VISAYAS STATE UNIVERSITY

DEPARTMENT OF PURE AND APPLIED CHEMISTRY
Visca, Baybay City, Leyte, PHILIPPINES
Telefax: 053-563-7747
Email:dopac @vsu.edu.ph
Website: www.vsu.edu.ph

OUTCOMES-BASED EDUCATION (OBE) COURSE SYLLABUS

Chem 115
Principles of Chemistry

I. UNIVERSITY INFORMATION

1. Vision of the University

A globally competitive university for science, technology, and environmental conservation

2. Mission of the University

Development of a highly competitive human resource, cutting-edge scientific knowledge and innovative technologies for sustainable communities and environment.

3. VSU Quality Policy Statement

The Visayas State University (VSU), a globally competitive university of science and technology and environmental conservation, is created by law to develop highly competitive human resource, cutting- edge scientific knowledge and innovative technologies for sustainable communities and environment.

Towards this end, we, at the Visayas State University, commit to:

- Produce highly competent, quality and world-class manpower in science and technology, especially for agriculture, environmental management and industry who are proficient in communication skills, critical thinking and analytical abilities;
- Generate and disseminate relevant knowledge and technologies that lead to improved productivity, profitability and sustainability in agriculture, environment and industry; and
- Satisfy the needs and applicable requirements of the industry, the community and government sectors who are in need of quality graduates and technology ready for commercialization through the establishment, operation, maintenance and continual improvement of a Quality Management System (QMS) which is aligned with the requirements of ISO 9001:2015.

It shall be the policy of the university that the quality policies and procedures are communicated to and understood by all faculty, staff, students and other stakeholders and that the system be continually improved for its relevance and effectiveness.

EDGARDO E. TULIN
President
v0 07-16-2019

4. Quality Goals of the College of **Arts and Sciences**

1. To produce quality manpower and graduates in biology, biotechnology, chemistry, English, liberal arts and behavioral sciences, mathematics, physics and statistics to serve the development needs of the region,
2. To uplift the economic well-being of the region through relevant R&D and extension programs, and
3. To enhance regional development of the Visayas for global competitiveness.

5. Quality Objectives of the Department of **Pure and Applied Chemistry**

1. Produce highly qualified and skilled Chemists and Chemical technicians for the industry and academia,
2. Generate relevant knowledge and technologies through basic and applied multi- and inter-disciplinary researches and
3. Achieve strong linkages and cooperation with domestic and international institutions and agencies involved in the pursuit of sustainable development.

II. PROGRAM INFORMATION

1. Name of the Program	Bachelor of Science in Chemistry
2. CHED CMO Reference	CMO No. 47 s. 2017
3. BOR Approval	BOR Resolution No. 63 s. 2018 (July 5, 2018)

4. Program Educational Objectives and Relationship to Institution Mission

Program Educational Objectives	Mission*		
	a	b	c
1. Occupy supervisory and /managerial position and in educational, research institution and industries both local and international.	✓	✓	✓
2. Participate in multidisciplinary or cross-disciplinary research team	✓	✓	✓
3. Establish own chemical - based business industries	✓	✓	✓
4. Pursue graduate studies and / specialized training program in chemistry and related field.	✓	✓	✓
5. Pursue other degree program	✓	✓	✓

**a - development of a highly competitive human resource, b - cutting-edge scientific knowledge, c - innovative technologies for sustainable communities and environment*

III. COURSE INFORMATION

1. Course Code	Chem 115
2. Course Title	Principles of Chemistry
3. Pre-requisite	None
4. Co-requisite	Chem 115.2
5. Credit	3 units lecture
6. Semester Offered	First semester, First year
7. Number of hours	3-hr per week
8. Course Description	Fundamental chemical concepts and inorganic structures; atomic and molecular structure; the periodic table and periodicity; chemical bonding; thermochemistry, kinetics and reaction rates, chemical equilibrium; acid-base and solubility equilibria; and basic

	thermodynamics; Electrochemistry, nuclear chemistry and descriptive chemistry of the representative elements

