MASTER COURSE OUTLINE

A. CHEM 1202 General Chemistry II

B. COURSE DESCRIPTION:

This is the second course of a two-semester sequence in general inorganic chemistry. Content includes properties of solutions, kinetics, equilibrium, acids and bases, thermodynamics and electrochemistry. This course is for students intending to transfer or pursue Bachelor's preparation and/or careers in chemistry and the other physical sciences, engineering and health sciences (medicine, pharmacy, veterinary medicine, four-year nursing). Prerequisite: MATH 1110 or higher and CHEM 1201 or CHEM 1210.
MnTC (Goals 3/NS and 2/CT); (5 Cr – 3 lect, 2 lab)

C. *MnTC Discipline: Natural Sciences **Core Theme: Critical Thinking

D. RIVERLAND INSTITUTIONAL LEARNING OUTCOMES

This course addressed the following Riverland Institutional Learning Outcome(s):
☒ ILO 1: critical thinking *(Core Theme Goal 2)*
☐ ILO 2: awareness of the larger global community *(Core Theme Goal 7 or 8)*
☐ ILO 3: ethical, engaged citizenship *(Core Theme Goal 9 or Goal 10)*
☐ ILO 4: communication and collaboration *(Discipline Goal 1 and by any learning outcome(s) involving communication or collaboration)*

E. MAJOR CONTENT AREAS:

- Intermolecular forces and solids and liquids
- Physical properties of solutions
- Chemical kinetics
- Chemical equilibrium
- Acids and bases
- Acid-base equilibria and solubility equilibria
- Thermodynamics
- Redox reactions and electrochemistry

F. GOAL TYPE, OBJECTIVES AND OUTCOMES:

GOAL TYPE	**OBJECTIVES** **Students will be able to:**	**OUTCOMES** **The student will successfully:**
MnTC Goal 3a	demonstrate understanding of scientific theories.	1. solve problems demonstrating the application of Henry's Law, Raoult's Law, the Nernst Equation, and LeChatelier's Principle. 2. apply knowledge of colligative properties of solutions, thermodynamics, and equilibrium to problem-solving and experimentation.
MnTC Goal 3b	formulate and test hypotheses by performing laboratory, simulation or field experiments in at least two of the natural science disciplines. One of these experimental components should develop, in greater depth, students' laboratory experience in the collections of data, its statistical and graphical analysis, and an appreciation of its sources or error and uncertainty.	1. conduct literature research on concepts discussed in the laboratory. 2. use the scientific method to formulate and test hypotheses in lab experimentation. 3. perform an in-depth analysis of an experiment, including statistical analysis of error, explaining the sources of error (% error), and uncertainty.
MnTC Goal 3c	communicate their experimental findings, analyses and interpretations both orally and in writing.	1. discuss the results of the experiments referenced in MnTC Goal 3b in oral and written formats, including predictions, graphs, and calculations.
MnTC Goal 2a	gather factual information and apply it to a given problem in a manner that is relevant, clear, comprehensive, and conscious of possible bias in the information selected.	1. research and complete an analysis of scientific findings on a current topic in chemistry. 2. include summary of the findings and any sources of error, bias or uncertainty in the evidence evaluated for the analysis above.
MnTC Goal 2b	imagine and seek out a variety of possible goals, assumptions, interpretations or perspectives which can give alternative meanings or solutions to given situations or problems.	1. conduct primary literature research on the topic referenced in MnTC Goal 2a. 2. explain and analyze the options to address the topic referenced in MnTC Goal 2a. Include analysis of underlying assumptions and/or bias on the part of the researcher. 3. describe the best solution available based on the current data and literature available.
MnTC Goal 2c	analyze the logical connections among the facts, goals, and implicit assumptions relevant to a problem or claim and then generate and evaluate implications that follow from them.	1. explain the implicit assumptions and the subsequent decision-making options relative to the report specified in the outcomes referenced for MnTC Goals 2a and 2b.

CS	demonstrate an understanding of solutions.	1. describe the energetics of solution formation. 2. calculate and convert between the solution concentrations of percent, molarity, molality, and mole fraction. 3. describe and perform mathematical calculations of solution colligative properties (such as vapor pressure lowering, freezing point depression, boiling point elevation, and osmotic pressure). 4. perform an experiment to determine the molecular mass or van't Hoff Factor of a compound using freezing point depression.
CS	demonstrate an understanding of states of matter and intermolecular forces.	1. identify the dominant intermolecular force for a molecular compound. 2. make qualitative predictions (rankings) concerning the physical properties (such as melting point, boiling point, viscosity, surface tension, vapor pressure etc.) of various liquids on the basis of their intermolecular forces. 3. describe the molecular interactions that differentiate solids, liquids, and gases. 4. describe and calculate the energies of phase changes. 5. Identify phase changes and interpret phase diagrams. 6. conduct a chromatography experiment and explain findings based on the concept of intermolecular forces.
CS	demonstrate an understanding of chemical kinetics	1. determine the order of a reaction from the rate law. 2. apply the integrated rate law and half-life equations for zero-order, first-order, and second-order reactions. 3. describe how temperature, activation energy, and molecular orientation influence reaction rates, including the Arrhenius equation. 4. determine the rate law from a reaction mechanism. 5. describe how a catalyst influences the rate of a reaction. 6. experimentally determine the rate of a reaction.

