<u>Syllabus</u>

Three Rivers Community College
Thames Valley Campus
574 New London Turnpike
Norwich CT 06360-2498

Concepts of Chemistry and Lab (CHE K 111)
Fall semester 2007
Sect T04 & T4A (CRN 30354 & 30355)
Lectures M and W 0930 a.m. - 1050 a.m., Labs T 0930 a.m. – 1230 p.m.

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Office hours: Mondays and Wednesdays before and after class, Tuesdays before lab, and by appointment.

CHE* K111 (formerly CHE K103)
4 CREDIT HOURS
CONCEPTS OF CHEMISTRY
Prerequisites: Placement test score indicating ENG* K101 or successful completion of ENG* K100 with a "C" grade or better and MAT* K137 with a "C" grade or better (or permission of the instructor on math requirement).
This course offers a brief and comprehensive survey of important chemical theories and some of the applications of chemistry. Topics covered will include measurements in chemistry, atomic structures and chemical bonding, chemical reactions, states of matter, stoichiometry, theories of solution, and basic organic and biochemical concepts. Course Design: CHE* K111 is meant for students with little or no background in chemistry who need the course in preparation for General Chemistry, or for students who need to meet a pre-admission requirement for nursing or other allied health programs, or those who need a lab science course.

<u>Required textbooks and materials:</u>
Burns, Ralph A., *Fundamentals of Chemistry, Fourth Edition w/ CD ROM*
    Prentice Hall. Pearson Education, Inc., 2003
Chemical splash-proof safety goggles
calculator
<u>Optional:</u> *Fundamentals of Chemistry Study Guide & Selected Solutions Manual*

<u>Statement for students with disabilities:</u> If you have a disability that may require classroom, laboratory, or test-taking modifications, be sure to notify the Counseling and Advising Center (383-5217), and the learning specialist (Chris Scarborough: 383-5751) if you have not already done so. Also please see me as soon as possible. Please note that I cannot provide accommodations based on disability until I have received an accommodation letter from the Disabilities Counselor. Your cooperation is appreciated.

Evaluative criteria and procedure for evaluation:
Grade determination:

 45%   3 "preliminary" examinations (15% each) (Returned for review.)
 20%   comprehensive final examination (will not be returned)
 10%   unannounced short quizzes on previous lectures (Lowest is dropped when
        average is computed.)
 25%   laboratory grade (average of lab exercises and 2X practical exams)
100%

Numerical letter grade statement:
Grades will be weighted as noted above. Grades will **NOT** be adjusted to fit a curve of normal distribution.
Letter grades will be earned by attaining averages indicated below:

93-100	= A	73-75.9	= C
90-92.9	= A-	70-72.9	= C-
86-89.9	= B+	66-69.9	= D+
83-85.9	= B	63-65.9	= D
80-82.9	= B-	60-62.9	= D-
76-79.9	= C+	00-59.9	= F

Make-up tests will not be given, except in extreme verifiable emergencies of unavoidable nature. Don't count on it. Death in the immediate family, personal illness, or incidents similarly beyond the control of the student will be considered at a conference with the instructor. Come prepared with verification. It is imperative that any make-up test be completed before the next class meeting.
  Short quizzes must be taken the day given, not made up later. Because of space, time and equipment limitations, laboratory work usually cannot be made up, although sometimes it is possible to join a session of another lab section. If you miss the final examination for properly documented satisfactory emergency reasons you may receive a grade of "I" (incomplete) if other work is satisfactory. Otherwise, "F" is assigned.

Exemption policy:

The instructor will determine who is to be exempted from the requirement to take the final exam, not the student. Exemption is an earned privilege. Any student exempted from the final exam will be notified in advance in writing. To be considered, minimum requirements are:
1. Take all hour-long exams when scheduled.
2. Have no test score lower than 88.
3. Have overall test average of 95.0 or more.
4. No more than one absence (excused or not).
5. Seldom late to class.
6. Good classroom/laboratory behavior.
7. Lab average 93 or above.