9. Program Outcomes (POs) in relation to the Program Educational Objectives (POEs)						
Program Outcomes (POs)		Program Educational Objectives				
		1	2	3	4	5
A	Demonstrate a broad and coherent knowledge and understanding in the core areas of chemistry: inorganic, organic, physical, biological and analytical chemistry; and in addition the necessary background in mathematics and physics	✓	✓	✓	✓	✓
B	Gather data using standard laboratory equipment, modern instrumentation and classical techniques	✓	✓	✓	✓	✓
C	Identify and solve problems involving chemistry, using current disciplinary and interdisciplinary principles	✓	✓	✓	✓	✓
D	Qualify for further study and/or for entry-level professional employment in the general workplace	✓	✓	✓	✓	✓
E	Work effectively and independently in multidisciplinary and multi-cultural teams	✓	✓	✓	✓	✓
F	Act in recognition of professional, social, and ethical responsibility	✓	✓	✓	✓	✓
G	Effectively communicate orally and in writing using both English and Filipino	✓	✓	✓	✓	✓
H	Articulate and discuss the latest developments in the specific field of practice (PQF level 6 descriptor)	✓	✓	✓	✓	✓
I	Interpret relevant scientific data and make judgments that include reflection on relevant scientific and ethical issues	✓	✓	✓	✓	✓
J	Preserve and promote "Filipino historical and cultural heritage" based on RA 7752	✓	✓	✓	✓	✓

10. Course Outcomes (COs) and Relationship to Program Outcomes (POs)											
After completing this course, the student must be able to perform the following COs:		*Program Outcomes Code*									
		A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
CO1	Describe the basic concepts of atoms, its theories and quantum theory; provide a basic quantum mechanical description of the hydrogen atom; determine the electron configurations of atoms; and use periodic trends to make predictions about atomic and chemical properties.	I		I	I			I	I		
CO2	Describe ionic and covalent bond formation; compare properties of ionic and covalent compounds; Write the chemical formulas from a chemical name and vice versa; write Lewis structures of molecules to predict the geometry and polarity of molecules.	I		I	I			I	I		
CO3	Describe the valence bond and molecular orbital theories of bonding; explain the concept of hybridization of atomic orbitals.	I		I	I			I	I		

CO4	Discuss the kinetic molecular theory of gases and determine the relationship between the properties of gases using gas laws; differentiate real gases from ideal gases.	I		I	I			I	I		
CO5	Identify and describe the intermolecular attractive forces and how they affect the properties of the states of matter and phase behavior; interpret a phase diagram. Classify solid by type and crystalline structure.	I		I	I			I			
CO6	Identify the different types of chemical reaction; write and balance chemical equations; calculate theoretical yields and percent yields; determine the reactivity of the main group elements.	I		I	I			I			
CO7	Describe various types of solutions; calculate the concentrations of solutions using various concentration units; explain the factors affecting solubility; define the colligative properties and perform calculations involving colligative properties of nonelectrolyte and electrolyte solutions.	I		I	I			I			
CO8	Write and interpret rate law; calculate reactant concentration as a function of time using a given rate law; state and explain factors that affect reaction rates; derive simple reaction mechanisms based on a given set of elementary reactions.	I		I	I			I			
CO9	Describe dynamic chemical equilibrium and factors affecting it; write equilibrium constant expressions and calculate their values; use Le Chatelier's Principle to determine shifts in equilibrium.	I		I	I			I			
CO10	Differentiate the theories of acids and bases; describe the behavior of strong and weak acids and bases in aqueous solutions; calculate for pH of solutions.	I		I	I			I			
CO11	Apply chemical equilibrium concepts to acids and bases and insoluble salts.	I		I	I			I			
CO12	Describe the thermodynamic changes of enthalpy, entropy and Gibb's free energy that accompany a chemical reaction and use standard tables to calculate their values for a given chemical reaction.	I		I	I			I			
CO13	Use the laws of thermodynamics to predict the spontaneity of chemical processes including electrochemical processes.	I		I	I			I			
CO14	Evaluate the relationship between chemistry and other disciplines, between chemistry and society.			I		I	I	I	I	I	I

Legend: I – Introductory, E – Enabling, D – Demonstrative

Each letter indicates the expected level of competency that each CO should provide for each PO.

