Syllabus

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

Concepts of Chemistry and Lab (CHE K 111)
Spring semester 2007
Sect T04 & T4A (CRN 10590 & 10591)
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.

Course description (as listed on website): **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.

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

Statement for students with disabilities: 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.

Conduct in classroom and laboratory: 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 expected.

Use of portable telephones or beepers 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 beeper, 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.

Plagiarism 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.

Attendance policy and "early warnings": 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 possible. 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 see me promptly.

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

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 [Fri 2 Feb 2007].
See college catalogue and *Spring Schedule 2007* for details.

Withdrawing: After the last drop date:

Last day to withdraw WITHOUT instructor's signature is Fri 30 Mar 2007.
Last day to withdraw WITH signature is Mon 23 Apr 2007.

See college catalogue and *Spring Schedule 2007* for details.

Failure to attend class is not 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 not 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.

Course subject outline
Concepts of Chemistry (K111)
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)
Spring semester 2007
Sect T04 & T4A (**CRN 10590 & 10591**)
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 22 January 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, 23	{*All labs: Study handouts prior to laboratory period.*}	LAB $_1$: Orientation: SAFETY, equipment, procedures
W, 24	Chap. 2	**Turn in signed safety agreement.** Matter and energy
M, 29	Chap. 3	First lecture quiz, then: Measurement$_1$
T, 30	***Remember to bring your goggles every lab session.***	LAB $_2$: 1. Quiz on Lab$_1$, then 2. Measurement, incl. density and specific gravity
W, 31	Chap. 3	Measurement $_2$
M, 5 February	Ch. 4 through 4.10 Review pp. 17-18.	Atoms, elements, compounds/ Law of Definite Proportions, Law of Multiple Proportions, properties
T, 6		Lab $_3$: Structure of a solid: "blue vitriol"
W, 7	Chap. 7	Periodicity in elements

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

M, 12 February 2007	Ch. 5: Sect. 5.4 - 5.10	Electrons in atoms
T, 13	Sec. 2.5: p.20-23	LAB $_4$: Properties of substances
W, 14	Sect. 5.7, Ch. 6 except section 6.8 (pp. 169-174)	Lewis dot symbols, valence electrons Chemical formulas and naming $_1$
M, 19 Feb 2007	**Presidents Day observed**	**Classes NOT in session**
T, 20	Ch. 6 except section 6.8 (pp. 169-174)	LAB: Representation of atoms, formula units, molecules
W, 21 Feb 2007		******* TEST $_1$**
M, 26	Ch. 6 except Section 6.8 (p. 169-174)	Chemical formulas and naming $_2$
T, 27 February 2007	**All labs to date**	****** LAB PRACTICAL EXAM $_1$, review, then formulas, names (problem-solving session)**
W, 28	Sect. 4.11, 4.12 (pp. 102-107), pp. 111-113, & Ch. 9 except section 9.6	Avogadro's nr, moles, formulas $_1$
M, 5 Mar	Sect. 4.11, 4.12 (pp. 102-107), pp. 111-113, & Ch. 9 except section 9.6 pp. 276-278	Avogadro's nr, moles, formulas $_2$, percent composition, intro to chemical equations
T, 6		LAB: Qualitative analysis and determining chemical formulas
W, 7	Chap. 10	Chem. reactions incl. balancing, types

M, 12 Mar 2007		Problem-solving: formula mass, MW, % composition, Avogadro's nr, moles
T, 13	Ch. 10: sect. 10.1 through 10.3 and Ch. 11: pp. 312, Sect. 11.3, Sect. 11.6 and Appendix D	LAB: (problem-solving session in room TBA**:_____,** balancing equations, molar ratios, stoichiometry
W, 14	Ch. 8	Bonds that electrons form
18-25 March 2007	**Spring break**	**Classes NOT in session**
M 26 Mar	Ch. 12	Fluids$_1$: Gasses, Gas Laws
T 27	Sect. 11.6 (p.323 +)	LAB: Mass relationships in a reaction (Stoichiometry)
W, 28 March 2007		******* TEST 2**
M, 2 April	Ch. 13	Liquids and solutions 1
T, 3	Ch. 14	LAB: Solutions
W, 4	Ch. 114 & Section 9.6 (pp. 262-265), Sect. 11.4 (pp. 319-321), and Ch. 16	More on solns: Molarity, dilutions Intro to acids, bases
M, 9	Ch. 16 & Sect. 6.8	Acids, bases, neutralization
T, 10	Ch 16 & sect. 6.8 (p. 169-174) & Sect. 8.6 (p. 230+)	LAB: Acids, bases, neutralization by titration
W, 11	Ch. 15	Reversible reactions, reaction rates, equilibria

More>>>>>>>

M, 16 Apr 2007	Ch. 17 & Section 6.7 (pp. 167-169)	Redox
T, 17 Oct		Lab: follow-up on solutions, then Lab: Some organic tests
W, 18 April 2007		***** **TEST 3**
M, 23	Ch. 19	Organic chemistry—an introduction, General, structural formulas, intro to hydrocarbons
T, 24 April 2007	Labs since first lab exam	*** **LAB PRACTICAL EXAM 2,** review, then electrolytes/ nonelectrolytes (Demo),
W, 25	Ch. 19	>24 x 10^6 of compounds: IUPAC, saturated, unsaturated hydrocarbons, *cis-*, *trans-* isomers, functional groups
M, 30	Ch. 19 & 20 & handout	Functional groups making more of the millions of compounds (More found or made daily!), aromatics, carbohydrates, lipids
T, 1 May	Ch. 19 & 20 & handouts	LAB: Modeling: Functional groups, dehydration synthesis and hydrolysis of polymers of biological importance room TBA**:_____**
W, 2	Ch. 20 and handouts	Proteins, nucleic acids, intro to biochemical reactions
M, 7 May.	Ch. 20 & handouts	More introduction to biochemical reactions: synthesis and metabolism of a simple sugar, DNA and the synthesis of proteins including enzymes.

More>>>>>>>

(8-16 May 2007 Prep. and take finals. "Final exam week")

<u>TUESDAY, 15 MAY</u> 2007 Everything! (comprehensive) <u>FINAL EXAMINATION</u>

(0930-1230 in Room <u>_____ (TBA).</u>

*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 *<u>work out the problems</u>*. Use Appendix F (p. 684 ff.) to *check* your work.

Handout materials, of course, must also be studied.