CHEM 104 General Chemistry II w/ Lab

4 credits

Prerequisites: CHEM 103 (or CHEM-I equivalent)

Instructors: Heather Dorman, Ph.D., Department Chair
Rodney Austin, Ph.D.
David Gallaher, Ph.D.
Kathy Austin, MEd
H Elaine Frey, MHA
Craig Kozminski, MAT
Hannah McGuire, MAT
Jessica Schiren, MS, MAT

Contact Information: Faculty may be contacted through the Canvas messaging system

Additional Information: www.portagelearning.com*

Course meeting times: CHEM 104 is offered continuously

Course Description: An examination of quantitative kinetics, collision theory and the associated reactions are assessed relative to chemical equilibria. Acid-base theories and chemical buffer systems are discussed along with practical titration practices. Discussion on thermodynamics, electrochemical principles and descriptive chemistry are included. Organic and nuclear chemistry and the approaches used to quantify their reactivity are explored, as well as the chemistry of elements. The laboratory component of this course is delivered using virtual labs and interactive simulations with detailed instruction and demonstrations from an experienced chemist.

Course Outcomes: As a result of this course experience a student should be able to:

- Describe and perform calculations with regard to reaction rates
- Predict the effect of various stresses on chemical equilibria
- Explain acid/base properties and perform pH and titration calculations
- Perform K_{sp} calculations and explain thermodynamic principles
- Describe electrochemical cells and perform cell potential calculations
- Explain the properties of nonmetals and transition metals
- Describe the structures and properties of simple organic compounds and name or write formulas for these compounds
- Predict and describe the typical reactions of simple organic compounds

* Portage Learning college courses are offered by Geneva College, which is accredited by the Middle States Commission on Higher Education. Portage Learning is included in the College's Department of Professional and Online Graduate Studies; courses are delivered through the PortageLearning.com platform.

- Recognize the structures of carbohydrates, lipids, proteins and nucleic acids and their building-block molecules

*Please see the *Module & Lab Topics* section below for expanded course outcomes.

Lab Outcomes: As a result of this laboratory experience a student should be able to:

- Practice safe procedures in the chemical laboratory
- Perform reaction rate measurements
- Perform pH measurements
- Carry out acid-base titrations
- Perform electrochemical procedures
- Carry out organic synthesis
- Perform a qualitative analysis

The CHEM 104 student learning outcomes are measured:

Directly by: (1) Module application problems (with instructor feedback)
(2) Module exams
(3) Lab notebooks and lab applications
(4) Cumulative final exam

Indirectly by an end of course student-completed evaluation survey

Course Delivery: This course is asynchronously delivered online and is composed of 10-15 hours of module assignments, 20-25 hours of video lectures, 10-15 hours of secure online exams, 10-15 hours of demonstration labs, 5-10 hours of lab notebook maintenance, 10-15 hours of lab applications.

Course Progression: It is the policy for all Portage Learning courses that only one (module lecture/final) exam is to be completed within a 48-hour period. Research on the best practices in learning indicates that time is needed to process material for optimal learning. This means that once an exam has been completed, the next exam may not be opened or taken until 48 hours after the submission of the previous module exam. This allows for instructor feedback/class expectations as the student moves through the material. Instructors, like the College, are not available during the weekend; grading, therefore, is M-F and may take up to 72 hours during these days. Also, it is the policy of Portage Learning to support a minimum of 28 days to complete a course; this is not a negotiable time period. Please plan your time accordingly.

Note: Professors reserve the right to reset any exam taken in violation of these guidelines.

Required readings, lectures and assignments: Portage courses do not use paper textbooks. Students are required to read the online lesson modules written by the course author which contain the standard information covered in a typical course. Please note the exam questions are based upon the readings. Video lectures

which support each lesson module subject should be viewed as many times as is necessary to fully understand the material.

We do not support the use of outside resources to study, except for the ones listed in the syllabus under "Suggested External References". If you have questions about the material or would like further explanation of the concepts, please contact your instructor.

Module Problem Sets: The module problem sets within the modules are required and a part of your final grade. They will be reviewed for completeness (not correctness) by the instructor. You must show your work in order to receive full credit. **Be sure to answer all of the problems, being careful to answer the questions in your own words at all times since this is an important part of adequate preparation for the exams.** After you submit the problem set, compare your answers to the solutions provided. If your answers do not match those at the end, attempt to figure out why there is a difference. If you have any questions, please contact the instructor via the Canvas messaging system (see Inbox icon).

Academic Integrity is a serious matter. In the educational context, any dishonesty violates freedom and trust, which are essential for effective learning. Dishonesty limits a student's ability to reach his or her potential. Portage places a high value on honest independent work. We depend on the student's desire to succeed in the program he or she is entering. It is in a student's own best interests not to cheat on an exam or put their work into question, as this would compromise the student's preparation for future work. It is the student's responsibility to review the **Student Handbook** and all policies related to academic integrity. If clarification is necessary, the student should reach out to their instructor for further explanation **before** initiating module one.

