University of Houston-Downtown

Course Prefix, Number, and Title: CHEM 1307: General Chemistry *

Credits/Lecture/Lab Hours: 3/0/0

Foundational Component Area: Life and Physical Sciences

Prerequisites: Credit or enrollment in MATH 1301 and CHEM 1107 and one year of high school chemistry or CHEM 1305/1105.
Co-requisites: None

Course Description: The first in a two course survey of the fundamentals of general chemistry for students majoring in the sciences. Descriptive material is correlated with the basic chemical principles and their applications. Modern concepts of atomic and molecular structure, chemical bonding, the gaseous state and the kinetic molecular theory of matter will be analyzed. There will be emphasis on stoichiometeric calculations of mass and molar relationships, energy relations and intermolecular forces.

TCCNS Number: CHEM 1311

Demonstration of Core Objectives within the Course:

Assigned Core Objective	Learning Outcome Students will be able to:	Instructional strategy or content used to achieve the outcome	Method by which students' mastery of this outcome will be evaluated
Critical Thinking Empirical & Quantitative Reasoning	Utilize scientific processes to identify questions pertaining to natural phenomena.	**1. Knowledge and Comprehension of the Various Types of Matter Present in the Universe.** Through lecture, observation and laboratory experience, students will classify materials into states of matter, identify the transitions between them, and be able to differentiate elements, compound and mixtures providing examples of each. **2. Knowledge and Comprehension of the atomic structure and**	1. The knowledge and comprehension of the various types of matter, along with other chemical principles, will be assessed in the CHEM 1307 by the use of on-line or written homework assignments, on-line or in-class quizzes, in-class testing, and a standardized comprehensive exam prepared by the American Chemical Society (ACS). The results of this latter assessment activity will be compared and analyzed with respect to national norms and statistics as well as 20+ years of UHD ACS exam records. The results from the ACS testing will be used as an indicator for overall student performance in general chemistry.

		chemical properties of elements from their position on the periodic table – In conjunction with the co-requisite CHEM 1107 laboratory, students will develop knowledge of the model of an atom. This includes quantum theory, and facilitates the predicting of light producing electron transitions.	**2.** Students will work in teams to examine the effects of electricity passing through different elements, determining if there is a correlation between electron configuration and the natural phenomena of colored light emission. Teams will complete worksheets showing their calculations which will be included in the lab book for grading. **3.** Students will perform calculations demonstrating the relationship between bond formation, bond breaking, thermal, potential, and chemical energies, and the heat involved in a chemical reaction. They will be evaluated in this exploration through the use of homework problems, and exam or quiz questions. **4.** Students will perform experiments involving chemical reactions in the co-requisite laboratory and will do calculations on homework, quizzes and exams, in lab and/or Recitation sessions. **5.** Students will use VSEPR (valence shell electron pair repulsion) theory and Lewis dot structures to explain and predict the shapes of molecules. Through the use of models, students will visualize how molecular three- dimensional geometries affect the physical properties of substance in nature. Evaluations will involve drawings, homework problems, and exam questions
Critical Thinking Empirical & Quantitative Reasoning	Utilize scientific processes to develop hypotheses, collect and analyze data using quantitative and qualitative	**In the co-requisite lab:** **1. Laboratory experiments** - Students will demonstrate the ability to carry out simple laboratory experiments (in the co- requisite laboratory course) using	**1.** Students will keep a laboratory notebook and learn to record careful observations, draw appropriate conclusions and reflect on what they have learned. The assessment will be carried out by grading lab reports and evaluating unknown materials in laboratory experiments. Learning in each

	measures.	common chemical measuring devices, SI units, and safety precautions. Every lab experience requires the written record of observations, both quantitative and qualitative, the analyses of these observations, and the drawing of conclusions. **2. Hypothesis Testing -** Students will form hypotheses concerning whether clear solutions are identical in composition or not. They will use qualitative methods of data collection while working in a small team environment. Example: **Identification of an unknown substance** – Students will determine the identity of unknown substances. The hypothesis is that it is possible to determine the identity of a substance from its solubility properties when it is formed by the mixing of two compounds in solution.	laboratory experience is further evaluated by both pre- and post-lab assignments and a quiz. **2**. Students will work in teams to collect data when they examine the effect of combining different solutions of known composition. Students will create a sequential diagram for precipitation. They will then use this information to determine the composition of several unknown solutions. The assessment will consist of pre- and post- assignments and quizzes as well as an evaluation of the accuracy of their conclusions
Critical Thinking Empirical & Quantitative Reasoning Communication	Utilize scientific processes to effectively communicate the analysis and results using written, oral and visual communication.	**Team Projects –** Working in small teams, students will develop a single research project, such as those listed below, that will be presented to the class in an appropriate format. **Examples:** **1. Project to Develop Lab**	**1.** Students will work in small groups to develop a demonstration of an experiment suitable for a General Chemistry laboratory. Peer review will supplement the faculty assessment of the presentation and the written manuscript. Both oral presentation and written assignments will be assessed using a rubric. **2.** Students will work in groups to