11. Course Content and Plan					
Week	**Topics**	**Learning Outcomes**	**Teaching and Learning Activities**		**Assessment Tasks**
			Teaching Activities	**Learning Activities**	
Class Orientation					
1	OBE Course Syllabus (including VSU Vision Mission, and Quality Policy Statement) Class Policies Requirements Grading System and Activities Learning Guide Submission of requirements Values Integration: Honesty Work ethics Self-help and mutual help	At the end of the week, the learners should be able to: • articulate the Vision, Mission and Quality Policy Statement of the university	**Face to Face:** Recitation through brainstorming activity	**Online Mode:** • Power point presentation • Sharing of ideas **Offline Mode:** Invited to online discussion meeting Reading and interpre-tation	Non-graded recitation relating the degree program's Educational objectives to the Vision, Mission and Quality Policy Statement of the university • Worksheet
CO1: Describe the basic concepts of atoms, its theories and quantum theory; provide a basic quantum mechanical description of the hydrogen atom; determine the electron configurations of atoms; and use periodic trends to make predictions about atomic and chemical properties.					

2-3	**Atoms and the Periodic Table** • Subatomic particles and atomic structure • Atomic number, mass number, and isotopes • Nuclear stability • Average atomic mass • The periodic table • The mole and molar mass **Quantum Theory and the electronic Structure of Atoms** • Energy and energy changes • The nature of light • Bohr's theory of the hydrogen atoms • Wave properties of mater • Quantum mechanics • Quantum numbers • Atomic orbitals • Electron	1. Explain the basic laws of matter and relate it to the Dalton's atomic theory 2. Differentiate atoms and sub-atomic particles and describe the atomic structures. 3. Differentiate atomic numbers and mass numbers; isotopes, isobars and isotones; and identify the element's position in the periodic table. 4. Describe a periodic table. 5. Write formulas and nomenclature of elements, ions and compounds. 6. Explain the mole concept. 7. Compute molar mass of a compound. 8. Convert mass to moles to number of particles using stoichiometric calculation 9. Describe the quantum mechani-cal model of the atom. 10. Describe the electronic structure of atoms in terms of main energy levels, sublevels and orbitals and relate this to energy. 11. Describe an atom by its set of quantum numbers. 12. Write the electron configuration of atoms 13. draw an orbital diagram	**Face to face:** Prior reading of the topic (Chapters 1 and 2 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets Poster making (group) Developmen t of Atomic Theory timeline Prior reading of the topic (Chapters 7 of Silberberg) PowerPoint presentation Class problem solving drills Worksheet/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discus sion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	"Standing on the shoulder of Giants" poster on the contribution of specific scientist to the atomic and quantum theories development Individual problem/ work sheet (conceptualiz ation/visualiz ation) [e-portfolio for the entire semester] Formative Assessment **(Quizzes)**

	configurations • Electron configurations and the periodic table **Periodic trends of the Elements** • The modern periodic table • Effective nuclear charge and periodic trends in the properties of elements • Electron configuration of ions • Ionic radius	configuration of atoms 14. Determine the magnetic property of atom based on its electronic configuration. 15. Explain the periodic recurrence of similar properties among elements in the periodic table in terms of electronic structure. 16. Relate the valence electrons of elements to their group number in periodic table. 17. Describe and explain the trends in atomic properties in the periodic table. 18. Compare the properties of families in the periodic table.	Prior reading of the topic (Chapter 8 of Silberberg) PowerPoint presentation Class problem solving drills Worksheet/ Problem set		
CO 2: Describe ionic and covalent bond formation; compare properties of ionic and covalent compounds; Write the chemical formulas from a chemical name and vice versa; write Lewis structures of molecules to predict the geometry and polarity of molecules.					
3-4	**Ionic and Covalent Compounds** • Lewis dot symbols • Ionic compounds and bonding • Lattice Energy • Naming ions and ionic compounds and writing formula of ionic compounds • Covalent bonding and molecules • Naming molecular compounds and writing molecular formula and empirical formula • Percent composition of compounds	1. Write the Lewis dot symbols of atoms, ions and molecules 2. Differentiate an ionic compound from a covalent compound and give examples. 3. Write the molecular and empirical formula of compounds. 4. Compute percent composition of compounds and identify the molecular formula from it.	Prior reading of the topic (Chapter 9 of Silberberg) PowerPoint presentation Class problem solving drills Worksheet/ Problem set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quiz/Work-sheets/ Problem Sets scores Formative Assessment **(Quizzes, WS)** [e-portfolio for the entire semester] Summative Assessment **(Long Exam 1)**

