SYLLABUS

CHE*K122 General Chemistry II
Three Rivers Community College
Norwich, CT 06360

David L. Cullen

Office: D205 E (Adjunct Faculty Office)

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Office Hours: TR 3:45-4:30
Others to be determined

Special Notice: If you have a disability that may affect your progress in this course, please meet with a Disability Service Provider (DSP) as soon as possible. Please note that accommodations cannot be provided until you provide written authorization from a DSP.

TRCC Disabilities Service Providers Counseling & Advising Office Room A-119	
Matt Liscum (860) 383-5240	• Physical Disabilities • Sensory Disabilities • Medical Disabilities • Mental Health Disabili
Chris Scarborough (860) 892-5751	• Learning Disabilities • ADD/ADHD • Autism Spectrum

Course: General Chemistry II/CHE*K122

Credits: 4 credit hours (3hr lecture/3hr lab each week)

Course Description: Further study of the principles, theories and laws of chemistry. Topics include kinetics, equilibrium, thermodynamics, oxidation-reduction, electrochemistry, organic chemistry, nuclear chemistry and the chemistry of the elements and their compounds.

Prerequisites: CHE*K121 with a "C" grade or better, MAT* K186 with a "C" grade or better.

Text: *Chemistry*, 11th ed., Chang and Goldsby, McGraw-Hill. The 10th edition is also acceptable. Chang is the only author on that edition.

Lab Manual: Lab manual is provided at first meeting of lab.

Other Required Materials: Chemical safety goggles, scientific calculator.

General Course Objectives:

1. To provide students with a solid understanding of the fundamental concepts of chemistry.
2. To encourage students to apply problem-solving skills toward chemical calculations.
3. To educate students in the language and nomenclature of chemistry.
4. To help students relate chemical concepts to practical applications.

Class Attendance Policy:
There is no formal attendance policy for lectures. However keep in mind that missing one day of lecture is the same as missing a entire week. Students are responsible for all material covered in lecture whether or not it is in the textbook. Examinations are based on the material covered in lecture.. The instructor will be disinclined to "give a break" in borderline situations to students who have excessive absences without acceptable excuses.

Attendance at all laboratory sessions is required unless there are acceptable mitigating circumstances. See section on make-ups below. An explanation of the cause of all absences should be given to your instructor.

Academic and Classroom Misconduct:

The instructor has primary responsibility for control over classroom and/or laboratory behavior and maintenance of academic integrity, and can request the temporary removal or exclusion from the classroom or laboratory of any student engaged in conduct that violates the general rules and regulations of the institution. The same is true for any student engaged in conduct deemed hazardous in the laboratory. Extended or permanent exclusion from lecture or laboratory activities or further disciplinary action can only be effected through appropriate procedures of the institution. Plagiarism, cheating on quizzes or tests, or any form of academic dishonesty is strictly prohibited. Students guilty of academic dishonesty directly or indirectly will receive a zero for the exercise or quiz or test and may receive an "F" grade for the course in addition to other possible disciplinary sanctions which maybe imposed through the regular institutional procedures. Any student that believes that he or she has been erroneously accused may appeal the case through the appropriate institutional procedures if their grade was affected.

College Withdrawal Policy:

Any student who finds it necessary to discontinue this course MUST complete a withdrawal form in the Registrar's Office at the time of the withdrawal. Students may withdraw from the course any time during the 14 weeks of class to receive a "W" grade for the course (Deadline will be announced). Students who do not withdraw, but stop attending will be assigned an "F" grade in in this course. Verbal withdrawals CANNOT be accepted. If you are unable to withdraw in person, you may call the Registrar's Office and provide them with the appropriate information. *Once you withdraw from the course you are no longer eligible to attend class or take any remaining quizzes or tests.*

Revisions to the Syllabus:
The instructor reserves the right to revise the objectives, topical outline, or academic schedule contained in this syllabus without notice. However, if the revisions affect scheduled unit tests a 48-hour notice will be given for the new test date.

Grade Determination:

3 Unit Tests	42%	140 points each	420 points
Final Examination (Cumulative)	23%		230 points
Problem Sets	10%		100 points
2 Lab Tests	12%	60 pts each	120 points
Lab reports	13%		130 points

1000 points

A more detailed break down of the points for laboratory reports will be provided later.

Grade Scale

The following is a somewhat "relaxed" version of the usual grading scale. There will be no grading on the normal distribution curve. At the discretion of the instructor, the specified limits may be varied somewhat at the discretion of the instructor. The limits will never be moved upward.