Required Computer Accessories: It is recommended that students use a desktop or laptop computer, PC or Mac, when taking the course. Some tablet computers are potentially compatible with the course, but not all features are available for all tablet computers. The latest full version of Google Chrome, Firefox, Edge, or Safari browser is required for the optimal operation of the Canvas Learning Management System. In addition, this course will use the Respondus Lockdown Browser for exams; a strong internet connection is needed. You are also **required to use LockDown Browser with a webcam**, which will record you during an online, nonproctored exam. (The webcam feature is sometimes referred to as "Respondus Monitor.") **Your computer must have a functioning webcam and microphone. Additionally, a photo ID that includes your picture and full name is required. Please note, Chromebooks and tablets (other than iPad) are not compatible on exams using the Lockdown Browser.** Instructions on downloading and installing this browser will be given at the start of the course. We highly recommend using a high-speed Internet connection to view the video lectures and labs. You may experience significant difficulties viewing the videos using a dial-up connection.

For more information on basic system and browser requirements, please reference the following:

Canvas browser and system requirements: https://community.canvaslms.com/t5/Canvas-Basics-Guide/What-are-the-browser-and-computer-requirements-for-Canvas/ta-p/66

Respondus Requirements: https://web.respondus.com/he/lockdownbrowser/resources/

Respondus Monitor Requirements: https://web.respondus.com/he/monitor/resources/

Modules and Labs

Module 1: This module contains a detailed examination of kinetics including calculation of reaction rate and its use to determine rate constants and reaction order. Radioactive decay is examined as an example of first order reactions. Collision theory is introduced leading to examination of energy of activation, transition state, reaction spontaneity, heat of reaction, catalysis and enzymes. Reversible reactions are examined so as to discuss equilibrium reactions and determination and use of the equilibrium constant and LeChatelier's principle.

Module 2: This module contains an extensive treatment of acid-base chemistry beginning with terminology definitions and a discussion and application of the three most common acid-base theories. Relative acid and base strengths are predicted, and types of reactions of acids and bases are considered. pH is defined and determined. Acid-base titration calculations are carried out and expanded to include titration curves and their use to determine endpoints and indicator choice. Weak acid/weak base equilibria are examined and applied to determine pH and percent ionization and extended to explain the effect of acid-base buffers.

Module 3: This module examines a special reversible reaction, solubility equilibria and calculation and use of its constant (K_{sp}). The second half of the module discusses chemical thermodynamics paying close attention to the three laws of thermodynamics and calculation of entropy, free energy and spontaneity.

Module 4: This module examines electrochemistry and voltaic and electrochemical cells and calculates cell potentials using the Nernst equation. The second part of the module studies descriptive chemistry focusing on the elements including their oxidation states, the compounds they form, the reactions they undergo, their physical properties and their chemical reactivity.

Module 5: This module presents the chemistry of organic compounds beginning with a review of the structure and nomenclature of the four types of hydrocarbons and continuing with structure and nomenclature of nine other common functional group types. The five most common types of organic reactions are listed and discussed. Organic structure determination by spectroscopic analysis is examined including SEM/EDS qualitative elemental analysis, Mass Spectrum

analysis for molecular weight, Infrared (IR) analysis for the presence of certain functional groups and Nuclear Magnetic Resonance (1H-NMR) analysis for H arrangement.

Module 6: This module includes an examination of biochemistry and nuclear chemistry. The structures and functions of each of the four main classes of biochemical materials (carbohydrates, lipids, proteins and nucleic acids) are presented. The nuclear chemistry section begins with an examination of nuclear particles and their involvement in the balancing of the five types of radioactive decay reaction equations or transmutation reaction equations. This section concludes with a treatment of nuclear half-life processes and mass-energy conversion and binding energy calculations.

Lab 1: Kinetic measurements. In this experiment, the speed, or rates, of reactions are studied. First, the speed of a reaction is determined with respect to concentration. From the data, a rate law is written for a reaction system, which includes determining orders of reactions. The importance of a catalyst and temperature on a reaction system is also covered.

Lab 2: Equilibrium Reactions. In this lab, equilibrium reactions are studied quantitatively by first determining the equilibrium constant for the acid-catalyzed esterification of acetic acid with 1-propanol. Then seven reversible reactions are studied to demonstrate the shifting of these equilibrium reactions according to LeChatelier's principle.

