

LAST REVIEW: 2010-2011
(i.e. 2006-2007)

NEXT REVIEW: 2015-2016
(i.e. 2011-2012)

STATUS: A
(A, I, D)

COURSE TITLE: Chemistry for Health Sciences

COMMON COURSE NUMBER: CHM1032

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN

(Per 16 week term)

CLOCK HOURS:
(Voc. Course ONLY)

Lecture: **48** Lab:
Clinic: Other:

PREREQUISITE(S): MAT 0024 or Appropriate Assessment Scores

COREQUISITE(S): None

PRE/COREQUISITE(S):

COURSE DESCRIPTION *(750 characters, maximum):* Selected topics from general chemistry, organic chemistry, and biochemistry This course is designed primarily for nursing and other allied health technology students. Prerequisite: MAT 0024 or appropriate assessment scores.

General Education Requirements – Associate of Arts Degree (AA), meets Area(s): 4B Area
General Education Requirements – Associate in Science Degree (AS), meets Area(s): 4 Area
General Education Requirements – Associate in Applied Science Degree (AAS), meets Area(s): Area

UNIT TITLES

- 1. Reading and Writing in Chemistry**
- 2. Introduction and Measurement**
- 3. Atomic Structure**
- 4. Nuclear Chemistry**
- 5. Bonding and the Nature of Compounds**
- 6. Stoichiometry**
- 7. Energy, States of Matter, and Gases**
- 8. Solution Chemistry (Properties, Concentrations, Acid-Base Chemistry)**
- 9. Organic Chemistry**
- 10. Carbohydrates**
- 11. Lipids**
- 12. Proteins**
- 13. Enzymes**

*** Complete the following only if course is seeking general education status ***

GENERAL EDUCATION Competencies and Skills *:

In the box to the right of the Competency/Skill, enter all specific **student learning outcome** unit numbers, as indicated in the course outline (i.e. 1.1, 2.7, 4.2, 4.0 and 5.12) that apply.

Course must include <u>all</u> of the following:	
1. Read with critical comprehension**	1.1, 1.2, 2.7, 6.5, 7.13, 8.9
2. Write clearly and coherently**	1.1, 1.3, 3.11, 4.4, 4.5, 5.5, 5.6, 5.8, 8.16, 8.19, 8.24, 9.3, 9.4, 9.5, 9.8, 9.9, 9.11, 9.12, 10.4, 11.2, 11.5, 12.6
3. Demonstrate literacy as appropriate within a given discipline**	b) 1.4 e) 1.1, 1.3, 2.3, 2.5, 2.6, 2.7, 3.7, 4.5, 6.1, 6.2, 6.3, 6.4, 6.5, 7.4, 7.7, 7.13, 8.20 f) 1.1, 1.2, 1.3, 2.1, 3.1, 3.3, 3.8, 4.1, 4.4, 4.10, 4.11, 5.1, 5.2, 5.6, 5.11, 7.1, 7.10, 8.3, 8.4, 8.11, 8.13, 8.15, 8.21, 8.23, 8.24, 9.1, 9.2, 9.7, 9.10, 9.11, 9.12, 10.1, 10.4, 11.1, 11.5, 11.7, 12.1, 12.6, 12.6, 12.7, 12.8, 12.9, 13.2
4. Apply problem solving skills or methods to make informed decisions in a variety of contexts**	1.1, 1.2, 1.3, 2.7, 3.8, 3.9, 5.3, 5.4, 7.8, 7.11, 8.9, 8.13, 9.13, 10.4, 10.7, 11.2, 11.3, 11.4, 11.5, 11.7, 12.4, 12.5, 12.6, 12.10
Course must include at least <u>one</u> of the following:	
5. Differentiate between ethical and unethical behavior	
6. Demonstrate an understanding of the physical, biological, and social environments and how individual behaviors impact this complex system.	2.1, 4.6, 4.7, 4.11, 8.18, 8.25, 9.13, 11.4, 12.8
7. Demonstrate an understanding of, and appreciation for, human diversities and commonalities.	
8. Speak and listen effectively.	