CS	demonstrate an understanding of nuclear chemistry	1. write balanced nuclear equations. 2. identify types of nuclear reactions including radioactive decay, fission and fusion.
CS	demonstrate an understanding of chemical equilibrium.	1. write equilibrium constant expressions for chemical equations. 2. calculate equilibrium concentrations from initial concentrations and the equilibrium constant. 3. determine the effect of concentration change, volume change, temperature change, and addition of a catalyst on equilibrium using LeChatelier's Principle. 4. experimentally determine the equilibrium constant for a reaction.
CS	demonstrate an understanding of acid-base equilibria.	1. define and identify acids and bases using the Arrhenius, Brønsted-Lowry, and Lewis definitions. 2. relate strengths of acids and bases to their conjugate pairs, identify a Lewis acid and base. 3. analyze equilibria of acids and bases using acid and base dissociation constants. 4. calculate pH of acids, bases, and buffers solutions. 5. construct acid/base titration curves.
CS	demonstrate an understanding of solubility equilibria.	1. calculate Ksp using solubility data. 2. use Ksp to determine solubility of pure compounds and in the presence of a common ion. 3. describe the factors the affect solubility, including the common ion effect, pH, and complex ion formation.
CS	demonstrate an understanding of laws of thermodynamics.	1. calculate ΔH, ΔS, and ΔG for phase transitions and chemical reactions, using appropriate standard values from thermodynamic tables. This includes finding the temperature range (and the value of T*), over which a reaction is spontaneous. 2. apply the relationships between thermodynamic quantities such as enthalpy, entropy, and Gibbs energy, and the direction of change in natural processes. 3. predict, on the basis of qualitative reasoning, the sign of ΔS for reactions and phase transitions.

		4. relate thermodynamic data (ΔH, ΔS, and ΔG) to the value of the equilibrium constant for a reaction (and vice versa).
CS	demonstrate an understanding of redox reactions and electrochemistry.	1. determine oxidation numbers. 2. balance aqueous redox reactions in acidic and basic solutions. 3. explain how an electrochemical cell works. 4. calculate standard potentials for electrochemical cells and relate to standard free energy, potentials under nonstandard conditions, and the equilibrium constant.
CS	demonstrate proper laboratory technique	1. conduct laboratory work in compliance with guidelines for personal lab safety and responsible management of chemical waste; this includes appropriate use of personal protective equipment and interpretation of Globally Harmonized System for Hazard Communication (GHS) labels. 2. measure quantities such as mass, volume, temperature, and absorbance with proper technique, and record the results of measurements with the appropriate number of significant figures and units. 3. record observations of chemical processes (such as precipitate formation, gas evolution, etc.) and write chemical reactions consistent with their observations. 4. demonstrate proper techniques for laboratory procedures, such as titration, filtration, solution preparation, spectrophotometric measurements, etc. 5. demonstrate proper use of glassware and equipment including beakers, Erlenmeyer flasks, volumetric pipets, burets, volumetric flasks, watch glasses, graduated cylinders, filtration apparatus, single-beam spectrophotometer, pH meter, balances. 6. communicate lab procedures, observations, and results in the form of laboratory notebook, written reports, and verbal presentations effectively. 7. interpret and analyze qualitative observations and quantitative

		results, incorporating graphs and tables as appropriate.

G. SPECIAL INFORMATION:

This course may require use of the Internet, the submission of electronically prepared documents and the use of a course management software program. Students who have a disability and need accommodations should contact the instructor or the Student Success Center at the beginning of the semester. This information will be made available in alternative format, such as Braille, large print, or current media, upon request. This course will cover the characteristics of hazardous wastes and its safe handling, storage, and disposal.

H. COURSE CODING INFORMATION: Course Code C/Class Maximum 48; Letter Grade

Revision date: 10/7/17; 1/22/19; 2/24/22
AASC Approval date: 2/19/19; 11/19/19; 4/19/22

***Riverland Community College Disciplines**	**MnTC Goal Number**
Communication (CM)	**1**
Natural Sciences (NS)	**3**
Mathematics/Logical Reasoning (MA)	**4**
History and the Social & Behavioral Sciences (SS)	**5**
Humanities and Fine Arts (HU)	**6**

****Riverland Community College Core Themes**	**MnTC Goal Number**
Critical Thinking (CT)	**2**
Human Diversity (HD)	**7**
Global Perspective (GP)	**8**
Ethical and Civic Responsibility (EC)	**9**
People and the Environment (PE)	**10**

*These five MnTC Goals have been identified as Riverland Community College Disciplines.
** These five MnTC Goals have been identified as Riverland Community College Core Themes.
NOTE: The Minnesota Transfer Curriculum "10 Goal Areas of Emphasis" are reflected in the five required discipline areas and five core themes noted in the Riverland Community College program of study guide and/or college catalog.