## Bergen Community College Division of Math, Science and Technology Department of Physical Sciences

# Master Course Syllabus CHM 100 Introduction to Chemistry

Semester and year:
Course Number:
Meeting Times and Locations:

Instructor:

Office Location:

Phone:

Office Hours:

Email Address:

#### COURSE DESCRIPTION:

**CHM 100** Introduction to Chemistry is designed to give the non-science major an awareness and an understanding of the fundamental concepts of modern chemistry. Topics include measurement, atomic theory, chemical bonding, the Periodic Table, chemical reactions, and stoichiometry. The course includes a writing and communications requirement that relates the topics covered to a broad historical, social, and cultural context.

**CREDITS/HOURS:** 4 credits / 3 lecture hours & 3 laboratory hours **PREREQUISITES:** MAT 011 or a passing score on the Basic Skills Exam.

**GENERAL EDUCATION COURSE:** Yes

# **STUDENT LEARNING OBJECTIVES:** As a result of meeting the requirements for this course, students will be able to:

- 1. Concepts: Students will be able to describe scientific concepts by utilizing proper terminology and nomenclature, creating accurate sketches and diagrams, and demonstrating clear scientific writing to describe the principles of physical science.
- 2. Mathematical Analysis: Students will be able to demonstrate logical reasoning in problem-solving by using appropriate mathematics to construct models, translating models to solve problems, interpreting solutions both qualitatively and quantitatively, creating accurate diagrams, and performing accurate unit analyses.
- 3. Laboratory Skills: Students will be able to collaborate in teams to demonstrate laboratory technical and analytical skills by demonstrating proper and safe use of laboratory equipment, instrumentation, and software to acquire data, identifying reputable sources of information, determining the magnitude and sources of error that affect the accuracy and precision of experimental results, and communicating experimental results using clear scientific language, verbally and in writing.

#### **GRADING POLICY:**

A student's final grade will be determined by a combination of the six criteria categories listed below. The contribution of each criteria category to a student's final grade should fall within the prescribed percentage ranges provided. At the discretion of the *individual* instructor is empowered to make minor modifications to a criteria category.

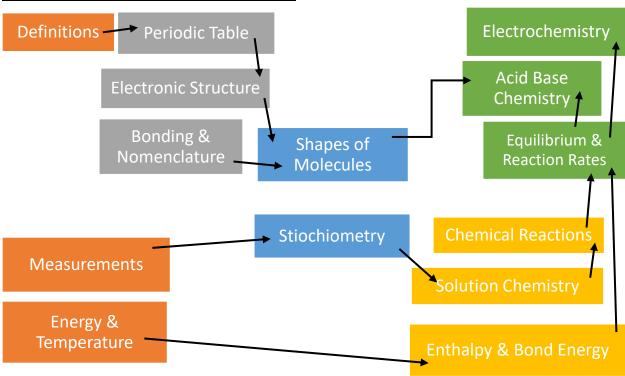
1. Unit Tests or Examinations,	50-75%
(This may include problems, definitions, and one essay.)	
2. Comprehensive Final Examination	0-20%
(This may include problems, definitions, and one essay.)	
3. Quizzes.	0-15%
4. Assigned homework or problem sets	0-20%
(This may be prepared by an instructor or from the textbook or online source.)	
5. Laboratory reports.	20-25%
(This may include pre- and post- laboratory assignments as well as a calculations page.)	
6. Other writing assignments.	0-5%

**TEXTBOOK:** Basic Chemistry, *Most Current* of the Editions, Timberlake and Timberlake Pearson, Benjamin Cummings. *Multiple editions are available including student, loose-leaf, and e-book*. **LABORATORY MANUAL:** College Publication

## **SUPPLEMENTARY READINGS / MATERIALS:**

Tro, Nialdo, <u>Introductory Chemistry</u>, Pearson/ Prentice Hall Zumdahl and DeCoste, <u>Introductory Chemistry</u>: A Foundation, Brooks/Cole <u>The McGraw-Hill Dictionary of Chemistry</u>, McGraw-Hill, 2203