	• Molar Mass **Representing Molecules** • The Octet Rule • Electronegativity and Lewis structures • Drawing Lewis Structures • Formal charges • Resonance • Exceptions to the octet rule Molecular geometry • VSEPR theory, bond length, bond angles, geometry and polarity	5. Discuss the octet rule and its exception. 6. Identify the electronegativity atoms 7. Draw the Lewis structures of ionic and covalent compounds 8. Compute the formal charges of each atom in a compound 9. Write different resonance structures and identify the most stable structure of the compound based on its formal charge. 10. Identify the geometry, bond angles and polarity of the molecule using VSEPR 11. Differentiate polar from non-polar compounds.	Prior reading of the topic (Chapter 10 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set		
CO 3: Describe the valence bond and molecular orbital theories of bonding; explain the concept of hybridization of atomic orbitals.					
5	**Bonding Theories** • Valence Bond Theory • Hybridization of atomic orbitals • Hybridization in molecules containing multiple bonds • Molecular orbital theory	1. Discuss the Valence bond concept in formation of single and multiple bonds between the bonded atoms in a molecule 2. Explain textually and visually the hybridization of atomic orbitals involved in bond formation 3. Discuss molecular	Prior reading of the topic (Chapters 10 and 11 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work	Worksheets/ Problem Sets scores Formative Assessment **(Quizzes)** [e-portfolio for the entire semester]

		orbital theory and its implication to the stability of a molecule. 4. Draw MO diagrams for homo- and hetero-nuclear diatomic molecules 5. Differentiate textually and visually the formation of bonds in VBT and MOT		**Offline Mode:** Learning Tasks	
CO 4: Identify and describe the intermolecular attractive forces and how they affect the properties of the states of matter and phase behavior; interpret a phase diagram; classify solid by type and crystalline structure.					
6	**Intermolecular forces, Liquids and Solids** • The condensed phases • Properties of liquids • Properties of solids • Types of crystalline solids • Intermolecular Forces • Dipole – dipole Force • Ion – dipole Force • Dispersion Force • Hydrogen bonding • Phase changes • Phase diagrams • Classification of solids based on type and crystalline structure	1. Explain the properties of solids and liquids using kinetic molecular model. 2. Describe and differentiate the types of intermolecular forces of attraction (IMFA) 3. Describe the properties of liquids; discuss the effect of IMFA on these properties and give examples. 4. Differentiate crystalline from amorphous solids 5. Compare the different types of crystalline solid in terms of physical properties, IMFA involved and uses. 6. Describe the	Prior reading of the topic (Chapter 12 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem Sets [e-portfolio for the entire semester] Summative assessment **[2nd Long Exam]**

		nature of the different phase changes of matter in terms of energy change and molecular order. 7. Identify the parts of phase diagram and interpret phase diagrams of carbon dioxide and water.			
CO 5: Discuss the kinetic molecular theory of gases and determine the relationship between the properties of gases using gas laws; differentiate real gases from ideal gases.					
7	**Gases** • The properties of gases • The kinetic molecular theory of gases • Gas Pressure • The "named" gas laws • The ideal gas equation • Real gases	1. Identify the properties of gases (volume, pressure, temperature) 2. Explain the kinetic molecular theory of gases. 3. Discuss the common gas laws and express in equation form. 4. Determine the pressure, volume, or temperature of a gas under certain conditions of change using gas laws and ideal gas / real gas equations. 5. Compare ideal gas from a real gas and discuss how reals gases deviate from the ideal gas law. 6. Solve gas law problems integrating	Prior reading of the topic (Chapter 5 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem Sets [e-portfolio for the entire semester]

