

# Syllabus

**Course Code: Chem 101**

**Title: General Chemistry I**

**Institute: STEM**

**Department: Chemistry**

**Course Description:** The student will investigate the fundamental concepts of chemistry from a theoretical approach and participate in a laboratory program that demonstrates this theory. The subjects covered include atomic structure; chemical bonding, acids and bases, gases, solids and liquids and properties of solutions. The course content is designed for the science major who wishes to transfer to a four year institution

**Prerequisites:** :HS Chemistry or a grade of "C" or higher in CHEM 100 or equivalent, and a grade of "C" or higher in MATH 151.

**Corequisites: None**

**Credits: 5**

**Lecture Hours: 4**

**Lab/Studio Hours: 3**

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## Required Textbook/Materials:

### Face to Face students:

Textbook: Chemistry: The Science In Context, 6th ed. by Gilbert, Kriss, Foster, et. al.,

Laboratory Manual: Laboratory Experiments for Chemistry: The Central Science, 14th ed by Brown, LeMay, et. al.

Safety Goggles: New Jersey state law requires that all students wear appropriate splash and impact proof safety goggles while performing laboratory experiments. They are available at the College Store

Laboratory Coat: available at the College Store

Calculator: Any scientific or graphing calculator will suffice

### Fully Online students:

Textbook: Chemistry: The Science In Context, 6th ed. by Gilbert, Kriss, Foster, et. al.,

Science Interactive Lab Kit purchased from manufacturer

Calculator: Any scientific or graphing calculator will suffice

**Additional Time Requirements: None**

**Additional Support/Labs:**

See <https://www.brookdalecc.edu/academic-tutoring/>

Department tutoring may be available depending upon staffing

**Course Learning Outcomes:**

1. Utilize critical thinking skills to learn fundamental chemical concepts from inorganic chemistry.  
(Critical Thinking, Mathematical Skill Competency, Problem Solving Competency)
2. Use the scientific method to perform chemistry-based problem-solving.  
(Critical Thinking, Mathematical Skill Competency, Problem Solving Competency)
3. Reinforcement of chemical concepts will be made as hands-on skills are developed in the laboratory program.  
(Critical Thinking, Mathematical Skill Competency, Problem Solving Competency)
4. Identify unknown compounds based on observed physical properties  
(Critical Thinking)
5. Describe how chemical reactions proceed  
(Critical Thinking, Problem Solving Competency)
6. Run successful titration experiments  
(Critical Thinking, Mathematical Skill Competency, Problem Solving Competency)
7. Analyze atomic spectra  
(Critical Thinking, Problem Solving Competency)

**Course Content:**

Unit 1: Introduction; Chemistry: The Study of Change; Atoms, Molecules, and Ions; Mass Relationships in Chemical reactions

Unit 2: Reactions in Aqueous Solutions; Quantum Theory and the Electronic Structure of Atoms; Periodic Relationships Among the Elements

Unit 3: Chemical Bonding: Basic Concepts; Chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals

Unit 4: Gases; Intermolecular Forces and Liquids and Solids; Physical Properties of Solutions

**CHAPTERS:** **1, 2, 3**

**UNIT 1:** Introduction, Mathematical Operations, Elements and Compound Composition, and a Study of Aqueous Reactions

**UNIT OBJECTIVE:** To acquaint the student with the mathematics necessary to pursue the subject matter of chemistry. To review basic chemical concepts and calculations covered in the prerequisite introductory chemistry course.

**Learning Objectives**

**Recommended Learning Experiences**

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|--|---|
| 1. Understand the science of chemistry.  | <b>READ:</b> 1.1  |
| 2. Distinguish between elements, compounds, and mixtures. Describe methods of mixture separation | <b>READ:</b> 1.2, 1.3<br><b>DO:</b> 1.1-2, 11-13, 15-16, 29 |
| 3. Distinguish between physical and chemical properties/changes.                                 | <b>READ:</b> 1.5<br><b>DO:</b> 1.23, 25, 27                 |
| 4. Differentiate between the three states of matter.   | <b>READ:</b> 1.6<br><b>DO:</b> 1.31                         |
| 5. Describe the importance of the scientific method and the steps involved                       | <b>READ:</b> 1.7<br><b>DO:</b> 1.37, 39                     |
| 6. List the common SI units and metric prefixes and their meanings.                              | <b>READ:</b> 1.8, Appendix 2                                |