#### **GRAPHICAL COURSE CONTENT** (Lecture):



## **COURSE CONTENT by Learning Topic** (Lecture). The required course content includes:

- 1. Use the proper Metric Units and significant figures in collecting data and creating mathematical solutions to problems.
- 2. Apply the Factor Label Method (dimensional analysis) to identify the proper equivalencies and conversion factors required to solve problems.
- 3. Identify the formulas and names for binary covalent and ionic compounds, as well as strong acids and bases. Be familiarity with the polyatomic ions and their use in naming binary compounds.
- 4. Balance Chemical Equations and recognize their different types.
- 5. Solve chemical word problems and report answers with the correct significant figures and units of measurement.
- 6. Solve stoichiometry problems.
- 7. Define and use technical terms associated with Solution Chemistry, Acid-Base Chemistry and Electrochemistry.
- 8. Use the **scientific method** of inquiry to understand how historically important experiments, which employed the scientific method, led to current knowledge of atomic structure.
- 9. Use modern chemical theories of atomic structure and bonding to predict the properties of substances encountered in everyday life in accordance with the **scientific method** of inquiry.
- 10. Use the **scientific method** of inquiry to demonstrate the ability to collect data, perform calculations, and propose hypothesis in accordance with the aforementioned methodology.
- 11. Recognize the rules for working safely in a chemical laboratory and employ those rules to work safely in a chemical laboratory setting.
- 12. Measure mass, volume, temperature as well as other units of measurements and report the data collected with the correct number of significant figures in a laboratory report.
- 13. Interpret data from laboratory exercises which utilizes quantitative and/or qualitative methods of analysis and use that data to identify a property, an identity, or the composition of a product as called for in the experimental protocol.
- 14. Interpret data from laboratory exercises, calculate intensive and extensive properties of compounds, and determine the accuracy and/or precision of the results using the scientific method of inquiry

**Note:** Course Content 8, 9, & 10 refer using the **scientific method** of inquiry.

## **COURSE CONTENT by Chapter Topic (Lecture)**

Chapter 1: Chemistry in Our Lives (Definitions)

- Learning Chemistry
- Elements & Compounds
- States of Matter
- Physical & Chemical Changes
- Scientific Method

## Chapter 2: Measurements

- Exact Numbers & Measurements
- Units of Measurement
- Scientific Notation, Significant Figures & Calculations
- Conversion Factors
- Dimensional Analysis Problems
- Density Problems

## Chapter 3: Matter & Energy

- Classification & States
- Temperature & Energy
- Specific Heat

## Chapter 4: Atoms and Elements

- Elements & Atoms
- Mendeleev's Law & Periodicity
- Periodic Table
- Atom & its Structure

## Chapter 5: Electronic Structure and Periodic Trends

- Electromagnetic Radiation
- Spectra & Energy Levels
- Shells & Sublevels & Orbitals
- Electron Configuration
- Periodic Trends

## Chapter 6: Ionic and Molecular Bonding

- Types of Bonds
- Lewis Dot Structures
- Electronegativity
- Nomenclature

## Chapter 10 Properties of Solids & Liquids (The Shape of Molecules)

- Electron Dot Formula
- VSEPR Theory & Molecules
- Electronegativity & Molecular Polarity
- Intermolecular Forces
- Changes of State

## Chapter 7: Chemical Quantities

- Mole and Formula Weight
- Gram to Gram Conversions
- Mass % Composition
- Empirical Formula

## Chapter 8: Chemical Reactions

- Balancing Equations
- Five Types of Reactions

## Chapter 9 Chemical Quantities in Reactions

- Mole to Mole and Formula Weight
- Gram to Gram Conversions
- Limiting Reagents Optional
- %, Yields (Theoretical, and Actual)
- Energy Calculations & Chemical Reactions

## Chapter 12: Solutions

- Definition of Solutions
- Electrolytes
- Solubility
- Molarity
- Solution Problems
- Colligative Properties skip
- Osmosis skip

## Chapter 13: Reaction Rates & Chemical Equilibrium

- Exothermic & Endothermic
- $\Delta E_{rxn}$
- Reaction Coordinate Chart
- Activation Energy

#### Chapter 14: Acids, & Bases

- Acids and Bases
- (Strong & Weak)
- pH
- Buffers

## Chapter 15: Oxidation and Reduction

- Oxidation Numbers / States
- Oxidation & Reduction
- Batteries and Galvanic Cells
- EMF Series
- Preventing Rust

SKIP: Gases, Nuclear Chemistry, Organic Chemistry, & Biochemistry Chapters

## **COURSE CONTENT by Laboratory Experiment:**

Instructors should plan to do a minimum of thirteen of the fourteen experiments listed below. In most cases instructors chose to do either Experiment 13 or 14. Instructors also may choose to use the fourteenth lab as a makeup lab for student who have missed a lab.