**General Education Competencies and Skills endorsed by 2010-2011 General Education Task Force*

****Required Competencies**

1) Read with critical comprehension.

The student will be introduced to the basic texts, concepts, vocabulary, and methods necessary for developing an understanding of the discipline and meeting the required benchmarks as stated in the course outline.

2) Write clearly and coherently.

The student will demonstrate an understanding and mastery of subject matter in a variety of ways, including writing. Writing activities may include both graded and ungraded essays, short answer quizzes, summaries, reactions, journals, and various other reports.

3) Demonstrate and apply literacy across all the disciplines (indicate which ones apply).

- a) **Information literacy** means understanding how to locate needed information, using the appropriate technology for the task, managing and evaluating the extracted information and using it effectively and ethically.
- b) **Technology literacy** is the ability to responsibly and effectively use appropriate technology to access, manage, integrate, or create information, and/or use technology to accomplish a given task.
- c) **Workplace literacy** is having the appropriate knowledge and skills to communicate and work with others effectively and perform job duties, whether it is through the use of computers and/or other technology.
- d) **Cultural literacy** is recognizing, understanding, and appreciating the similarities and differences between one's own culture and the cultures of others through a study of the arts, customs, beliefs, values, and history that define a culture.

- e) **Quantitative literacy** is having the ability to formulate, solve and interpret mathematical/statistical operations and graphical/tabular representations to make informed decisions.
- f) **Scientific literacy** means understanding the methodology and application of the scientific process, the physical and biological worlds, and recognizing that scientific knowledge is continuously updated or revised as new information is discovered.

4. Apply problem-solving skills or methods to make informed decisions in a variety of contexts.

The student will use acquired skills or methods to recognize, analyze, adapt, and apply critical thinking to solve problems and make informed decisions.

EVALUATION:

In the box to the right of the Methods of Assessment, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 4.0, 4.2 and 5.12) that apply.

1. Portfolio	
2. Short essays	1.1, 1.3, 2.1, 4.6, 4.11, 7.12, 8.11, 8.23, 8.25, 9.13, 10.1, 11.6, 11.7, 11.14, 12.9, 13.5
3. Research Papers	1.0, 2.1, 4.11, 8.13, 11.7, 12.9
4. Group projects	1.0, 4.7, 4.11, 8.13, 8.25, 12.8, 12.9
5. Discussions (In class and online)	1.3, 1.4, 4.6, 4.11, 7.12, 8.6, 8.13, 8.25, 9.13, 10.7, 11.3, 11.6, 12.7, 12.9, 13.3, 13.5
6. Multiple Choice tests	2.2, 2.4-2.7, 3.1, 3.2, 3.5, 4.2-4.4, 5.1, 6.1, 6.5, 7.1, 7.7, 8.9, 8.17, 9.8, 10.3, 10.5, 10.7, 11.5
7. Presentations	
8. Service Learning Projects	
9. Quizzes (pop, announced, etc.)	2.2-2.7, 3.7, 3.10, 5.5, 5.6, 5.8, 6.3, 8.9, 8.16, 8.22, 9.3, 9.5, 9.9, 9.12, 11.1, 12.1, 12.3, 12.5
10. Take-home tests	1.0, 2.2, 2.4, 4.6, 7.12, 8.25, 9.13, 11.6, 13.5
11. Summaries, critiques, and analyses	
12. Reaction papers	
13. Surveys	
14. Performance	
15. Short answer tests	1.0, 2.5-2.7, 3.8, 4.8, 5.3, 5.7, 5.9, 5.11, 7.6, 7.11, 8.3, 8.21, 9.4, 10.2, 11.2, 12.6, 13.4
16. Classroom debates and colloquia	
17. Blogs, wikis, web pages	
18. Other (Please explain)	

Common Course Number: CHM 1032

UNITS

Unit 1: Reading and Writing in Chemistry

General Outcome:

1.0 The student shall be able to clearly communicate in writing information derived from course related readings about the major concepts and themes in the chemical sciences.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 1.1 Demonstrate in writing the ability to analyze, evaluate, compare, and/or extract data relevant to chemistry from course related readings.**
- 1.2 Evaluate the validity of information from a variety of sources, including but not limited to such sources as electronic, print sources, and data bases.**
- 1.3 Demonstrate with the use of diagrams, drawings, outlines, concept maps, and/or other methods the connections among chemical concepts.**
- 1.4 Demonstrate the ability to use the appropriate technology to carry out course requirements.**

Common Course Number: CHM 1032

Unit 2 Introduction and Measurement

General Outcome:

- 2.0 The student shall be able to demonstrate knowledge of the nature of chemistry and demonstrate their understanding of the measurement systems used in chemistry by solving related problems.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 2.1 Define chemistry and evaluate its modern applications and impact on complex systems such as the environment, medicine, industry, and technology.**
- 2.2 Differentiate and use the terms accuracy and precision.**
- 2.3 Perform calculations using scientific notation and significant figures and analyze their answer for correctness.**
- 2.4 Distinguish and apply the common metric/SI units for mass, length, volume, and energy; using the prefixes kilo, deci, centi, milli, and micro.**
- 2.5 Perform conversions among metric units and between certain English and metric units using dimensional analysis and analyze their answers for correctness.**
- 2.6 Interconvert temperatures among Celsius, Fahrenheit, and Kelvin scales.**
- 2.7 Read with critical comprehension experimental data to solve problems involving density and specific gravity; analyze and interpret their answers for correctness.**

Common Course Number: CHM 1032

Unit 3 Atomic Structure

General Outcome:

- 3.0 The student shall be able to describe the structure and components of atoms and apply these concepts to the information contained in the Periodic Table.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 3.1 Differentiate between pure substances and mixtures, and correctly use specific terms such as matter, atoms and elements, molecules and compounds, pure substances, and homogeneous and heterogeneous mixtures.**
- 3.2 State the chemical symbols for common elements such as H, Li, Na, K, Mg, Ca, Sr, Ba, Al, C, Si, Sn, Pb, N, P, As, O, S, F, Cl, Br, I, He, Ne, Ar, Fe, Co, Ni, Cu, Zn, Ag, Au, Hg, U.**
- 3.3 Differentiate between protons, electrons, and neutrons; particularly in regard to their relative masses, charges, and location.**
- 3.4 Identify atomic numbers and atomic masses from the periodic table.**
- 3.5 Use atomic numbers to establish the number of protons (and electrons) in the atom of a given element.**
- 3.6 Describe isotopes and how mass numbers uniquely identify them.**
- 3.7 Calculate atomic masses from isotopic masses and abundances.**
- 3.8 Diagram the electron arrangement for the first 20 elements using principal energy levels.**
- 3.9 Organize elements in the Periodic Table based on their chemical and physical properties, atomic numbers, and valence electrons.**
- 3.10 Use the Periodic Table to identify periods, groups, representative elements, transition elements, metals, non-metals, alkali metals, alkaline earth metals, halogens, and noble gases.**
- 3.11 Write electron dot formulas for the representative elements.**

Common Course Number: CHM 1032

Unit 4 Nuclear Chemistry

General Outcome:

- 4.0 The students shall be able to identify the changes that occur within the nucleus of an atom, and recognize some of the important applications of nuclear chemistry.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 4.1 Distinguish between nuclear changes and ordinary chemical changes.**
- 4.2 Define and use the terms: radiation, radioactivity, nuclide, isotope.**
- 4.3 Compare and contrast alpha particles, beta particles, gamma rays, and x-rays.**
- 4.4 Define and write nuclide symbols for common types of subatomic particles.**
- 4.5 Write and balance nuclear equations.**
- 4.6 Describe how radiation damages cells.**
- 4.7 List the methods used to detect and measure radiation, and describe the measures used to protect living things from radiation.**
- 4.8 Define half-life and perform calculations involving half-life.**
- 4.9 Define the terms “maximum permissible dose,” Curie, Roentgen, rad, rem, LD₅₀.**
- 4.10 Define and recognize equations that represent nuclear fission and fusion.**
- 4.11 Discuss applications for radioactive nuclides, such as imaging and cancer treatment.**