**MEMORIZE:** Tables 1.1, 1.2

**DO:** 1.44

7. Convert SI and non-SI units using dimensional analysis

**READ:** 1.9, Appendix 2

**DO:** 1.47, 51, 55

8. Determine the number of significant figures from measurements and their role in measurement precision

**READ:** 1.10 p. 22-7 only

**DO:** 1.65, 69, 73

9. Convert measurement values to scientific notation

**READ:** Appendix 1

10. Perform calculations involving density. **READ:** 1.5  
**DO:** 1.59-60, 92
11. Convert temperatures among Fahrenheit, Celsius, and Kelvin scales. **READ:** 1.11 p. 32-4  
**DO:** 1.81-82, 89
12. Describe the contribution of each of the following to our understanding of the atom: Dalton, Thomson, Millikan, Rontgen, Becquerel, Curie, Rutherford, and Chadwick. **READ:** 2.2  
**DO:** 2.13, 15
13. Give the approximate size, relative mass and charge of an atom, a proton, neutron, and an electron **READ:** 2.2  
**STUDY:** Table 2.1
14. Describe the composition of the atom in terms of protons, neutrons, and electrons. Know their relationship to atomic number, mass number, and isotopes. **READ:** 2.3  
**DO:** 2.23, 25
15. Relate atomic mass to the abundance and mass of the isotopes. **READ:** 2.4  
**DO:** 2.17, 18, 21, 27
16. Understand the arrangement of elements and the parts of the periodic table. Use the table to classify elements as metals, nonmetals or metalloids. Learn the group names **READ:** 2.5  
**DO:** 2.7, 41, 43, 47, 127

17. Describe the two types of compounds and distinguish between empirical formulas and molecular formulas  
**READ:** 2.6  
**DO:** 2.49
18. Determine the charge a particular atom will have when it becomes an ion (an anion or cation). State the numbers of protons, neutrons, and electrons it will have.  
**READ:** 2.6  
**DO:** 2.57
19. Determine the formula of an ionic compound based on ion charges determined from the periodic table.  
**READ:** 2.7
20. Write the name of an inorganic compound given its chemical formula and perform the reverse operation.  
**READ:** 2.7  
**MEMORIZE:** Table 2.2, 2.3  
**DO:** 2.65, 67, 69, 71, 75, 77, 79, 83, 88  
Memorize the name, charge, and formula of each of the polyatomic ions in Table 2.3. Know some common elements that can have more than one charge. Memorize prefixes for naming molecular (covalent) compounds in Table 2.2.
21. Identify substances as acids and bases. Distinguish between them.  
**READ:** 2.7  
**DO:** 2.91, 93
22. Define the mole. Convert between numbers of moles, mass in grams and  
**READ:** 3.2  
**DO:** 3.15, 19, 25, 27, 35, 39, 150

numbers of atoms or molecules using  
molar mass and Avogadro's number

- |   |   |
|---|---|
| 23. Balance chemical equations.   | <b>READ:</b> 3.3<br><b>DO:</b> 3.45, 49, 51, 55   |
| 24. Use a balanced equation to calculate amounts of reactants and products with stoichiometry.                  | <b>READ:</b> 3.5<br><b>DO:</b> 3.61, 62, 63, 64   |
| 25. Calculate the percent composition and empirical formulas of compounds.                                      | <b>READ:</b> 3.7<br><b>DO:</b> 3.91, 95, 97, 99   |
| 26. Determine the molecular formula of compounds from empirical formulas experimentally.                        | <b>READ:</b> 3.8<br><b>DO:</b> 3.5, 107, 109      |
| 27. Describe the importance of the mass spectrometer in determining percent composition and empirical formulas. | <b>READ:</b> 3.8                                  |
| 28. Solve problems involving limiting and excess reagents.  | <b>READ:</b> 3.6<br><b>DO:</b> 3.2, 73, 77, 81    |
| 29. Calculate percent yield using a balanced chemical equation.   | <b>READ:</b> 3.6<br><b>DO:</b> 3.86, 87, 133, 141 |

**CHAPTERS:** 4, 7.1-7.8

**NAME OF UNIT 2:** Aqueous Solutions, Quantum Theory and the Electronic Structure of Atoms

**UNIT OBJECTIVE:** To study reactions in aqueous solution. To study the quantum theory and its relationship to the structure of atoms.