Lab 3: Titrations. In this lab, five acid-base titrations are carried out for various purposes. (1) The first titration is a weak acid- strong base titration between potassium biphthalate and sodium hydroxide solution for the purpose of standardizing the NaOH. (2) The standard NaOH is then used in another weak acid- strong base titration between vinegar and the NaOH to determine the percent acetic acid in the vinegar. (3) The standard NaOH is then used in a strong acid-strong base titration between a HCl solution and the NaOH to standardize the HCl solution. (4) The standard HCl is then used in a strong acid- weak base titration between household ammonia and the HCl to determine the percent ammonia in the cleaning solution. (5) The standard HCl and standard NaOH are also used in a back-titration procedure between antacid tablets and the HCl to determine the percent $CaCO_3$ in the cleaning solution.

Lab 4: Molarity/Titration of Vitamin C. This experiment covers the topics of concentration and titration. Students will learn to calculate the concentration in terms of molarity and mg/mL. The juice from three fruits is titrated for Vitamin C content to demonstrate the importance of titration in determining concentration.

Lab 5: Study of buffers. The importance of weak acids and weak bases to aqueous systems is

investigated in this experiment. Weak acids and bases can be used to prepare buffer systems, which are systems that resist pH changes. The ability of an aqueous buffer to resist pH changes is demonstrated. Then the importance of pH to the function of an enzyme is investigated.

Lab 6: Electrochemistry. In this video laboratory, the fundamentals of redox reactions are covered. Then, the reaction of one metal with ions of a second metal is investigated. Based on the data, a voltaic cell is constructed and tested.

Lab 7: Organic Synthesis. In this lab, organic synthesis is demonstrated as three syntheses are carried out from available precursors. Aspirin is synthesized from salicylic acid and the product's structure is confirmed by chemical test, melting point and Infrared spectroscopy. Urea is synthesized from ammonium cyanate and the product's structure is confirmed by melting point and Infrared spectroscopy. Salicylic acid is synthesized from oil of Wintergreen and the product's structure is confirmed by chemical test, melting point and Infrared spectroscopy. In all syntheses, percent yields are determined.

Lab 8: Urinalysis. In this lab, six qualitative chemical tests are performed on a simulated urine sample to demonstrate urinalysis. The tests performed are for calcium, chloride, ammonium, protein, sugar and ketones.

Required Labs and Assignments:

For the laboratory portion of the course, students will observe an experienced lab instructor. **It is the responsibility of the student to view each lab video in its entirety** and only mark the lab as “done” when it is completed. Do not open all the labs at once; otherwise, they may be reset at the discretion of the instructor. Students are required to keep a lab notebook while watching the videos and submit their signed and dated notebook prior to the related lab exam. The lab notebook is a graded component of the course. A lab notebook template and explanation and expectations are provided under "Lab Overview". The lab notebook and explanation and expectations can be used as a resource to the student while completing their lab application assignment(s). Please note that the use of outside material (i.e. the internet, textbooks, articles, etc.) is not permitted while completing their lab application assignment(s). A recommended lab schedule can be found under "Lab Overview"; the student should follow this schedule to meet course objectives.

Additional Tools: There are two different calculators that will be provided within the exam. One of the calculators can be found here: https://www.desmos.com/scientific. If you plan on using this calculator for the exams it would be wise to practice using it for both the practice problems and module problem sets. There is also a calculator that is built into LockDown Browser. It can be found in the top left hand corner as a small calculator symbol and only appears during exams. If you have any questions regarding how to input numbers

or perform certain calculations, please contact your instructor for assistance before moving forward in the course. You are also welcome to use a personal calculator (non-cell phone) if you would like. Keep in mind that you do not need to purchase an expensive calculator as the features you will need are available on basic scientific calculators with a cost of less than $20.

Suggested Timed Course Schedule (to complete the course within a typical college semester)

All Portage courses are offered asynchronously with no required schedule to better fit the normal routine of adult students, but the schedule below is suggested to allow a student to complete the course within a typical college semester. Students may feel free to complete the course on a schedule determined by them within the parameters outlined under “Course Progression.”

Time Period	Assignments	Subject Matter
Days 1-15	Module 1, Exam 1	Rate laws, reaction mechanisms, activation energy, catalysis, chemical equilibria
	Lab 1, Lab Exam 1	Kinetics
	Lab 2, Lab Exam 2	Chemical Equilibrium/LeChatelier's Principle
Days 16-30	Module 2, Exam 2	Acids and bases, pH calculations, titration calculations, acid-base equilibria, buffers
	Lab 3, Lab Exam 3	Titrations
Days 31-46	Module 3, Exam 3	Solubility equilibria, Thermodynamics
	Lab 4, Lab Exam 4	Molality Vitamin C
	Lab 5, Lab Exam 5	Buffers
Days 47-62	Module 4, Exam 4	Electrochemistry, descriptive chemistry
	Lab 6, Lab Exam 6	Electrochemistry
Days 63-78	Module 5, Exam 5	Organic chemistry, spectroscopy
	Lab 7	Organic Synthesis
Days 79-93	Module 6, Exam 6	Biochemistry, nuclear reactions, radiation, half-life
	Lab 8, Lab Exam 8	Urinalysis
Days 94-108	Final Exam	Comprehensive - including all course material

