STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

COURSE OUTLINE

CHEM 120 – General, Organic, and Biochemistry

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SCHOOL OF SCIENCE, HEALTH & PROFESSIONAL STUDIES
SCIENCE DEPARTMENT
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CHEM 120– General, Organic, and Biochemistry

A. **TITLE:** General, Organic, and Biochemistry

B. **COURSE NUMBER: CHEM 120**
SHORT TITLE: General, Organic, and Biochemistry

C. **CREDIT HOURS:** 3 credit hours

D. **WRITING INTENSIVE COURSE (OPTIONAL):** N/A

E. **COURSE LENGTH:** 15 weeks

F. **SEMESTER(S) OFFERED:** Fall/Spring

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
Three hours lecture per week

H. **CATALOGUE DESCRIPTION:**
An integration of general chemistry, organic chemistry and biochemistry providing the student with a basic understanding of chemical processes and knowledge useful in a variety of degree programs. Topics include matter/atomic structure review, chemical bonding, intermolecular forces, physical behavior of gases, solutions, chemical kinetics, chemical equilibrium, acid/base equilibrium including buffers, an overview of organic chemistry, and an overview of biochemistry. The course is particularly useful to students in health related curricula where an understanding of life processes at the molecular level is essential. This course requires the co-requisite of CHEM 121 the first time CHEM 120 is attempted.

I. **PRE-REQUISITES/CO-COURSES:**
Prerequisites:
High School Regents chemistry(65 grade minimum) or Introduction to Chemistry (CHEM 101) and High School Algebra or Intermediate Algebra (MATH 106)
Co-requisites/ prerequisites:
CHEM 121 (General, Organic, and Biochemistry Laboratory).

J. **GOALS (STUDENT LEARNING OUTCOMES):**

Course Student Learning Outcomes	Institutional Student Learning Outcomes
Define the basic components of the scientific method including accuracy and precision	Professional Competence
Perform calculations associated with density, mass/molecules/moles relationships, stoichiometry, physical behavior of gases, solutions, chemical equilibrium, acids/bases, and radioactivity	Professional Competence Critical Thinking
Determine the electron configuration of the elements, formulae of ionic and covalent compounds, the bonding in covalent bound polyatomic molecules and ions, and define the basic tenants of VSEPR bonding theory including orbital hybridization.	Professional Competence Critical Thinking
Define polar bonds, molecular polarity, acids and bases, and chemical equilibrium	Professional Competence

Define solubility, solutions, solution types, and interpolate solubility graphs.	Professional Competence Critical Thinking
Know the structure, IUPAC nomenclature, properties, stereochemistry, preparation and reactions of selected organic chemical functional groups.	Professional Competence Critical Thinking
Define and differentiate carbohydrates, amino acids, and proteins.	Professional Competence

K. **TEXTS:** A representative text is General, Organic, and Biochemistry, Blei and Odian, 2nd Edition, Freeman Publishers.

L. REFERENCES: N/A

M. EQUIPMENT: N/A

N. GRADING METHOD: (P/F, A-F, etc.) (A-F)

O. MEASUREMENT CRITERIA/METHODS:

Quizzes
Examinations

P. GENERAL TOPICAL OUTLINE:

I. Scientific Method
II. Measurement, Accuracy, and Precision
III. Matter and Energy
IV. Structure of the Atom
V. Chemical Bonding
VI. Chemical Calculations
VII. Physical Behavior of Gases
VIII. Solutions
IX. Chemical Energetics and Chemical Equilibrium
X. Radioactivity
X. Acids/Bases
XI. Organic Chemistry Overview
XII. Biochemistry Overview

Q. DETAILED TOPICAL OUTLINE:

I. Scientific Method
  A. Observation/Question
  B. Hypothesis
  C. Experimentation/Data Analysis
  D. Conclusion
  E. Examples
II. Measurement, Accuracy, and Precision
  A. Accuracy vs. Precision
    1. definition

2. significance of accuracy and precision in the analysis of experimental results
3. examples

B. Principles of measurement
1. determining the degree of precision for non-digital measuring devices
2. determining the degree of precision of digital measuring devices
3. significant digits
4. scientific notation
5. mathematical operations with numbers expressed in scientific notation