<u>Conduct in classroom and laboratory:</u> Every student is required and expected to behave responsibly. The instructor bears primary responsibility for control and maintenance of safety and academic integrity, and can request temporary removal and exclusion from class or laboratory of any student for proscribed conduct including conduct deemed hazardous in the laboratory.

Courteous and appropriate behavior is <u>expected</u>.

Use of portable telephones or pagers during classes is neither courteous nor appropriate, so please be considerate of your fellow students: *Turn the devices off or to silent mode before joining the class*. **Under no circumstances are phones to be answered in class or lab. Thank you.**
If due to extenuating circumstances a student must be available by phone or pager, that student must come to an agreement with the instructor before class.

If you must leave during class or arrive late, please do so quietly.

<u>Plagiarism</u> or other cheating: **Don't.** In addition to any institutional procedures or sanctions, a student will receive ZERO for a grade on any examination or other exercise in which participation or assistance of cheating occurs. Zero on a test makes it difficult to earn a passing average.

<u>Attendance policy and "early warnings":</u> Regular attendance is NECESSARY, required and expected. If you miss a class activity, remember that you are still responsible for learning the material. Four absences could result in missing enough learning opportunities to lose credit for the course. Problems with attendance? See the instructor IN ADVANCE if at all <u>possible</u>. Let US see if we can work out a fair solution together.
   Your continuing accumulation of graded exercises (especially tests) serves as a reminder of your progress. If you have not done well on a test, or if you have a problem that might interfere with your satisfactory progress or attendance, please <u>see me promptly</u>.

<u>In case a class session is canceled by the instructor</u>, students will be notified by email and/or an announcement on WebCT Vista if possible.

Peanuts By Charles M. Schulz

3

If the college opens two hours late (1000) (e.g. due to weather) we will still meet, 1000-1050. Half a class session is better than none. If it is safe for you to come, do so.

Revisions to syllabus: The instructor reserves the right to revise the academic schedule, topical outline or objectives. However, if any revision alters the date of a major test, the students will be given 48 hours notice.

College withdrawal policy:
Dropping courses:
Students may drop courses in person through the last day to drop classes with partial refund of tuition as specified in the academic calendar [Sun 9 Sep 2007].
See college catalogue for details.
Withdrawing: After the last drop date:
 Last day to withdraw from classes is Mon 3 Dec 2007.
 See college catalogue for details.
Failure to attend class is <u>not</u> an acceptable method of either dropping or withdrawing.
This will result in a failing grade of "F" on the student's permanent transcript and can seriously affect future reinstatement or transfer to another college. Non-attendance does <u>not</u> cancel the financial obligation[s].

General course objectives (CHE K 111):

A: To provide students with understanding of the basic fundamental principles, concepts, and methods of the science of chemistry.

B: To provide useful information and skills for students with little or no background in chemistry.

C: To help students to develop ability to use scientific principles to think critically.

D: To encourage students to be aware of how chemistry affects their professional and personal activities.

E. To help students to develop skills in collaborative problem-solving.

Specifically:

1. The student will learn about and be able to apply scientific (critical) thinking, scientific methods, and facts and procedures of chemistry to derive sound conclusions from scientific data.

2. The student will be able to define chemistry, and list and define the various branches of chemistry.

3. The student will be able to identify and safely use various laboratory equipment.

4. The student will be able to define matter, describe its characteristics and differences from energy, and identify and describe its (three usual) physical states.

5. The student will be able to distinguish between homogeneous and heterogeneous matter.

6. The student will learn the Laws of Conservation of Mass and Energy.

7. The student will be able to distinguish between a pure substance and a mixture.

8. The student will learn to differentiate between metals and nonmetal elements using physical and chemical properties.

9. The student will comfortably use the metric system of measurement of length, volume, mass, and temperature.

10. The student will be able to convert between units of the metric system, and between British and metric systems.

11. The student will be able to apply rules of identifying significant figures.

12. The student will be learn to correctly use significant figures in basic mathematical operations.

13. The student will be able to define and describe mass, weight, degrees, calories, specific heat, density, and specific gravity.