## Check-in & Experiment 1.

- Safety: Laboratory Safety
- Departmental Safety Rules.
- Introduction to the Use of Laboratory
- Laboratory Report Writing.
- Equipment
- Math Review
- Significant Figures.
- Use of Unit Conversion Factors
- Metric System & Measurements

## **Experiment 2**: Physical & Chemical Changes

- To observe physical & chemical changes
- To identify physical & chemical changes

#### **Experiment 3**: Density Determination

- To recognize that density is an intensive property and is independent of the amount of sample used.
- To recognize that the volume of an object cen be determined by the volume of the water it can displace.
- To determine the density of a mixture and recognize its density is between the density of the constituents forming the mixture.

#### **Experiment 4**: Specific Heat of Metal

- To practice the concept of conservation of energy
- To demonstrate that heat flows from the hot object to the cold object
- To demonstrate that metals are good conductors of heat because of their low specific heats.

#### **Experiment 5**: Flame Test and Chemical Fingerprinting

- To demonstrate the characteristic colors produced by metals vaporized in a flame.
- To identify unknown metallic ions by means of their characteristic flame color.
- To validate that elements which belong to the same group on the periodic table possess similar properties

## **Experiment 12**: Paper Chromatography

- To practice the technique of paper chromatography
- To separate mixtures of substances in a qualitative manner
- To use intermolecular force as a means of chemical resolution.

## **Experiment 6**: Lewis Dot Structure & VSEPR

- To compose Lewis Structures for the variously bonded covalently bonded molecules.
- To use model kits to construct the molecules/ions for the purpose of exploring their structures & shapes.
- To predict molecular shapes using VSEPR Rules

## **Experiment 7**: Qualitative Analysis of Anions

- To test the solubility of a set of anions in solutions.
- To use litmus paper, a centrifuge, and a dropper in the laboratory

## **Experiment 8**: Water of Hydration

• To use evaporation techniques to explore the % composition property

#### **Experiment 10** Empirical Formula

- To synthesize an oxidized metal by adding heating.
- To determine the empirical formula of a compound based upon its % composition by weight.

#### **Experiment 9**: Types of Chemical Reactions

- To classify reactions based upon observed changes.
- To identify the type chemical reaction.
- To predict products of a chemical reaction.

## **Experiment 11**: Percent Yield of a Chemical Reaction.

- To determine the theoretical yield from a double replacement reaction
- To determine the percent yield from a chemical reaction
- To determine the limiting (& excess) reactant in a chemical reaction (optional)

#### **Experiment 14**: Solutions and pH

- To practice preparing an aqueous solution.
- To practice diluting aqueous solutions
- To measure the pH of an aqueous solution

# **Experiment 13**: Oxidation Reduction

- To practice calculating the oxidation number of various elements in a compound.
- To demonstrate predict reactivity based upon the activity series.
- Balance redox reactions (optional)

odule	Topic/Activi	ty/Assignments	<b>Student Learning Objectives</b>
1.	Chapter 1:	<ul> <li>Chemistry in Our Lives</li> <li>Learning Chemistry</li> <li>Elements &amp; Compounds</li> <li>States of Matter</li> <li>Physical &amp; Chemical Changes</li> <li>Scientific Method</li> </ul>	1
	Chapter 2:	<ul> <li>Measurements</li> <li>Exact Numbers &amp; Measurements</li> <li>Units of Measurement</li> <li>Scientific Notation,</li> <li>Significant Figures &amp; Calculations</li> </ul>	1
2.	Chapter 2:	<ul><li>Measurements</li><li>Conversion Factors</li><li>Dimensional Analysis Problems</li><li>Density Problems</li></ul>	2
	Chapter 3:	<ul><li>Matter &amp; Energy</li><li>Classification &amp; States</li><li>Temperature &amp; Energy</li><li>Specific Heat</li></ul>	1
3.	Review Test 1		
4.	Chapter 4:	Atoms and Elements	1
	Chapter 5:	<ul> <li>Electronic Structure and Periodic Trends</li> <li>Electromagnetic Radiation</li> <li>Spectra &amp; Energy Levels</li> <li>Shells &amp; Sublevels &amp; Orbitals</li> <li>Electron Configuration</li> <li>Periodic Trends</li> </ul>	1
5.	Chapter 6:	<ul> <li>Ionic and Molecular Bonding</li> <li>Types of Bonds</li> <li>Lewis Dot Structures</li> <li>Nomenclature</li> </ul>	1