100.00 - 92.00 = A	76.99 - 73.00 = C+	54.99 - 00.00 = F
91.99 - 88.00 = A-	72.99 – 68.00 = C	
87.99 – 85.00 = B+	67.99 – 64.00 = C-	
84.99 - 82.00 = B	63.99 - 61.00 = D+	
81.99 - 77.00 = B-	60.99 – 55.00 = D	

Problem Sets:

Required problem sets will be distributed on Tuesdays except for the weeks before examinations. These will be due the following Tuesday by the end of lecture. If a problem set is turned in by the end of lab on the following Thursday, it will be graded with a 5% penalty applied. If it is turned in by the end of lecture on the following Tuesday, it will be graded with a 10% penalty applied. No problem sets will be accepted after that point. If there is a legitimate reason for the lateness, no penalty will be applied. Supplementary problem sets may be given I the weeks before examinations, but these will not be collected or graded. Grades will be given both as a raw score and as a percentage. The percentage score will be averaged to give the overall problem set point grade. If there are acceptable mitigating circumstances for a missed problem set, that problem set will not be included in the average. If there is no such mitigating circumstance, a percentage grade of 0 will be recorded. Collaborative efforts are permitted, but simply copying somebody's problem set is not.

Make-Ups:

Any assignment missed can be obtained from the instructor. Lab work may be made during the lab time for the other sections of Chemistry 121 if space is available. If this is not possible then an alternate written assignment will be assigned. Make up of unit tests must be arranged through the instructor. Students have the option of taking one unit test during the semester later than scheduled. In such cases the examination must be completed by the following Friday. You should inform the instructor if you wish to exercise this option. Further requests for extensions must be for extremely compelling and legitimate reasons. . "I need to study more" or "I'm not prepared" are NOT considered valid reasons for further extensions.

Cellular Phones and/or beepers: ***Cellular phones and beepers are only allowed in class or lab if they are turned off or in silent mode. Under no circumstances are phones to be answered in class. During an examination they are be stored out of reach sight and sight. Sending or receiving text messages in class is disrespectful to the instructor and other students and is similarly prohibited When there are extenuating circumstances that require that a student be available by phone or beeper, that student must speak to the instructor prior to class, so that together they can arrive at an agreement.***

Course Objectives: CHE K122- General Chemistry II

1. The student will be able to distinguish between sigma and pi bonds.
2. The student will be able to understand the concept of orbital hybridization.
3. The student will be able to understand molecular orbital theory, including bonding and antibonding orbitals
4. The student will learn the basic properties of liquids and solids.
5. The student will learn the factors affecting solubility of gases, liquids and solids in solution.
6. The student will learn the basics of the eneregetics of ionic bond formation.
7. The student will be able to understand phase changes and phase diagrams.
8. The student will learn the basics of crystal structure.
9. The student will learn the properties of solutions, including solution terminology and electrolyte behavior.
10. The student will learn about the factors which affect the rate of chemical reaction.
11. The student will be able to write a rate law.
12. The student will understand the meaning of reaction order.
13. The student will learn how to calculate the half-life for a reactant.
14. The student will be able to understand the meaning of activation energy.
15. The student will learn about different types of catalysts and how they function.
16. The student will be able to calculate the instantaneous and the average reaction rate.
17. The student will be able to understand the concept of reaction mechanism.
18. The student will be able to define enzymes and understand basic enzyme catalysis.
19. The student will be able to define chemical equilibrium.
20. The student will learn how to write an equilibrium expression.
21. The student will learn how to interpret the equilibrium constant.
22. The student will be able to understand the relationship between kinetics and equilibrium.
23. The student will learn how to calculate equilibrium concentrations of reactants and products.
24. The student will understand LeChatelier's principle and factors which affect equilibrium.
25. The student will learn the definitions of acids and bases.
26. The student will learn how to determine the strength of acids and bases.
27. The student will be able to define pH and calculate the pH of acid or base solutions.
28. The student will be able to understand weak acids and the acid ionization constant.
29. The student will learn how to calculate the pH of a weak acid or base solution.
30. The student will be able to understand the concept of Lewis acids and bases.
31. The student will learn how to determine the acid-base properties of salts.
32. The student will be able to understand how titrations are used to quantitate acids and bases.
33. The student will learn how acid-base indicators are used.
34. The student will be able to define a buffer and learn how buffers work.
35. The student will learn how to use the Henderson-Hasselbalch equation.
36. The student will be able to understand the concept of solubility equilibria.
37. The student will learn the definition of the solubility product, K_{sp}.