		stoichiometry.			
CO 6: Identify the different types of chemical reaction; write and balance chemical equations; calculate theoretical yields and percent yields; determine the reactivity of the main group elements.					
8-9	**Chemical Reactions** • Chemical equations • Combustion analysis • Calculations with balanced chemical equations • Limiting reactants • Periodic trends in reactivity of the main qroup elements • Precipitation reactions • Acid-base reactions • Oxidation -reduction reactions	1. Identify the parts of the chemical equation 2. Identify the types of chemical reaction. 3. Write and balance a chemical equation using inspection method. 4. Differentiate limiting reagent from excess reagent. 5. Calculate theoretical and percent yields of certain reaction. 6. Identify insoluble products using solubility rules. 7. Determine the reactivity of the main group elements.	Prior reading of the topic (Chapter 3 and 4 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem Sets [e-portfolio for the entire semester]
10	**Midterm Examination**				**Summative Exam 3**
CO 7: Describe various types of solutions; calculate the concentrations of solutions using various concentration units; explain the factors affecting solubility; define the colligative properties and perform calculations involving colligative properties of nonelectrolyte and electrolyte solutions.					
10	**Solutions** • General properties of aqueous solutions • Concentration of solutions • Aqueous reactions and chemical analysis • Colligative and non-colligative properties	1. Describe the types of solutions based in conductivity, amount of solute, pH and state. 2. Calculate concentrations of solutions using different units and convert one unit to the	Prior reading of the topic (Chapter 13 of Silberberg) PowerPoint presentation Class problem solving drills	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work	Quizzes Worksheets Problem Sets [e-portfolio for the entire semester]

		other. 3. Differentiate colligative from a non-colligative property. 4. Understand the various colligative properties and give examples. 5. Solve problems involving colligative properties of electrolyte and non – electrolyte solution.	Worksheets/ Problem Set Prior reading of the topic (Chapter 13 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Offline Mode:** Learning Tasks	
CO 8: Write and interpret rate law; calculate reactant concentration as a function of time using a given rate law; state and explain factors that affect reaction rates; derive simple reaction mechanisms based on a given set of elementary reactions.					
11	**Chemical Kinetics** • Reactions rates • Collision theory of reaction rates • Dependence of reaction rate on reactant concentrations • Dependence of reactant concentration on time • Dependence of reaction rate on temperature • Reaction mechanisms • Catalysis	1. Describe how various factors influence the rate of reaction. 2. Explain collision theory and transition state theory and how the product(s) is/are formed. 3. Write and interpret rate law. 4. Write a mathematical relationship between reaction rate, rate constant and concentration of reactants. 5. Differentiate zero, first and second order reactions. 6. Derive a simple	Prior reading of the topic (Chapter 16 of Silberberg) PowerPoint presentation Class problem solving drills Worksheet/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Worksheets/ Problem Sets Group project **1** Formative exam **4** [e-portfolio for the entire semester] Summative assessment **[4th Long Exam]**

		elementary reactions 7. Define a catalyst and explain how it affects the rate of reaction.			
CO 9: Describe dynamic chemical equilibrium and factors affecting it; write equilibrium constant expressions and calculate their values; use Le Chatelier's Principle to determine shifts in equilibrium.					
12	**Chemical Equilibrium** • The concept of equilibrium • The equilibrium constant • Equilibrium expressions • Chemical equilibrium and free energy • Calculating equilibrium concentrations • Le Chatelier's principle	1. Explain a chemical equilibrium in terms of the reaction rates of the forward and reverse reactions. 2. Write expressions for the reaction quotient and equilibrium constants. 3. Explain the importance of equilibrium constant value. 4. Calculate equilibrium constant and the pressure or concentration of reactants or product in the reaction mixture. 5. Predict the shifts in equilibrium based in Le Chatelier's principle. 6. Identify the factors affecting chemical equilibrium	Prior reading of the topic (Chapters 18 and 19 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set Prior reading of the topic (Chapter 18 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Summative Assessment 4 Worksheets/ Problem Sets Formative exam **5** [e-portfolio for the entire semester]
CO 10: Differentiate the theories of acids and bases; describe the behavior of strong and weak acids and bases in aqueous solutions; calculate for pH of solutions.					
13	**Acids, Bases, and Salts** • Acid-base definitions	1. Discuss the different theories of acids and bases	Prior reading of the topic (Chapter 19	**Online Mode: VSUEE/VC:** Reading	Quizzes Worksheets