	Review		
6.	Test 2		
	Chapter 10	Properties of Solids & Liquids	1
	1	Electron Dot Formula VSEPR	
		Theory & Molecules	
		Electronegativity & Molecular	
		Polarity	
7.	Chapter 10	Properties of Solids & Liquids	1
		<ul> <li>Electronegativity &amp; Molecular</li> </ul>	
		Polarity	
		<ul> <li>Intermolecular Forces</li> </ul>	
		<ul> <li>Changes of State</li> </ul>	
	Chapter 7:	Chemical Quantities	2
		<ul> <li>Mole and Formula Weight</li> </ul>	
		<ul> <li>Gram to Gram Conversions</li> </ul>	
		<ul> <li>Mass % Composition</li> </ul>	
		<ul> <li>Empirical Formula</li> </ul>	
	<u>Review</u>		
8.	Test 3		
	Chapter 8:	Chemical Reactions	1
		<ul> <li>Balancing Equations</li> </ul>	
		• Five Types of Reactions	
9.	Chapter 9	Chemical Quantities in Reactions	2
		<ul> <li>Mole to Mole and Formula Weight</li> </ul>	
		<ul> <li>Gram to Gram Conversion</li> </ul>	
		<ul> <li>Limiting Reagents - Optional</li> </ul>	
		• %, Yields (Theoretical, and Actual)	
		<ul> <li>Energy Calculations &amp; Chemical</li> </ul>	
		Reactions	
10.	Chapter 12:	Solutions	2
		<ul> <li>Definition of Solutions</li> </ul>	
		• Electrolytes	
		• Solubility	
		<ul> <li>Molarity</li> </ul>	
		<ul> <li>Solution Problems</li> </ul>	
		<ul> <li>Colligative Properties – skip</li> </ul>	
		<ul> <li>Osmosis – skip</li> </ul>	
	Review		
11.	Test 4	Describe Described Character 1 In 1911	1
	Chapter 13: R	teaction Rates & Chemical Equilibrium	1
		• Exothermic & Endothermic	
		• $\Delta E_{rxn}$	
		Reaction Coordinate Chart	
10	Clarit 14	Activation Energy  Active & Breeze	1
12.	Chapter 14:	Acids, & Bases	1

	Chapter 15:	<ul> <li>Acids and Bases</li> <li>(Strong &amp; Weak)</li> <li>pH</li> <li>Buffers</li> <li>Oxidation and Reduction</li> <li>Oxidation Numbers / States</li> <li>Oxidation &amp; Reduction</li> <li>Batteries and Galvanic Cells</li> <li>EMF Series</li> <li>Preventing Rust</li> </ul>	1
13.	Review		
1.4	Test 5		
14.	Review		
	Final Exam		

Review sessions can be used for additional instructional time as per the instructor's preference. Quizzes can be substituted for Tests as per the instructor's preference.

Laboratory Course Outline as correlated to Student Learning Objectives			
<b>Sessions</b>	<b>Experiments</b>	<b>Student Learning Objectives</b>	
1.	Check-in Safety: Instructor will review	3	
	department safety rules. Intro to use of lab		
	equipment, Math Review, Exp. 1		
2.	Exp 2 Physical & Chemical Changes	1,3	
3.	Exp 3 Density Determination	2, 3	
4.	Exp 4 Specific Heat of Metal	2, 3	
5.	Exp 5 Flame Test and Chemical Fingerprinting	1, 3	
6.	Exp 12 Paper Chromatography	1, 3	
7.	Exp 6 Lewis Dot Structure & VSEPR	1, 3	
8.	Exp 7 Qualitative Analysis of Anions	1, 3	
9.	Exp 10 Empirical Formula	2, 3	
10.	Exp 8 Water of Hydration	2, 3	
11.	Exp 9 Types of Chemical Reactions	1, 3	
12.	Exp 11 Percent Yield of a Chemical Reaction	2, 3	
13.	Exp 14 Solutions and pH	1,3	