Common Course Number: CHM 1032

Unit 5 Bonding and the Nature of Compounds

General Outcome:

- 5.0** The student shall be able to explain the main types of chemical bonds and how they are formed; predict and draw structures for simple ionic and covalent compounds, including those containing common polyatomic ions; and name and write their chemical formulas.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 5.1** Differentiate between ionic and covalent bonds and compounds, and compare and contrast their properties.
- 5.2** Predict which combinations of elements tend to bond ionically and which tend to bond covalently.
- 5.3** Explain cation and anion formation by using the chemical properties of metals and non-metals.
- 5.4** Apply the concept of valence electrons and the octet rule to construct ions from atoms of representative elements.
- 5.5** Write the name, formula, and charge for mono- and polyatomic ions. At a minimum, the following ions should be covered: Li^+ , Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Ba^{2+} , Al^{3+} , O^{2-} , S^{2-} , F^- , Cl^- , Br^- , I^- , Ag^+ , Zn^{2+} , Cu^+ , Cu^{2+} , Fe^{2+} , Fe^{3+} , NH_4^+ , H_3O^+ , OH^- , SO_4^{2-} , CO_3^{2-} , HCO_3^- , PO_4^{3-} , HPO_4^{2-} , H_2PO_4^- , NO_3^- and NO_2^- .
- 5.6** Construct the chemical formula for an ionic compound given its name, and write the name for an ionic compound given its chemical formula.
- 5.7** Apply the octet rule and/or electron pairing to explain covalent bonding.
- 5.8** Write Lewis structures for simple covalent compounds that contain single, double, and triple bonds.
- 5.9** Define electronegativity and interpret its trend within the Periodic Table.
- 5.10** Define polar covalent and non-polar covalent bonds, and use the Periodic Table to assess the type of bond formed between any two elements.
- 5.11** Define polar and non-polar molecules, and distinguish between simple examples of the two.

Common Course Number: CHM 1032

Unit 6 Stoichiometry

General Outcome:

- 6.0 The student shall be able to define and use the concept of the mole to balance chemical equations and to calculate specific quantities of reactants and/or products involved.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 6.1 Calculate formula and molecular weights for ionic and covalent compounds.**
- 6.2 Explain the concept of the mole and its relationship to atoms and molecules by applying Avogadro's number as a conversion factor.**
- 6.3 Apply dimensional analysis to interconvert between the mass of a given substance and the corresponding number of moles.**
- 6.4 Balance chemical equations utilizing the mole concept.**
- 6.5 Given a balanced equation, read data with critical comprehension to construct a diagram that demonstrates the relationship between the number of moles and grams for various substances in a chemical equation. Use those relationships to calculate specific quantities of reactants and/or products involved.**

Common Course Number: CHM 1032

Unit 7 Energy, States of Matter, and Gases

General Outcome:

- 7.0** The students shall be able to define the three (3) states of matter, detail the transitions among them, and the energy involved in these transitions. They shall also be able to explain the properties of gases, and perform calculations based on the gas laws.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 7.1** Differentiate between a chemical and a physical change.
- 7.2** Describe and compare the three states of matter.
- 7.3** Recognize the following changes of state: melting, freezing, boiling, condensation, sublimation, and deposition.
- 7.4** Diagram energy changes by using heating and cooling curves. Identify specific energy changes such as heat of fusion and heat of vaporization from these diagrams.
- 7.5** Define energy and the energy units calorie and kilocalorie.
- 7.6** Explain how different substances can absorb different amounts of energy; yet increase their temperature by the same number of degrees. Apply that concept to define specific heat.
- 7.7** Use specific heats to calculate the amount of energy produced by a given substance in a calorimetry experiment.
- 7.8** Define nutritional calories and apply the number of nutritional calories per gram of protein (4), carbohydrate (4), or lipid (9) as a conversion factor to calculate the energy content of a specific food that contains a particular number of grams of protein, carbohydrate, and/or lipid.
- 7.9** Define pressure and the units commonly used to measure it.
- 7.10** Define vapor pressure; explain its relationship to temperature, evaporation, boiling point, and atmospheric pressure.
- 7.11** Examine the relationship between pressure, volume, and temperature. Use those relations to construct the gas laws: Boyle's, Charles's, Gay-Lussac's and the Combined Gas Law.
- 7.12** Apply the gas laws to explain the mechanics of respiration and blood gas transport.
- 7.13** Read with critical comprehension experimental data to solve problems involving the gas laws; analyze and interpret their answers for correctness.

Common Course Number: CHM 1032

Unit 8 Solution Chemistry (Properties, Concentrations, Acid-Base Chemistry)

General Outcome:

- 8.0 The students shall be able to define terms that are pertinent to solutions; describe the process of solution formation; do calculations that are based on concentration; compare and contrast diffusion and osmosis; discuss the properties and behavior of acids and bases; write equations for acid-base neutralization reactions; perform fundamental calculations that involve pH; and understand the nature of buffers.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 8.1 Define solution, solute, and solvent.**
- 8.2 Explain the difference between a polar and a non-polar solvent.**
- 8.3 Describe hydrogen bonding and illustrate some of the many examples of hydrogen bonding in nature: interactions among water molecules, surface tension, base-pair recognition in DNA, protein folding, docking of specific substrates to enzymes, etc.**
- 8.4 Describe the process of solution formation, with emphasis on solutes that are electrolytes dissolving in water.**
- 8.5 Define heat of solution and examine examples of endothermic and exothermic dissolution.**
- 8.6 List ways that can be used to increase the rate of dissolution.**
- 8.7 Define solubility and discuss general solubility rules.**
- 8.8 Define concentration; describe and calculate different units of concentration (percent by volume and molarity).**
- 8.9 Read with critical comprehension experimental data and apply each unit of concentration as a conversion factor to interconvert between the mass (moles) of solute and the mass (volume) of solution. Analyze and interpret their answers for correctness.**
- 8.10 Describe the process of dilution, and solve problems involving dilutions.**
- 8.11 Characterize and differentiate between suspensions, colloids, and true solutions.**
- 8.12 Define diffusion, osmosis, concentration gradient, and semipermeable membranes.**
- 8.13 Explain osmotic pressure and its relationship to hypertonic, hypotonic, and isotonic solutions. Analyze how a cell can undergo hemolysis or crenation in solutions with different osmotic pressures.**

- 8.14 Characterize common properties of acids and bases.
- 8.15 Understand the Arrhenius and Brønsted-Lowry definitions of acids and bases. Give common examples that illustrate these definitions.
- 8.16 List and write formulas for some strong and weak acids (HCl, HNO₃, H₂SO₄, H₃PO₄, HC₂H₃O₂, H₂CO₃) and bases (NaOH, KOH, NH₃); write equations for the ionization/dissociation reaction of these common acids and bases in water.
- 8.17 Describe an electrolyte and differentiate between strong, weak, and non-electrolytes. Illustrate how common strong and weak acids and bases act as electrolytes in solution.
- 8.18 Define equivalent and milliequivalent; use these units of concentration to illustrate the concentration of various electrolytes in blood. Discuss the importance of a normal electrolytic balance in the body to prevent major issues such as a heart attack.
- 8.19 Define salts, and write balanced equations for simple neutralization reactions given the reactants.
- 8.20 Describe the self-ionization of water and the relationship of [H₃O⁺] and [OH⁻] in an aqueous solution using the K_w expression. Use that expression to calculate [H₃O⁺] from [OH⁻] and vice versa.
- 8.21 Examine how pH changes as [H₃O⁺] changes; and define acidic, basic, and neutral solutions relative to the pH scale.
- 8.22 Define pH and calculate pH for aqueous solutions of strong acids and strong bases.
- 8.23 Explain how a buffer works and give some simple examples of buffers.
- 8.24 Illustrate the equilibrium of CO₂, H₂CO₃, and HCO₃⁻ in water by writing the appropriate chemical equation. Use this equation to explain the carbonic acid/bicarbonate buffer system in our body.
- 8.25 Define acidosis and alkalosis, and analyze scenarios in which our body buffer system is overwhelmed, resulting in respiratory or metabolic acidosis or alkalosis. Discuss treatments for each of those conditions based on the dynamic equilibrium of CO₂, H₂CO₃, and HCO₃⁻ in our body.