38. The student will be able to understand the common ion effect.
39. The student will be able to understand the laws of thermodynamics.
40. The student will be able to differentiate spontaneous from nonspontaneous processes.
41. The student will be able to define entropy.
42. The student will be able to understand the concept of free energy.
43. The student will learn how to predict spontaneity based on the free energy change, ΔG.
44. The student will learn about the relationship between the equilibrium constant and free energy.
45. The student will be able to understand the relationship between enthalpy, entropy and free energy.
46. The student will be able to understand how equilibrium and free energy are central to living systems.
47. The student will learn how to balance redox equations.
48. The student will be able to understand the basics of galvanic cells.
49. The student will learn the significance of standard reduction potentials.
50. The student will be able to write half-cell reactions.
51. The student will be able to understand the thermodynamics of redox reactions.
52. The student will be able to define the Faraday constant.
53. The student will learn how to use the Nernst equation.
54. The student will be able to understand how batteries work.
55. The student will learn how an electrolytic cell works.
56 The student will be able to understand corrosion of metals.
57. The student will learn the basics of atmospheric chemistry.
58. The student will be able to understand the phenomenon of acid rain.
59. The student will be able to understand the greenhouse effect.
60. The student will be able to understand various aspects of environmental chemistry including smog.
61. The student will learn the definition of a coordination compound.
62. The student will be able to define coordination number, ligand, and chelating agent.
63. The student will learn the basic nomenclature of coordination compounds.
64. The student will be able to understand the bonding in coordination complexes.
65. The student will learn how coordination chemistry applies to biological systems.
66. The student will learn the basic nomenclature of organic compounds.
67. The student will be able to distinguish between types of organic compounds.
68. The student will be able to define and differentiate between geometric, optical and regioisomers.
69. The student will be able to predict the physical and chemical properties of various organic compounds.
70. The student will be able to differentiate between the different types of nuclear particles.
71. The student will be able to understand the fundamentals of nuclear reactions.
72. The student will be able to understand the basis of nuclear stability.
73. The student will be able to write and balance nuclear equations.
74. The student will learn the definition of nuclear binding energy.
75. The student will be able to understand natural radioactivity and half-life of radioactive decay.
76. The student will be able to understand the concept of nuclear transmutation.
77. The student will be able to understand the concept of nuclear fission.

78. The student will learn how radioactive isotopes are used in biology and medicine.
79. The student will learn about the chemistry of metals and nometals in greater detail.

Course Outline: CHE* K122- General Chemistry II

UNIT 1

I. Chemical Kinetics

A. Reaction Rate
1. factors affecting reaction rate
2. measuring reaction rates
a. instantaneous rate
b. average rate
c. rate constants
3. rate law
4. reaction order
5. half-life

B. Activation Energy and Collision Theory
1. transition state
2. Arrhenius equation for determining E_{act}

C. Reaction Mechanism
1. elementary steps
2. rate-determining step
3. reaction intermediates
4. molecularity
a. unimolecular, bimolecular and termolecular reactions
5. verification of possible mechanism from observed rte law

D. Catalysts
1. homogeneous catalysts
a. enzymes
2. heterogeneous catalysts
a. Haber process
b. catalytic converters
c. catalytic hydrogenation

II. Bonding in Molecules

A. Review of orbitals, electron configurations, Lewis Structures, VSEPR, polarity

B. Valence Bond theory
1. hybrid orbitals
2. sigma and pi orbitals
3. Nomenclature-relationship to structure

C. Molecular Orbital Theory
1. bonding orbitals
2. antibonding orbitals
3. diatomic molecules
4. Polyatomic molecules—Delocalization

D. Ionic Bonding
    1. Lattice energy
    2. Born-Haber calculations

III. Liquids and Solids
    A. Review of Intermolecular Forces
    B. Properties of Liquids and Solids
    1. viscosity
    2. surface tension
    3. density
C. Crystal structure
    1. unit cell
    2. packing spheres
    3. x-ray crystallography
        a. Bragg equation
    4. ionic crystals
    5. covalent crystals
    6. molecular crystals
    7. metallic crystals
D. Amorphous Solids

C. Phase Changes (Some of this will be review)
    1. vapor pressure
    2. evaporation
    3. molar heat of vaporization
    4. condensation
    5. boiling point
    6. critical temperature
    7. critical pressure
    8. melting point and freezing point
    9. molar heat of fusion
    10. sublimation
    11. deposition

D. Phase Diagrams
    1. triple point
    2. supercritical fluids

IV. Properties of Solutions

A. Solution Terminology
    1. solute, solvent, solvation
    2. miscibility
    3. saturated, unsaturated, supersaturated solutions.