**Learning Objectives**

**Recommended Learning Experiences**

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|---|---|
| 1. Calculate the molar concentration of compounds or ions.  | <b>READ:</b> 4.2<br><b>DO:</b> 4.13, 17         |
| 2. Describe how to dilute a solution and solve dilution problems  | <b>READ:</b> 4.1, 4.3<br><b>DO:</b> 4.9, 29, 33 |
| 3. Classify compounds as strong electrolytes, weak electrolytes and non-electrolytes, and distinguish between them. | <b>READ:</b> 4.4,<br><b>DO:</b> 4.39, 47        |
| 4. Write balanced molecular equations, balanced overall ionic equations, and balanced net ionic equations.          | <b>READ:</b> 4.7<br><b>DO:</b> 4.81, 83         |



5. Classify compounds as strong or weak acids, strong or weak bases, or salts. Write balanced chemical equations for the neutralization of an acid and a base. Distinguish between Arrhenius and Bronsted acids and bases.
- READ:** 4.5  
**MEMORIZE:** Table 4.4  
**DO:** 4.53, 55, 59, 61
6. Describe the analytical method of titration and solve titration problems.
- READ:** 4.6  
**DO:** 4.67, 69, 73
7. Solve problems involving precipitation and gravimetric analysis.
- READ:** 4.7  
**MEMORIZE:** Table 4.4  
**DO:** 4.85, 87
8. Define and give examples of: oxidation, reduction, oxidizing agent, reducing agent, oxidation number and half reaction.
- READ:** 4.8 (omit balancing redox reactions)  
**DO:** 4.103
9. Calculate the oxidation number of each element in a compound.
- READ:** 4.8  
**DO:** 4.101
10. Use the equations  $c = \lambda$  and  $E = h\nu$  to describe the wave properties of light.
- READ:** 7.2-3  
**DO:** 7.9, 17, 29
11. Explain Planck's quantum theory and relate it to Einstein's explanation of the photoelectric effect.
- READ:** 7.3  
**DO:** 7.37

12. Explain the origin of spectra and relate it to the quantum theory and the Bohr model of the atom **READ:** 7.4  
**DO:** 7.47
13. Calculate the energy differences between any two allowed energy states (transitions) of the electron in hydrogen. Identify the names associated with each transition **READ:** 7.4  
**DO:** 7.57, 58
14. Calculate the wavelength of a particle from its mass and velocity (De Broglie's equation). **READ:** 7.5  
**DO:** 7.63, 67
15. Describe Heisenberg's uncertainty principle and wave-particle duality **READ:** 7.5
16. Describe the quantum numbers  $n$ ,  $l$ ,  $m_l$  and  $m_s$ , and their relationship to Schrodinger's equation. Predict possible permutations of quantum numbers. Describe the importance of the Pauli Exclusion Principle **READ:** 7.6  
**DO:** 7.77, 79, 81, 83, 85
17. Describe the shapes of the s, p, and d orbitals **READ:** 7.7  
**DO:** 7.1, 142  
**READ:** 7.7
18. Explain the concepts of orbital, electron density, probability and  $\Psi^2$  as used in the quantum theory.

19. Write the orbital box diagram and the electron configuration for any atom. Predict if an atom is paramagnetic or diamagnetic

**READ:** 7.8

**DO:** 7.8, 89, 99, 101, 103

**CHAPTERS:**

7.8-12, 8, 9

**NAME OF UNIT 3:** Periodic Relationships Among Elements, Bonding, and Geometry of Molecules

**UNIT OBJECTIVE:** To study the relationship of chemical properties based on elements' positions on the periodic table and bonding theories, and to determine the shapes of molecules