C. Density/Specific Gravity
1. definition
2. problems using formulae for density/specific gravity

III. Matter and Energy

A. Matter
1.definition
2.pure substances/mixtures
a. pure substances
1. elements
2. compounds
b. mixtures
1. homogeneous mixtures
2. heterogeneous mixtures
3. extensive/intensive matter properties
4. states of matter
5. physical and chemical change
6. symbols and nomenclature of the elements
7. chemical formulas
8. periodicity

B. Energy
1. definition of kinetic and potential energy
2. thermal vs. electromagnetic energy including ionizing and non-ionizing
3. First and Second laws of Thermodynamics
4. heat transfer problems using $Q = Sm\Delta T$

IV. Structure of the Atom
A. subatomic particles
B. atomic number, mass number, and isotopes
C. radioactivity and radioactive decay
D. quantum mechanical model of the electronic structure of an atom
E. electron configurations

V. Chemical Bonding
A. ionic bonding and formulae construction of ionic compounds
1. periodic ionic charges
2. polyatomic anions and cations
B. covalent bonding
1. definition of single, double and triple covalent bonds
2. determination of the number of covalent bonds in a molecule
3. determination of formal charges in a polyatomic anion or cation

VI. Chemical Calculations
A. atomic mass
B. molecular mass
C. mol
D. molar mass

E. percent composition
F. stoichiometry

VII. Physical Behavior of Gases
A. definition of pressure
B. Kinetic Molecular Theory
C. Combined Gas Law
D. Dalton's Law of Partial Pressures
E. Ideal Gas Law including molar mass and gas density problems

VIII. Solutions
A. definitions
B. concentration units
C. intermolecular forces
D. solubility trends
E. unsaturated, saturated, and supersaturated solutions
F. interpretation of solubility curves
G. concentration unit problems
H. solution preparation problems
1. from pure solute and pure solvent
2. dilution problems
3. solution preparation by mixing solutions
I. colligative properties

IX. Chemical Energetics and Chemical Equilibrium
A. $\Delta G^o = \Delta H^o - T\Delta S^o$
B. thermodynamic terms
C. reaction profile diagrams
D. chemical kinetics
1. rate law for a chemical reaction
2. factors influencing the rate of chemical reaction
3. determination of the rate law from initial rate data
4. enzyme kinetics
E. chemical equilibrium
1. definition of the equilibrium condition
2. equilibrium expression
3. empirical relationship between stability of reactants and products vs. Equilibrium constant value
4. mathematical relationship between the equilibrium constant and the free energy for a chemical reaction using $\Delta G^o = -RT\ln Keq$
5. LeChatelier's Principle

X. Acid/Base Equilibrium
A. acid/base systems
B. strong vs. weak acids and bases
C. Ka expression
D. pKa
E. qualitative relationship between Ka and pKa
F. pH and pOH
G. Kw and pKw = pH + pOH
H. Calculations using the Ka expression for a weak acid or base
I. hydrolysis
K. pH buffers
1 Definition
2. Henderson-Hasselbach equation

3. Buffer problems

XI. Organic Chemistry Overview

A. ubiquity carbon

1. multicarbon chains
2. acyclics, cyclics, polycyclics, bridged polycyclics
3. chemical bonding of carbon
    a. sp^3 hybridization
    b. sp^2 hybridization
    c. sp hybridization

B. acyclic and cyclic hydrocarbons, and alkyl halides

1. structure and structure representation conventions
2. constitutional isomerism
3. geometrical isomerism
4. nomenclature

C. optical isomerism

D. alcohols

E. carboxylic acids and acid derivatives

F. amines and amine derivatives

XII. Biochemistry Overview

A. carbohydrates

1. structure and categories
2. acyclic and cyclic forms including structural conventions
3. D and L designations
4. polymerization and glycoside linkages
5. reducing carbohydrates
6. non-metabolic carbohydrates

B. lipids

1. fatty acids
2. triglycerides
3. prostaglandins
4. steroids

C. amino acids and proteins

1. amino acid classifications
2. electrophoresis and isoelectric points
3. peptide linkages
4. polypeptide amino acid sequencing by end group analysis and enzymatic cleavage
5. primary, secondary, tertiary, and quaternary protein structure