		Experiment – Students will select an experiment or demonstration that is suitable for CHEM 1107 laboratory and develop it for presentation **2. Current Event Research Topic -** Students will design and execute a team presentation of all facts and arguments surrounding a topic of their choice that is currently in the news.	research all aspects of a current topic with an application to chemistry, write a research paper following a specific rubric, and then synthesize a creative exposition with both an oral and visual component. Evaluation will involve a peer review of the project and its presentation.
Teamwork	Collaborate in the evaluation of the quality of scientific evidence from multiple perspectives toward the goal of reaching a shared objective.	**1. Chemical Safety –** Students will watch a presentation about chemical safety and determine if their safety practices are adequate. **2. Current Event Research Topic -** Students will design and execute a team presentation of all facts and arguments surrounding a topic of their choice that is currently in the news.	**1.** Student will work in teams to demonstrate examples of best practices in chemical safety. Student participation in this activity will be recorded on a graded worksheet or notebook. **2.** Students will work in groups to research all aspects of a current topic with an application to chemistry, write a research paper following specific guidelines, and then synthesize a creative exposition with both an oral and visual component. Evaluation will involve a peer review of the project and its presentation. Faculty assessment will follow a rubric for oral and written communication.

Additional Course Outcomes:

Lecture:

- State a clear definition of chemistry.
- Speak and write the basic language and symbols of chemistry.
- Describe and use the scientific method.
- Understand and use scientific notation, significant figures, and the metric and SI systems of measurement.
- Readily identify the various types of matter.
- State the difference between physical and chemical properties.
- Write, balance, and interpret chemical equations.
- Describe the types of reactions that take place in aqueous (water-based) solutions.

- Solve mathematical problems related to stoichiometry, gas laws, and thermochemistry.
- Describe the laws governing the behavior of gases and the kinetic-molecular theory that is used to explain those laws.
- Understand the relationship of the Periodic Table to atomic masses, atomic numbers, electronic configurations, chemical bonding, and the properties of the elements.
- Describe the nature of intermolecular attractive forces and how they produce the solid and liquid states of matter.

Lab:

- Work ***SAFELY*** in the laboratory
- Keep an accurate record of laboratory results
- Make careful observations and draw valid conclusions
- Predict the effects of errors on experimental results
- Make measurements using appropriate laboratory equipment
- Handle liquids, solids, and gases appropriately
- Use correct laboratory terminology
- Perform titrations with accuracy and precision

Course Topics

Lecture:

- Matter, Measurement, and Problem Solving
- Atoms and Elements
- Molecules, Compounds, and Chemical Equations
- Chemical Quantities and Aqueous Reactions
- Gases
- Thermochemistry
- Quantum Mechanical Model of the Atom
- Periodic Properties of the Elements
- Chemical Bonding I: Lewis Theory
- Chemical Bonding II: Molecular Shapes, Valence Bond Theory and Molecular Orbital Theory
- Liquids, Solids, and Intermolecular Forces

Lab

- Introduction/Lab Check-In/ Safety Video/Dimensional Analysis Pre-Lab
- Lab Measurements: Significant Figures
- Density Determination
- Separation of the Components of a Mixture
- Periodic Table: Elements and their Atomic Structures
- Determination of the Empirical Formula of a Metal Oxide
- Chemical Reactions and Their Classification
- Double Replacement Reactions
- Single Displacement Reactions/Writing and Balancing Equations
- Standardizing a Basic Solution
- Nine Solutions and Their Interactions (Part A)

Lecture Grading/Course Content which Demonstrates Student Achievement of Core Objectives:
Course Grade A: 90-100 B: 80-89 C: 70-79 D: 60-69 F: 0-59

Summary of Course Exams, Quizzes, Activities, and Final	
4 Examinations (Final exam replaces lowest)	40%
MGC Homework Assignments (Lowest 2 will be dropped)	9%
4 MGC Quizzes (5% each, lowest dropped)	15%
i>Clicker Participation (Correct Answer/Participation = 100/50)	6%
Final Exam	20%
5 Special Assignments	10%

Lab-Grading/Course Content which Demonstrates Student Achievement of Core Objectives:
Course Grade A: 90-100 B: 80-89 C: 70-79 D: 60-69 F: 0-59

Summary of Course Exams, Quizzes, Activities, and Final	
Quizzes	40%
Pre-lab Questions	5%
Lab Reports/Post Lab Questions	15%
Team Projects/Presentations	10%
Practical Final Examination	10%
Written Final Examination	20%