Common Course Number: CHM 1032

Unit 9 Organic Chemistry

General Outcome:

- 9.0 The students shall be able to recognize organic compounds, to name and write formulas of the basic functional groups, and to classify and write out simple organic reactions.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 9.1 Differentiate between inorganic and organic compounds.**
- 9.2 Define hydrocarbon, alkane, and saturated hydrocarbon.**
- 9.3 Write the formulas for the first 10 straight-chain alkanes given their name, and write their name given their formula.**
- 9.4 Recognize and write the formulas for constitutional (structural) isomers and various alkyl groups (methyl, ethyl, propyl, isopropyl).**
- 9.5 Write the formulas for simple branched alkanes and cycloalkanes given their name, and write their name given their formula.**
- 9.6 Differentiate between different functional groups.**
- 9.7 Define alkene, alkyne, and unsaturated hydrocarbon.**
- 9.8 Write the formulas for simple alkenes given their name, and write their name given their formula.**
- 9.9 Distinguish between cis- and trans- isomers; write their formulas given their name, and write their name given their formula.**
- 9.10 Recognize benzene and name simple benzene derivatives. Illustrate some of the many different examples of aromatic hydrocarbons in nature and the pharmaceutical industry, such as pain relievers (aspirin, acetaminophen, ibuprofen), sulfa drugs (various antibiotics), or the cancer-causing polycyclic aromatic hydrocarbons.**
- 9.11 Recognize the general formula for alcohols, ethers, thiols, sulfides, disulfides, aldehydes, ketones, organic acids and their salts, esters, amines, and amides. Write the formulas for simple molecules containing these functional groups given their name, and write their name given their formula. Examine the properties of molecules containing each of these functional groups; such as polarity, ability to hydrogen bond, water solubility, boiling points, or how carboxylic acids act as acids and amines act as bases.**

- 9.12 Write the general types of reactions (hydrogenation, condensation, hydrolysis, oxidation, ionization, or neutralization as applicable) for molecules containing the functional groups mentioned above.**
- 9.13 Apply reactions in organic chemistry to illustrate some of the chemistry in our bodies. For example, discuss the oxidation of alcohols to aldehydes and acids in the liver, resulting in metabolic acidosis; or the formation of kidney stones from the calcium salt of oxalic acid, a common acid in vegetables such as spinach.**

Common Course Number: CHM 1032

Unit 10 Carbohydrates

General Outcome:

- 10.0** The students shall be able to define the terms related to carbohydrates, to recognize their basic structures, and to discuss the important biochemical aspects of these macromolecules.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 10.1** Categorize carbohydrates by structure and differentiate between mono-, di-, and polysaccharides.
- 10.2** Construct ring structures for glucose, galactose, fructose, and ribose from their open-chain counterparts.
- 10.3** Recognize alpha- and beta- isomers.
- 10.4** Analyze and write equations for the formation of a glycosidic bond as an example of a condensation reaction, as well as the reverse reaction (hydrolysis) to break glycosidic bonds. Identify glycosidic bonds in di- and polysaccharides.
- 10.5** Recognize the disaccharides maltose, lactose, and sucrose.
- 10.6** Recognize polysaccharides such as starch or cellulose. Discuss why we are unable to digest cellulose.
- 10.7** Distinguish between the following carbohydrate tests and identify the specific carbohydrates to which each applies: iodine test, Benedict's test, Tollen's test, and fermentation test.