14. The student will be learn to use correct procedures for measuring mass (weight) and volume.

15. The student will be able to define the term atom and describe in general terms the modern model of atomic structure.

16. The student will be able to describe protons, neutrons, and electrons, and describe their relative locations in atoms and ions and molecules.

17. The student will be able to explain what isotopes are, how they differ from each other, and how they are used.

18. The student will be able to describe and apply Heisenberg's Uncertainty Principle to describe modern understanding of electrons in atoms.

19. The student will be able to demonstrate the arrangement of electrons with principle energy levels as described by quantum mechanics, and in sublevels and orbitals.

20. The student will be able to explain and use the concepts of ionic charge, valence electrons and oxidation numbers.

21. The student will be able to differentiate between the terms atom and element, molecule and compound, formula unit and molecule.

22. The student will recognize the general characteristics of the groups of elements in the Periodic Table of Elements.

23. The student will learn to use the Periodic Table of Elements.

24. The student will be able to describe, recognize and use the periodic changes in characteristics of elements shown in the Periodic Table.

25. The student will be able to describe and contrast ionic and molecular (covalent) bonding of atoms to each other.

26. The student will be able to recognize electron arrangements in atoms, and use them to describe and predict possible chemical bonding.

27. The student will learn the methods of assigning names to inorganic compounds, and be able to write correct formulas from the names of compounds.

28. The student will learn to calculate formula weights and molar masses of elements, ions, molecules, and ionic compounds.

29. The student will learn to calculate the percent composition of each element in a compound, and the empirical formula of a compound.

30. The student will be able to learn the concept of chemical equations and how and why they are used.

31. The student will learn the terms and symbols used in chemical equations, and what they mean.

32. The student will learn the guidelines for balancing chemical equations.

33. The student will be able to recognize types of chemical reactions from their equations.

34. The student will be able correctly write and balance chemical equations.

35. The student will be able to use chemical equations to do simple stoichiometric calculations.

36. The student will demonstrate knowledge of characteristics of gases, and of the gas laws.

37. The student will be able to perform calculations using combined gas laws.

38. The student will demonstrate knowledge of the characteristics of liquids generally, water specifically, and solids.

39. The student will be able to demonstrate knowledge of the characteristics of solids and how some are formed.

40. The student will be able to define the term solution, and will be able to recognize, identify, and list characteristics of different types of solutions.

41. The student will be able to explain recognize how solubility and rates of solubility are affected by various influences.

42. The student will be able to explain the difference between concentrated and dilute solutions, and the differences between saturated, unsaturated, and supersaturated solutions.

43. The student will be able to perform calculate percent by mass, and molar and normal concentrations of solutions.

44. The student will be able to state various definitions of acids and bases.

45. The student will be able to explain properties of acids and bases.

46. The student will be able to define pH, and recognize its log scale.

47. The student will be able to define and explain the process of neutralization.

48. The student will be able to define the term buffer, and explain how buffering agents work.

49. The student will be able to define the term electrolyte, and differentiate between electrolytes and non-electrolytes.

50. The student will be able to define oxidation-reduction, REDOX, and to balance simple oxidation-reduction reaction equations.

51. The student will be able to understand reversible reactions, equilibria, and reaction rates.

52. The student will be able to define organic chemistry and recognize its applications.

53. The student will learn to identify classes of hydrocarbons and some derivatives of hydrocarbons.

54. The student will learn the basis for systematic IUPAC nomenclature of hydrocarbons, and be able to recognize and correctly name simple hydrocarbons.

55. The student will learn the chemical composition of some functional groups in derivatives of hydrocarbons including aromatic compounds.

56. The student will learn the chemical composition of some simple organic compounds, and to recognize their formulas.

57. The student will be able to describe basic characteristics, including chemical composition, of carbohydrates, lipids, proteins, and nucleic acids.