Grading Rubric:

Check for Understanding =	1 pt.
6 Module Problem Sets = 5 pts. each x 6 =	30 pts.
6 Module Exams = 100 pts. each x 6 =	600 pts.
8 Lab Reports = 5 pts. x 8 =	40 pts.
8 Lab Exams = 30 pts each x 8 =	240 pts.
Final Exam = 120 pts.	120 pts.
Total	1031 pts.

The current course grade and progress is continuously displayed on the student desktop.

Grading Scale:

96.5% - 100% = A+
92.5% - 96.4% = A
89.5% - 92.4% = A-
86.5% - 89.4% = B+
82.5% - 86.4% = B
79.5% - 82.4% = B-
76.5% - 79.4% = C+
72.5% - 76.4% = C
69.5% - 72.4% = C-
66.5% - 69.4% = D+
62.5% - 66.4% = D
59.5% - 62.4% = D-
0% - 59.4% = F

Suggested External References:

If the student desires to consult a reference for additional information, the following textbooks are recommended as providing complete treatment of the course subject matter.

- Jean Umland, **General Chemistry**, West Publishing
- Darrell Ebbing, **General Chemistry**, Houghton Mifflin Publishing

NOTE: We do not support the use of outside resources to study, except the ones listed above.

Learning Support Services:

Each student should be sure to take advantage of and use the following learning support services provided to increase student academic performance:

Video lectures: Supports diverse learning styles in conjunction with the text material of each module

Messaging system: Provides individual instructor/student interaction

Tech support: Available by submitting a help ticket through the student dashboard

Accommodations for Students with Learning Disabilities:

Students with documented learning disabilities may receive accommodations in the form of an extended time limit on exams, when applicable. To receive the accommodations, the student should furnish documentation of the learning disability at the time of registration, if possible. Scan and e-mail the documentation to studentservices@portagelearning.com. Upon receipt of the learning disability documentation, Portage staff will provide the student with instructions for a variation of the course containing exams with extended time limits. This accommodation does not alter the content of any assignments/exams, change what the exam is intended to measure or otherwise impact the outcomes of objectives of the course.

One-on-one Instruction

Each student is assigned to his/her own instructor. Personalized questions are addressed via the student dashboard messaging system.

Online learning presents an opportunity for flexibility; however, a discipline to maintain connection to the course is required; therefore, communication is essential to successful learning. **Check your messages daily.** Instructors are checking messages daily Monday-Friday to be sure to answer any questions that may arise from you. It is important that you do the same, so you do not miss any pertinent information from us.

Holidays:

During the following holidays, all administrative and instructional functions are suspended, including the grading of exams and issuance of transcripts.

New Year's Day
Memorial Day
Labor Day
Christmas Break
Easter
Independence Day
Thanksgiving weekend

The schedule of holidays for the current calendar year may be found under the Student Services menu at www.portagelearning.com

Code of Conduct: Students are expected to conduct themselves in a way that supports learning and teaching and promotes an atmosphere of civility and respect in their interactions with others. Verbal and written aggression, abuse, or misconduct is prohibited and may be grounds for immediate dismissal from the program. This is a classroom; therefore, instructors have the academic freedom to set forth policy for their respective class. Instructors send a welcome e-mail detailing the policy of their class, which students are required to read prior to beginning the course.

Grievances: If a student has a complaint about the course, the student is advised to first consult the instructor of the course. After communicating with the instructor, if the matter is still unresolved, students may file a formal grievance for consideration by the Academic Review Committee. The process must be initiated via written communication to academics@portagelearning.com, with “Academic Grievance” listed in the subject line of the email.

Remediation: At Portage Learning we allow a "one-time" only opportunity to re-take an alternate version of **one** module exam AND **one** lab exam on which a student has earned a grade lower than 70%. This option must be exercised before the final exam is started. If an exam is retaken, the original exam grade will be erased, and the new exam grade will become a permanent part of the course grade. However, before scheduling and attempting this retest, the student must resolve the questions they have regarding the material by reviewing both the old exam and the lesson module material. Once ready to attempt the retest of the exam they must contact their instructor to request that the exam be reset for the retest. Remember, any module retest must be requested and completed **before** the final exam is opened.

Note: Exams on which a student has been penalized for a violation of the academic integrity policy may not be re-taken.

Syllabi are subject to change as part of ongoing educational review practices. Students are responsible for accessing and using the most recent version of the course syllabus.