#### **GENERAL GRADING POLICY:**

- A missed exam will result in a grade of zero for the exam. Make-up examinations will be administered according to the instructor's grading policy. Alternately, the instructor may provide for substitution of the student's final examination grade for the grade on a missed exam.
- 2. Academic dishonesty on the part of the student will result in a grade of zero on the given paper, quiz, or examination. A grade of zero resulting from academic dishonesty will not be replaced, or omitted, regardless of any other provision in the instructor's grading policy. The student should read the Bergen Community College statement on academic integrity that is to be found in the college catalog.
- 3. At the discretion of the instructor, the grade on the final examination may be substituted for the lowest unit exam grade for the purpose of calculating the course grade provided that the final examination grade is higher than the lowest unit examination grade.
- 4. A passing grade in the course requires acceptable levels of work in **both** the lecture and the laboratory sections of the course. Acceptable levels of work will mean a score of 60% or greater.
- 5. A writing assignment will be given unless essay questions are included in the unit examinations. This may involve chemistry topics in the news or the analysis of one or more journal articles. The writing assignment will count **no more** than 5% of the course grade.
- 6. Laboratory: Students will be required to complete pre-laboratory assignments and laboratory reports for each laboratory class. Laboratory reports will be due at the laboratory session following the one in which the experiment is completed. At the instructor's discretion a late laboratory report may be accepted for a reduced grade. No student will be permitted to submit more than two laboratory reports late during the semester. A missed report counts (grade = 0). Instructor's will make an effort to assist a student in making up a missed laboratory class but the possibility of making up a missed laboratory depends on scheduled classes and space in those classes. The laboratory grade will be based primarily on average of the student's laboratory report grades (90%) and the student's level of completion of the pre-laboratory assignments (10%). The student's laboratory grade will count 20% to 25% of the course grade.
- 7. Instructors may make small modifications to the General Grading Policy for the course and will give each student a copy of the grading policy for the given section.

## **OTHER REQUIREMENTS:**

- 1. A calculator is required. Calculators attached to cellular telephones may not be used during exams. Any student who has a cellular telephone accessible during an exam will be considered to be engaged in academic dishonesty.
- 2. Access to an on-line homework program will require the purchase and may be counted toward the final grade for the class. Instructors have the responsibility of notifying students two weeks prior to the beginning of the semester of this expense. This will provide students with an opportunity to enroll in a section that does not use online homework

#### **INSTRUCTOR'S GRADING POLICY:**

• Each Instructor will provide a written copy of the grading policy for the given section of the course.

#### ATTENDANCE/LATENESS POLICY:

- 1. All students are expected to attend every meeting of the course punctually.
- 2. The individual instructor's attendance/lateness policy will be provided, in writing, at the beginning of the course.
- 3. Attendance will be kept by the instructor for administrative and counseling purposes.
- 4. Students who are late to the laboratory class and have missed the instructions, including safety instructions, for the laboratory experiment may be refused permission to perform the experiment.

## **OTHER POLICIES:**

- 1. Students carrying portable electronic devices should put them on silence mode before entering the classroom or laboratory.
- 2. Calculators will be required for the course and students are responsible for bringing a calculator to all quizzes, exams, and laboratory classes. The calculators used for exams should not be calculators attached to cellular telephones nor can they be graphing calculators. Any student who has a cellular telephone accessible during an exam will be considered to be engaged in academic dishonesty.

#### STUDENT AND FACULTY SUPPORT SERVICES:

- 1. Students are encouraged to get assistance with any and all aspects of the course in a **timely** manner.
- 2. Students should make note of the instructor's office hours and should see the instructor for assistance with understanding concepts or problem solving.
- 3. *The STEM Learning Center* and the Tutoring Center provide student support in chemistry, math and other sciences. The BCC library provides extensive support services for student research.
- 4. A wide variety of services are available to students with documented disabilities. It is highly recommended that students with any manner of documented disabilities contact the Office of Specialized Services (www.bergen.edu/oss).