58. The student will be able to define the terms metabolism, anabolism, and catabolism.

59. The student will be able to describe the basic biochemical mechanisms of photosynthesis, cellular respiration, and synthesis of lipids, proteins, nucleic acids and complex carbohydrates.

<u>Course subject outline</u>
<u>Concepts of Chemistry (K111)</u>
Please note that the sequence of presentation may differ from this outline.

Introduction to chemistry

Scientific methodology

Matter and energy
       definition of matter
       physical states of matter
              solid, liquid, gas
       homogeneous and heterogeneous matter
              pure substance
              solutions
              mixtures
       energy defined, and types of energy
       energy-mass relations
       Law of Conservation of Mass
       Law of Conservation of Energy
              Endothermic (= endergonic = endoergic) reactions /
              Exothermic (= exergonic = exoergic) reactions
       elements
              definition
              atoms
Measurement
       Système International (d'Unites) (SI)
              how and why
       significant figures
              importance and use of
       scientific notation
               how and why
       mass and weight
              definitions
              use of
       the metric system
              prefixes and meanings
                     kilo-, deci-, centi-, milli-, micro-, nano-, pico-
              units of length, mass, and volume
                  converting units
              converting to and from another system
              scales and units of temperature
                  Kelvin, Celsius, and Fahrenheit
                     conversions between C, K scales

       density
       specific gravity

Atoms
  definitions
  models--why
  Dalton's Atomic theory
  subatomic particles
    protons, neutrons, electrons
    charges and mass
    locations in atoms
  atomic number
  atomic mass units (amu)
  atomic weight
  metal/nonmetals
  isotopes
    definition
    natural radioactivity: α, β, γ
    uses
  electron configuration
    energy levels and capacity
    arrangement of electrons
      principle energy levels, sublevels, orbitals
  models
    3-dimensional
    two-dimensional
      electron dot method
Periodicity of the elements
  The Periodic Law
  The Periodic Table of the Elements
    periods, groups / families
  general characteristics of the groups
  using the Periodic Table

Reactivity and electron arrangement
  valence
  oxidation numbers
  chemical bonds
    electrovalent, ionic bonds
    covalent (molecular) bonds
      polar
      nonpolar
    hydrogen bonding (<u>between</u> molecules)

  writing formulas for compounds

Chemical nomenclature of inorganic compounds
       Greek prefixes in naming molecular compounds
           Why and what they mean
       different compounds
           binary compounds
               a metal and a nonmetal
               metals with fixed/variable oxidation numbers
               two nonmetals
           higher compounds
           common names

Calculations involving elements and compounds
       Avogadro's number
       moles
       formula weight/molecular weight
       grams, moles conversion
       molar volume of a gas
     molar masses
       percent composition of compounds
       empirical and molecular formulas

Chemical equations
       definition
       reactants and products
       catalysts
       symbols and their meanings
           single arrow, double arrow, equal sign,
           plus sign, arrows pointing up and down,
           delta above arrow, g, l, s, aq
       rules for balancing chemical equations
       balancing equations
       writing and balancing word equations
       combination, decomposition and replacement, and combustion reactions

Stoichiometry
       the mole method—three basic steps
       types of stoichiometry
           mass-mass
           mass-volume
           volume-volume
       heat energy in chemical reactions

Gases
  The Kinetic Molecular Theory
  pressure of gases
  the gas Laws
    Boyles' Law
    Charles' Law
    Gay-Lussac's Law
    Combined Gas Laws
    Dalton's Law of Partial Pressures
    Henry's Law of solubility of gasses under pressure
    solving problems using the gas laws

Water
  structure
  hydrogen bonding
  physical properties
  hydrates
  hydrogen peroxide

Liquid state
  contrast with gas state
  evaporation
  vapor pressure
  surface tension
  boiling points
  distillation

Solid state
  melting/freezing points
  crystalline structures/amorphous solids
  sublimation

Heat energy transformation between states of matter

Solutions
  definition
  types
    different states
    true solutions
    emulsions
    suspensions
    colloids

