontaneity of chemical reactions.
(21) the laws of thermodynamics and their relationships with the thermodynamic functions
(22) how the driving force of a chemical reaction is related to the thermodynamic functions
(23)how to calculate the standard free energy, std entropy, std free energy and how to calculate the non-std funtions as well
(24) how equilibrium constant is related to the free energy change?
(25)the electrochemical cells and half reactions and what are the differences between Galvanic cells and non-Galvanic cells(electrolytic cells)
(26) how cell potential, electrical work, and free energy are related to each

other?
(27) how to calculate the std free energy change from a cell reaction
(28) what is the concentration cells and use of Nernst Equation to calculate the cell potential
(29) how equilibrium constant is related to the electrode potentials?

(30) what is electroplating and how it works?
(31) what is radioactivity and what are radioactive isotopes
(32) what are the fundamental particles and how to write the nuclear reactions
(33) what is half life and its relationships with the order of the reactions
(34) Nuclear Binding Energy and how to calculate the nuclear binding energy in terms of various units e.g., electron volts, kJ, etc.
(35) what are the applications of radioactive isotopes
(36) What is Valence Bond Theory and Molecular Orbital Theory and how these theories are applied to complex compounds and how bond orders are calculated.

Grading policy:

Laboratory	150
Assignments & Quizes	150
Exams	700
TOTAL	1000

(EXAM I 150 points
EXAM II 100
EXAM III 100
EXAM IV 150
FINAL 200

700

Scores	Letter grade
90-100%	A
80-89%	B
70-79%	C
60-69%	D
<60%	F

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HAPPY STUDYING: Never get tired of learning
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