	• Molecular structure and acid strength • The acid-base properties of water • The pH and pOH scales • Strong acids and bases • Weak acids, weak bases, and ionization constants • Conjugate acid-base pairs • Diprotic and polyprotic acids • Acid-base properties of salt solutions • Acid-base properties of oxides and hydroxides	(Arrhenius, Bronsted-Lowry and Lewis). 2. Explain the properties of acids and bases in terms of structure. 3. Calculate Kw, pH and pOH 4. Compare strong acids, weak acids, strong bases and weak bases with examples. 5. Identify conjugate acid-base pairs from a given acid-base reaction. 6. Give examples of diprotic and polyprotic acids. 7. Compare the acid-base properties of salt solutions, oxides and hydroxides.	of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set Class demonstration	and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Problem sets [e-portfolio for the entire semester]
CO 11: Apply chemical equilibrium concepts to acids and bases and insoluble salts.					
14	**Acid-Base Equilibria and Solubility Equilibria** • The common ion effect • Buffer solutions • Acid-base titrations • Solubility equilibria • Factors affecting solubility • Separation of ions using differences insolubility	1. Write an acid-base equilibrium expression from a given acid-base reaction and calculate Ka and Kb 2. Explain the effect of common ion in the equilibria. 3. Define a buffer system 4. Discuss the importance of buffer in biological system. 5. Explain how buffers are prepared by applying	Prior reading of the topic (Chapter 19 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set Class demonstration	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem sets [e-portfolio for the entire semester] Summative assessment **[5th Long Exam]**

		Henderson-Hasselbalch equation 6. Examine the parts and describe a tritration curve of various acid-base reactions. 7. Write a solubility equilibrium expression from a given precipitation reaction. 8. Calculate Ksp values and solubility values			
CO 12: Describe the thermodynamic changes of enthalpy, entropy and Gibb's free energy that accompany a chemical reaction and use standard tables to calculate their values for a given chemical reaction.					
15	**First Law of thermodynamics** • Energy and energy changes • Introduction to thermodynamics • Enthalpy • Calorimetry • Hess's Laws • Standard Enthalpies of Formation • Bond energy and the stability of covalent molecules	1. Explain the energy changes during chemical reactions. 2. Distinguish between exothermic and endothermic processes. 3. Discuss the first law of thermodynamics. 4. Explain enthalpy of a reaction. 5. Write the thermochemical equation for a given chemical reaction. 6. Calculate the change in enthalpy of a given reaction using Hess Law. 7. Explain the stability of molecules in terms of bond energy.	Prior reading of the topic (Chapter 20 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set Class demonstration	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem sets [e-portfolio for the entire semester]
CO 13: Use the laws of thermodynamics to predict the spontaneity of chemical					

processes including electrochemical processes.					
16	**Entropy and Free Energy** • Entropy • Entropy changes in the system and surroundings • Second law of thermodynamics • Gibb' s Free Energy • Predicting spontaneity of reactions	1. Define entropy. 2. Describe how entropy changes in the system and its surroundings with a change in temperature, phase and number of particles. 3. Explain the second law of thermodynamics and its significance. 4. Use Gibb's free energy to determine the direction of reaction. 5. Predict spontaneity of reactions based in enthalpy, entropy and Gibb's free energy.	Prior reading of the topic (Chapter 20 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	Quizzes Worksheets Problem sets [e-portfolio for the entire semester]
17	**Electrochemistry** • Redox reaction • Galvanic cell and Electrolytic cells • Standard reduction potentials • Spontaneity of redox reactions	6. Define and balance a redox reaction using oxidation number method. 7. Differentiate a galvanic cell from electrolytic cell using a diagram. 8. Identify reactions occurring in different parts of the cell. 9. Write the balanced overall cell reactions. 10. Identify a spontaneous redox reaction.	Prior reading of the topic (Chapter 21 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set Class demonstration	**Online Mode: VSUEE/VC:** Reading and web-research Group work/discussion (Peer-learning) Individual work **Offline Mode:** Learning Tasks	**Group Project**: Make a video of a Do-It-Yourself (DIY) operational electrochemical cell and submit a written report of your group's work Worksheets Problem Sets [e-portfolio for the entire semester]
CO 14: Evaluate the relationship between chemistry and other disciplines, between					

	chemistry and society				
	Applications of Chemistry to society and other disciplines - Family and Society - Medicine - Agriculture - Technology - Criminology, etc.	1. Discuss the importance of Chemistry in other disciplines. 2. Explain how chemistry gave an impact to society by giving situations.	Prior reading of the topic (Chapter 22 of Silberberg) PowerPoint presentation Class problem solving drills Worksheets/ Problem Set	Activity / Class Demonstration by group	**Group output:** Video presentation Poem writing Song **[Final submission of e-portfolio for the entire semester]**
18	**Final Assessment**				**Summative Assessment 6 (Finals)**