B. Solubility
    1. factors affecting solubility
    2. gas solubility
        a. Henry's Law

    2. Tyndall effect
    3. soaps and micelles

V. Chemical Equilibrium

A. Law of Mass Action
    1. Equilibrium Constant

C. Equilibrium Expressions
    1. homogeneous equilibria
    2. heterogeneous equilibria
    3. K_c vs. K_p
    4. multiple equilibria

D. Relationship between Kinetics and Equilibrium

E. Reaction Quotient, Q_c

F. LeChatelier's Principle
    1. factors affecting equilibrium

UNIT 2

I. Acids and Bases
  A. Definitions/Theories
    1. Arrhenius
      a. hydronium ion
    2. Bronsted-Lowry
      a. conjugate acid-base pairs
    3. Lewis
  B. Properties of Acids and Bases
  C. Ion Product of Water
    1. K_w
    2. pH, pOH
  D. Strengths of Acids and Bases
    1. acid ionization constant K_a; percent ionization
    2. monoprotic, diprotic, polyprotic acids
    3. molecular structure and acid strength
  E. Acid-Base Properties of Salts
  F. Acid-Base Properties of Oxides and Hydroxides
    1. acidic and basic oxides
    2. basic and amphoteric hydroxides
  G. Organic Acids and Bases
    1. carboxylic acids
    2. amines
II. Acid-Base Equilibria
  A. Common Ion Effect
    1. Henderson-Hasselbalch equation
    2. pKa
  B. Buffers
    1. importance in biological systems
  C. Acid-Base Titrations
    1. strong acid-strong base
    2. strong acid-weak base
    3. weak acid-strong base
    4. indicators
III. Solubility Equilibria
  A. Solubility Product
    1. K_{sp}
    2. ion product, Q
    3. solubility
    4. molar solubility
  B. Precipitation Reactions
    1. fractional precipitation
    2. qualitative analysis

C. Factors Affecting Solubility
    1. common ion effect
    2. pH effect
D. Complex Ions

UNIT 3

I. Second Law of Thermodynamics
    A. Entropy
        1. spontaneous processes
        2. microstates
        3. standard entropy
        4. relationship between ΔS and ΔH
II. Third Law of Thermodynamics
    A. Absolute Entropy
    B. Gibbs Free Energy (G)
        1. standard free energy change, ΔG°
        2. relationship between ΔG, ΔS and ΔH
            a. predicting the sign of ΔG
III. Free Energy and Equilibrium
    A. $\Delta G = -RT\ln K$
    B. Application of Thermodyanmics in Biological Systems
        1. glycolysis
        2. biosynthesis
IV. Electrochemistry
    A. Oxidation-Reduction Reactrions
        1. balancing redox equations
    B. Galvanic Cells
        1. anode, cathode
        2. half-cell reactions
        3. cell potential or emf
        4. Daniel cell
        5. standard reduction potentials
    C. Thermodynamics of Redox Reactions
        1. relationship between E_{cell}, ΔG and K
    D. Effect of Concentration on E_{cell}
        1. Nernst equation
    E. Batteries
        1. dry cell battery
        2. mercury battery
        3. lithium ion battery
        4. lead storage battery
    F. Fuel Cells
    G. Corrosion
    H. Electrolytic Cells and Electrolysis

V. Environmental Chemistry
- A. Chemistry of the Atmosphere
  1. troposphere, stratosphere, mesosphere, ionosphere (thermosphere)
  2. nitrogen cycle
  3. oxygen cycle
  4. ozone
  5. CFC's
- B. Volcanoes
- C. Greenhouse Effect
  1. greenhouse gases
- D. Acid Rain
- E. Smog and Emissions
- F. Water
- G. Alternative Fuels

UNIT 4

I. Transition Metal Chemistry
- B. Electron Configurations
- C. Coordination Chemistry
  1. coordination number
  2. donor atom
  3. ligand
  4. chelating agent
  2. nomenclature
  3. structure
  4. isomerism
     a. geometric isomers, optical isomers, chirality
  5. bonding
     a. crystal field theory
  6. reactivity
  7. applications of coordination chemistry
     a. industrial
     b. biological

Ii. Nuclear Chemistry
- A. Subatomic Particles
  1. protons, neutrons, electrons
  2. beta particles, alpha particles, positrons
- B. Fundamentals of Nuclear Reactions
  1. radioactive decay
  2. nuclear transmutation
  3. conservation of atomic number
  4. conservation of mass number