**Learning Objectives**

**Recommended Learning Experiences**

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|---|---|
| 1. Describe effective nuclear charge and its impact on the valence electrons  | <b>READ</b> 7.9   |
| 2. Explain the development of the Periodic Table and how electron configurations relate to its arrangement. Use the Periodic Table to predict charges of monoatomic ions. Write electron configurations for ions. | <b>READ</b> 7.8-9   |
| 3. Explain the periodic nature of atomic radius, ionic radius, and metallic and nonmetallic behaviors.  | <b>READ:</b> 7.10<br><b>DO:</b> 7.121, 123                            |
| 4. Describe the periodic trends in ionization energy and electron affinity.   | <b>READ:</b> 7.11-12<br><b>DO:</b> 7.125, 129, 131, 133, 135          |
| 5. Determine the number of valence electrons for any atom and write its Lewis symbol.   | <b>READ:</b> 8.2<br><b>STUDY:</b> Figure 8.5<br><b>DO:</b> 8.1, 7, 35 |

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|---|--|
| 6. Write Lewis structures for molecules and ions containing covalent bonds.   | <b>READ:</b> 8.2,<br><b>DO:</b> 8.47, 49, 53, 163                          |
| 7. Be able to write Lewis structures for molecules that do not obey the octet rule.                                 | <b>READ:</b> 8.6<br><b>DO:</b> 8.105                                       |
| 8. Draw allowed resonance structures for compounds.   | <b>READ:</b> 8.4<br><b>DO:</b> 8.77, 81, 87                                |
| 9. Calculate formal charges on atoms in Lewis structures.   | <b>READ:</b> 8.5<br><b>DO:</b> 8.93, 97, 149                               |
| 10. Use electronegativity values to predict relative polarities of bonds.   | <b>READ:</b> 8.3<br><b>STUDY:</b> Table 8.6<br><b>DO:</b> 8.55, 65, 71, 73 |
| 11. Describe a covalent bond in terms of Lewis structures and describe the trend in bond length and bond stability. | <b>READ:</b> 8.7<br><b>DO:</b> 8.123, 127                                  |
| 12. Differentiate between electron-pair and molecular geometry.   | <b>READ:</b> 9.2<br><b>DO:</b> 9.3   |
| 13. Use VSEPR Theory to predict shapes of molecules.  | <b>READ:</b> 9.2   |

**MEMORIZE:** Table 9.1

**DO:** 9.21, 9.29, 9.31, 9.35

14. Predict whether a molecule has a dipole moment from its molecular geometry and electronegativities

**READ:** 9.3

**DO:** 9.47, 9.49, 9.50, 9.51, 9.57

15. Explain the concept of hybridization and its relationship to geometrical structure using valence bond theory.

**READ:** 9.4

16. Assign hybrid orbitals to an atom knowing the number and geometrical arrangement of the atoms to which it is bonded.

**READ:** 9.4

**STUDY:** Table 9.3

17. Formulate the bonding in a molecule in terms of bond overlap, sigma bonds and pi bonds.

**READ:** 9.4

**DO:** 9.65, 9.69

18. Describe molecular orbital theory in terms of atomic orbital overlap.

**READ:** 9.6

19. Explain the relationship between bonding and antibonding molecular orbitals.

**READ:** 9.6

20. Construct energy level diagrams for the molecular orbitals of diatomic molecules or ions built from elements of the first or second period and

**READ:** 9.6

**DO:** 9.11, 107, 109

predict the bond order, stability of the molecule, type of magnetism, electron configuration of the molecule, and relative bond length.

21. Use the Molecular Orbital Theory to explain delocalization. **READ:** 9.6

**CHAPTERS:** 5, 10-12

**NAME OF UNIT 4:** Gases, Liquids, Solutions, and Solids

**UNIT OBJECTIVE:** To study the three states of matter. To study the physical properties of solutions.

**Learning Objectives**

**Recommended Learning Experiences**

1. Identify how gases compare to other states of matter.

**READ:** 5.2  
**DO:**

2. Define the units of pressure: atm, mmHg, Torr, and Pa. Be able to interconvert them. Describe how barometers and manometers work.

**READ:** 5.2  
**DO:** 5.1, 5.25, 5.27, 5.37

3. Describe how a gas responds to changes in pressure, volume, temperature, and quantity of gas. Be able to do calculations involving Boyle's Law, Charles's Law, Gay-Lussac's Law, and Avogadro's Law.