** VSUEE/VC – VSU E-Learning Environment/ Virtual Classroom*

13. Contribution of Course to Meeting the Professional Component (%)

General Education:
Basic Education *(Foundation)*:
Professional Education (*Major Field*): ***100%***

14. References and Other Learning Resources

A. Textbook(s)/ E-Books

1. Silberberg, M. S. & Amateis, P. (2018). Chemistry: The molecular nature of matter and change. 8th edition, McGraw-Hill Education, New York, USA
2. Chemistry 2e. Openstax [https://openstax.org/books/chemistry-2e/pages/1-introduction]
3. Other chemistry textbooks
4. Journal of Chemical Education

15. Course Assessment and Evaluation

The performance of students will be assessed and evaluated based on the following:

Item No.	Assessment Tasks	Percentage Contribution (1)	No. of Times in the Semester (2)	Individual Task % Contribution (1/2)
1	Summative Examination	60	6	10%
2	Formative Assessments (Worksheets, Quizzes, Problem Sets)	20	20	1.0%
3	Group project	5		5%
5	Individual project	5	2	2.5%

6	E-portfolio	10 100%	1	10%

COs	Assessment Tasks	Weight in Percent	Minimum Average for Satisfactory Rating	Target and Standards
CO 1	Formative/Summative Assessments [Problem Set, Poster making, Quiz]	20%	60 %	At least 70% of the students have at least 60% score
CO 2	Formative Assessment [Problem Set, Quiz] Summative Assessment 1	20%		
CO3	Formative Assessment [Problem Set, Quiz] Summative Assessment 2	20%		
CO4	Formative Assessment [Problem Set, Quiz] Summative Assessment 3	20%		
CO5	Formative Assessment [Problem Set, Quiz] Summative Assessment4	20%		
TOTAL		100%		

Grading System (% Passing: 60 %)

Range	Grade	Range	Grade
97 – 100	1.00	75 - 79	2.25
93 – 96	1.25	70 - 74	2.50
89 – 92	1.50	65 - 69	2.75
85 – 88	1.75	60 - 64	3.00
80 – 84	2.00	< 60	5.00

16. Course Materials and Facilities Available

VSUEE (Moodle Platform)
Worksheets
Problem Sets

17. Revision History

Revision number	Date of Revision	Date of implementation	Highlights of Revision
00	July 5, 2018	August 2018	OBE-based syllabus for in campus instruction
01	August 20, 2021	August 23, 2021	Additional assessment tools are incorporated; online instruction mode
02	September 23, 2022	September 12,2022	Inclusion of face to face mode of instruction delivery, topic coverage remain the same

18. Preparation			
Prepared by	Name	Signature	Date Signed
	Jacob Glenn F. Jansalin		Sept. 26, 2022

III. INSTRUCTOR/PROFESSOR INFORMATION

1. Name of Instructor/Professor	JACOB GLENN F. JANSALIN
2. Office and Department	DOPAC
3. Telephone/Mobile Numbers	09267490881
4. Email Address	jgfjansalin57@vsu.edu.ph
5. Consultation Time	Office time during weekdays; as scheduled thru appointment

19. Department Instructional Materials Review Committee:

Committee	Name	Signature	Date Signed
Member:	ATOZ A. VASQUEZ		Sept. 26, 2022
Member:	MARIA ROBELYN A. INSIK		Sept 26, 2022
Chairperson	ELIZABETH S. QUEVEDO		October 4, 2022

	Name	Signature	Date Signed
Verified by:	MA. THERESA P. LORETO College Dean		
Validated by:	NANCY D. ABUNDA Head, IMD		

Note:

1) The number of POs will depend on each degree program offered
2) COs and Relationship to POs
   a. (I) - **Introductory** – an Introductory Course to an outcome
   b. (E) - **Enabling** – an Enabling Course or a course that strengthens the outcome
   c. (D) - **Demonstrated** – a Demonstrative Course or a course demonstrating an outcome.

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