Common Course Number: CHM 1032

Unit 11 Lipids

General Outcome:

- 11.0** The students shall be able to define the terms related to lipids, to recognize their basic structures, and to discuss the important biochemical aspects of these molecules.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 11.1** Recognize the general structure for waxes, triglycerides, phospholipids, glycolipids, terpenes, and steroids.
- 11.2** Analyze and write equations for the formation of an ester bond in complex carbohydrates (waxes, triglycerides, phospho- and glycolipids) as an example of a condensation reaction.
- 11.3** Compare the saturated and unsaturated fatty acid content of animal fats and vegetable oils and relate these to their physical state.
- 11.4** Examine the hydrogenation of vegetable oils to make soft spreads and sticks of margarine. Discuss why trans fatty acids may result from this process.
- 11.5** Analyze and write equations for the acid hydrolysis and basic hydrolysis (saponification) of an ester bond in triglycerides.
- 11.6** Examine the hydrophilic and hydrophobic portions of molecules such as soap, resulting from the saponification of triglycerides. Explain how soap cleans based on its hydrophilic and hydrophobic nature.
- 11.7** Compare the behavior of soap to molecules such as lipoproteins; and discuss how high and low density lipoproteins (HDL and LDL) are used as a capsule to transport a hydrophobic molecule such as cholesterol in blood.

Common Course Number: CHM 1032

Unit 12 Proteins

General Outcome:

- 12.0 The students shall be able to define the terms related to proteins, to recognize their basic structures, and to discuss the important biochemical aspects of these macromolecules.**

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 12.1 Define protein and amino acid.**
- 12.2 Construct the general formula of an amino acid.**
- 12.3 Classify and identify the “R” groups of the 20 common amino acids as polar or non-polar; and identify the acidic and basic “R” groups.**
- 12.4 Describe the ionization of amino acids, and how this results in the formation of positive (cations), negative (anions), or neutral (zwitterion) species.**
- 12.5 Relate the term isoelectric point to pH, and propose the charge of various amino acids in blood based on their isoelectric point.**
- 12.6 Analyze and write equations for the formation of a peptide bond from the condensation reaction of amino acids to form di-, tri-, and polypeptides, and the hydrolysis of a peptide bond to form amino acids from various peptides.**
- 12.7 Describe the primary, secondary, tertiary, and quaternary levels of protein structure, and the concept of a biologically active protein. Discuss the bonds that maintain the primary, secondary, tertiary, and quaternary structure of a protein: hydrogen bonds, hydrophobic attractions, salt bridges, and disulfide bonds.**
- 12.8 Examine the denaturation process: how agents such as alcohols, acids and bases, heavy metals, or heat can cause denaturation and the biological effect of denaturation on proteins.**
- 12.9 Discuss how proteins are denatured and hydrolyzed in our body during digestion; and how our cells reassemble the resulting amino acids into “human” proteins based on our genetic code via a condensation reaction.**
- 12.10 Describe each of the following tests and identify the protein or amino acid to which each applies: biuret test; ninhydrin test; xanthoproteic test; and sulfur test.**

Common Course Number: CHM 1032

Unit 13 Enzymes

General Outcome:

13.0 The students shall be able to define the terms related to enzymes, to recognize their basic structures, and to discuss the important biochemical aspects of these macromolecules.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the students shall be able to:

- 13.1 Recognize how enzymes are named based on substrates or type of reaction involved.**
- 13.2 Discuss substrate specificity of an enzyme, describing the enzyme's three-dimensional "fit" with its substrate.**
- 13.3 Discuss the effect of substrate concentration, enzyme concentration, and pH on enzyme activity.**
- 13.4 Define isoenzyme and enzyme inhibitors.**
- 13.5 Discuss the role of coenzymes, and give some examples in the human body.**