C. Nuclear Stability
    1. belt of stability
    2. nuclear binding energy
D. Kinetics of Radioactive Decay
    1. half-life
    2. radiocarbon dating
E. Nuclear Fission
    1. critical mass
    2. nuclear chain reaction
    3. nuclear reactors
F. Uses of Radioisotopes
    1. mechanistic studies

III. Chemistry of Metals
A. Sources/Production
    1. minerals
    2. ores
    3. alloys
B. Band Theory
    1. conductors and semiconductors

IV. Chemistry of Nonmetals
A. Carbon, Nitrogen, Oxygen, Sulfur, Phosphorus and the Halides

V. Organic Chemistry
A. Classes of Compounds/Nomenclature
    1. aliphatic hydrocarbons
        a. alkanes, alkenes, alkynes, alicyclic hydrocarbons
    2. aromatic hydrocarbons
        a. benzene and related compounds
B. Functional Groups
    1. alcohols
    2. carboxylic acids
    3. amines
    4. amides
    5. aldehydes
    6. ketones
    7. esters
    8. ethers
C. Physical and Chemical Properties
    1. mp, bp, solubility
    2. reactivity
D. Isomers
    1. cis/trans isomers
    2. regioisomers
    3. optical isomers and chirality
    2. biology and medicine

CHE*K122 General Chemistry II **Tentative** Academic Schedule Spring 2013
11931 Lecture: T 6:00- 9:00 PM D230
11932 Lab: R 6:00-9:00 p.m. B222

week 1
R-Jan 24 Introduction to course;
Chapter 13: Kinetics

week 2
T-Jan 29 Kinetics cont'd
Review of orbitals and electron configurations
R-Jan 31 *LAB: Exp #1:Kineticss I- Iodination of Acetone* .

week 3
T-Feb 5 Chapter 10: Review of Lewis structures, VSEPR;
Valence Bond Theory
R-Feb 7 *LAB: Exp #2: Kinetics II-The Iodine Clock Reaction*

week 4
T-Feb 12 Chapter 9: Energetics of Ionic Bond Formation
Chapter 11: Physical Properties of liquids and solids; phase diagrams
R-Feb 14 *LAB: Exp 3: Chemical Equilbirium.*

week 5
T-Feb 19 **UNIT TEST 1 (Ch 10, 11, 12, 13)**
R-Feb 21 9:00 a.m. *LAB: Exp.#4: Aspirin: Synthesis and Melting Point Determination.*

week 6
T-Feb 26 Chapter 10: Molecular Orbital Theory
Chapter 14: Equilibrium
R-Feb 28 *LAB: Exp: #5 Determination of Vitamin C in Fruit Juice*

week 7
T-Mar 5 Chapter 14: Equilibrium
Chapter 15: Acid and Bases
R-Mar 7 **LAB EXAM 1 (Exp. 1-5)**

week 8
T-Mar 12 Chapter 15: Acids and Bases
Chapter 16: Acid-Base Equilibria, Solubility Equilibria
R-Mar 14 *Lab: Exp #6: pH and Buffers*

week 9
T-Mar 19 **SPRING BREAK**
R-Mar 21 **SPRING BREAK**

week 10
T-Mar 26 Chapter 16: Acid-Base Equilibria, Solubility Equilibria
R-Mar 28 **UNIT TEST 2 (CH 14,15/24, 16)**

week 11
T-Apr 2 Chapter 17: Entropy, Free Energy and Equilibrium
R-Apr 4 *LAB: Exp #7: Water Hardness Titration*
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week 12
T-Apr 9 Entropy, Free Energy and Equilibrium cont'd.
Chapter 18: Electrochemistry
R-Apr 11 *LAB: Exp. #8: Solubility Product Constant*

week 13
T-Apr 16 Electrochemistry cont'd.
Chapter 20: Chemistry in the Atmosphere.
R-Apr 18 *LAB: Exp: 9: Determination of Iron by Redox Titration.*

week 14
T-Apr 23 **UNIT TEST 3 (Ch 17, 18, 20)**
R-Apr 25 *Lab: Exp 10: Thin-Layer Chromatography*

week 15
T-Apr 30 Chapter 23: Chemistry of the Transition Metals.
R-May 2 *LAB: Ex.10: Molecular Models and Lewis Structures II*

week 16
T-May 7 Chapter 19: Nuclear Chemistry.
R-May 9 *LAB: Ex.11: Analysis of Sugars by Optical Rotation*
week 17
T-May 14 Chapter 21, 22: Chemistry of Metals and Non-Metals
Chapter 24: Organic Chemistry
R-May 16 **Lab Exam 2 (Exp. 6-12)**

week 18
T-May 21 **FINAL EXAM**