(Solutions, continued)
        effects on solubility and rate of solution by:
                properties of solute, solvent
                temperature
                pressure
                particle size
                stirring

        unsaturated, saturated, supersaturated solutions
        concentration of solutions
                concentrated, dilute
                percent by mass
                Molarity
                molality
                Normality

Reaction rates and chemical equilibria
        reaction rates
                surface area
                nature of reactants
                concentration of reactants
                temperature
                catalysts
        chemical equilibria
                reversible reactions
                irreversible reactions
                Le Châtelier's Principle
                Law of Mass Action (Equilibrium Constant expression)

Acids, bases, and ionic equations
        definitions, nomenclature, and properties
                acids
                bases
                salts
         titration
        ionization of water
        pH
        buffers
        electrolytes and nonelectrolytes
        writing ionic equations--rules

oxidation and reduction
        definitions
        oxidizing and reducing agents

balancing equations using oxidation numbers
balancing equations using ion-electron method
electrochemical cells—applications of REDOX
    electrolytic cells
    electrolysis
    Voltaic (galvanic) cells, batteries
    practical applications

Organic chemistry
    definition and characteristics
    hydrocarbons
        definition
        aliphatic: alkanes, alkenes, alkynes
        aromatic
            definition, characteristics
        some derivatives
    organic compounds in living systems/biochemistry
        kinds, characteristics, composition, synthesis of
            carbohydrate, lipids, proteins, nucleic acids
        metabolism: definitions, examples
            anabolism, catabolism
            release of energy
                glycolysis, Krebs cycle, e^- transport
                fermentation
            photosynthesis, chemosynthesis
            DNA synthesis
            protein synthesis
                transcription
                translation

Concepts of Chemistry and Lab (CHE K 111)
Fall semester 2007
Sect T04 & T4A (CRN 30354 & 30355)
Lectures M and W 0930 a.m. - 1050 a.m.
Labs T 0930 a.m. – 1230 p.m.

Tentative schedule of assignments and major topics:

Date	Required study *	Topics
M, 27 Aug 2007	Letter (p. xxvii-xxxiii), pp. 1-2, 4-11 except fig. 1.3. Skim Appendices.	Introduction and orientation to science, to chem, to the course
T, 28	{*All labs: Study handouts <u>prior</u> to laboratory period.*}	LAB $_1$: Orientation: SAFETY, equipment, procedures
W, 29	Chap. 2	**Turn in signed safety agreement.** Matter and energy
M, 3 Sep 2007	**Labor Day**	**College closed.**
T, 4	***Remember to bring your goggles every lab session.***	LAB $_2$: 1. Quiz on Lab$_1$, then 2. Measurement, incl. density and specific gravity
W, 5	Chap. 3	First lecture quiz, then: Measurement$_1$
M, 10	Chap. 3	Measurement $_2$
T, 11		Lab $_3$: Structure of a solid: "blue vitriol"
W, 12	Ch. 4 <u>through</u> 4.10 Review pp. 17-18.	Atoms, elements, compounds/ Law of Definite Proportions, Law of Multiple Proportions, properties

* **See note at end of list.**

M, 17 Sep 2007	Chap. 7	Periodicity in elements
T, 18	Sec. 2.5: p.20-23	LAB 4 : Properties of substances
W, 19	Ch. 5: Sect. 5.4 - 5.10	Electrons in atoms
M, 24	Sect. 5.7, Ch. 6 except section 6.8 (pp. 169-174)	Lewis dot symbols, valence electrons Chemical formulas and naming 1
T, 25	Ch. 6 except section 6.8 (pp. 169-174)	LAB5: Representation of atoms, formula units, molecules
W, 26 September 2007		******* TEST 1**
M, 1 Oct	Ch. 6 except Section 6.8 (p. 169-174)	Chemical formulas and naming 2
T, 2 October 2007	**All labs to date**	****** LAB PRACTICAL EXAM 1, review, then formulas, names (problem-solving session)**
W, 3	Sect. 4.11, 4.12 (pp. 102-107), pp. 111-113, & Ch. 9 except section 9.6	Avogadro's nr, moles, formula mass1
M, 8 Oct 2007	**Columbus Day observed**	**Classes NOT in session**
T, 9		LAB: Qualitative analysis and determining chemical formulas
W, 10	Sect. 4.11, 4.12 (pp. 102-107), pp. 111-113, & Ch. 9 except section 9.6. Chap.10: pp. 276-278	Avogadro's nr, moles, formulas 2: Problem-solving: MW, percent composition, moles Intro to chemical equations

M, 15 Oct 2007	Chap. 10	Chem. reactions incl. balancing, types
T, 16	Chap. 10, Ch. 11: pp. 312-319, (through Sect 11.3), Sect. 11.6 and Appendix D	LAB: (problem-solving session in **room TBA:_____,** balancing equations, mole ratios, stoichiometry
W, 17		More stoichiometry problem-solving
M, 22	Ch. 8	Bonds that electrons form
T, 23	Sect. 11.6 (p.323 +)	LAB: Mass relationships in a reaction (Stoichiometry)

W, 24 October 2007   ******* TEST $_2$**

M, 29	Ch. 12	Fluids$_1$: Gasses, Gas Laws
T, 30	Ch. 14	LAB: Solutions
W, 31	Ch. 13	Liquids and solutions $_1$
M, 5 Nov	Ch. 14 & Section 9.6 (pp. 262-265), Sect. 11.4 (pp. 319-321), and Ch. 16	More on solns: Molarity, dilutions Intro to acids, bases
T, 6	Ch 16 & sect. **6**.8 (p. 169-174) & Sect. 8.6 (p. 230+)	LAB: Acids, bases, neutralization by titration
W, 7	Ch. 16 & Sect. **6**.8	Acids, bases, neutralization

M,12 Nov 2007	Ch. 15	Reversible reactions, reaction rates, equilibria
T, 13		Lab: follow-up on solutions, then Lab: Some organic tests
W, 14 November 2007		******* TEST 3**
M, 19	Ch. 17 & Section 6.7 (pp. 167-169)	Redox
T-W, 20-21 Nov 2007 "Classes NOT in session, but		Make-up/Supplemental sessions may be scheduled."
Th-Sun 22-25 Nov 2007		**Thanksgiving Recess-College closed.**
M, 26	Ch. 19	Organic chemistry—an introduction, General, structural formulas, intro to hydrocarbons
T, 27 November 2007	Labs since first lab exam	*** **LAB PRACTICAL EXAM 2,** review, then electrolytes/ nonelectrolytes (Demo),
W, 28	Ch. 19	$>24 \times 10^6$ of compounds: IUPAC, saturated, unsaturated hydrocarbons, *cis-, trans-* isomers, functional groups
M, 3 Dec	Ch. 19 & 20 & handout	Functional groups making more of the millions of compounds (More found or made daily!), aromatics, carbohydrates, lipids
T, 4	Ch. 19 & 20 & handouts	LAB: Modeling: Functional groups, dehydration synthesis and hydrolysis of polymers of biological importance **room TBA:_____**
W, 5 Dec	Ch. 20 and handouts	Proteins, nucleic acids, intro to biochemical reactions

M, 10 Dec. Ch. 20 & handouts More introduction to biochemical reactions: synthesis and metabolism of a simple sugar, DNA and the synthesis of proteins including enzymes.

(11-19 Dec 2007 Prep. and take finals. "Final exam week")

TUESDAY, 18 Dec 2007 Everything! (comprehensive) FINAL EXAMINATION

(0930-1230 in Room _____ (TBA).

Note: Appropriate "Problems" at ends of chapters should also be solved. It is not enough to read and review problems in the chapters. Full understanding generally requires that you *work out the problems*. Use Appendix F (p. 684 ff.) to *check* your work. Handout materials, of course, must also be studied.