**READ:** 5.3  
**DO:** 5.55, 5.57, 5.59, 5.145

4. Solve problems using the Ideal Gas Law. Use the Ideal Gas Law in problems involving molar mass, and density.

**READ:** 5.4. 5.6  
**DO:** 5.67, 5.71, 5.75, 5.89, 5.91, 5.161



5. Use the Ideal Gas Law to do calculations from balanced chemical equations (using stoichiometry). **READ:** 5.5  
**DO:** 5.77, 5.81
6. Calculate the partial pressure of any gas in a mixture using Dalton's Law. Calculate the mole fraction of the gas. **READ:** 5.7  
**DO:** 5.99, 5.108, 5.109
7. Explain the assumptions on which the Kinetic Molecular Theory is based. **READ:** 5.8
8. Describe how the distribution of speeds and the average speed of gas molecules changes with temperature. **READ:** 5.8  
**DO:** 5.121
9. Compare and contrast effusion and diffusion and their relationship with the root mean square of gases. Calculate the relative speeds of molecules using Graham's Law of Effusion **READ:** 5.8  
**DO:** 5.135
10. Describe the deviation of real gases from ideal behavior and give reasons for it. Make corrections using the van der Waals equation. **READ:** 5.9  
**DO:** 5.143, 10.11
11. Contrast intermolecular and intramolecular forces. Describe the various types of intermolecular **READ:** 10.1-3  
**DO:** 10.9, 17, 29

attractive forces and state the kinds of intermolecular forces expected for a substance given its molecular structure.

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|--|---|
| 12. Rationalize the physical states and solubilities of substances in various solvents.  | <b>READ:</b> 10.4   |
| 13. Describe the effects of temperature and pressure on solubility of gases in water.  | <b>READ:</b> 10.4   |
| 14. Explain the way in which the vapor pressure of a substance changes with intermolecular forces and temperature.                           | <b>READ:</b> 10.4<br><b>OMIT:</b> Clausius-Clapeyron Equation<br><b>DO:</b> 10.31 |
| 15. Utilize phase diagrams to predict phases and phase transitions. Define critical temperature and pressure.                                | <b>READ:</b> 10.5<br><b>DO:</b> 10.41, 43, 53, 101, 105                           |
| 16. Determine how the structure of water leads to its remarkable properties. Explain the meaning of the terms viscosity and surface tension. | <b>READ:</b> 10.6<br><b>DO:</b> 10.57, 63, 65                                     |
| 17. Understand the relationship between polarity and solubility.   | <b>READ:</b> 10.7<br><b>DO:</b> 10.71   |

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|---|--|
| 18. Describe the solubility of gases in water.  | <b>READ:</b> 10.8<br><b>DO:</b> 10.87                        |
| 19. Describe energy changes that occur in the solution process in terms of solute-solute, solvent-solvent, and solute-solvent attractive forces; describe the role of disorder in the solution process. | <b>READ:</b> 11.1-2<br><b>OMIT:</b> Born-Haber Cycle         |
| 20. Define various concentration units: percent by mass, mole fraction, molarity, and molality.   | <b>READ:</b> 4.2, 5.7, 11.5<br><b>DO:</b> 4.13, 5.108, 11.65 |
| 21. Describe the impact of adding a nonvolatile solute to a solvent on the solvent's vapor pressure. Calculate using Raoult's Law   | <b>READ:</b> 11.3<br><b>DO:</b> 11.39                        |

22. Describe the effect of solute concentration on the boiling point, freezing point, and osmotic pressure of a solution. **READ:** 11.5  
**DO:** 11.71, 73, 75
23. Explain the difference in the change in colligative properties caused by electrolytes compared to nonelectrolytes. **READ:** 11.5
24. Determine the concentration and molar mass of a nonvolatile nonelectrolyte from its effect on the colligative properties of a solution. **READ:** 11.5
25. Distinguish between crystalline and amorphous solids. **READ:** 12.1  
**DO:** 12.1
26. Classify substances as to type of solid and predict the general properties of each. **READ:** 12.1  
**STUDY:** Table 12.1
27. Determine the net contents of a cubic unit cell. Relate this information to density. **READ:** 12.2  
**DO:** 12.2, 3, 91
28. Describe packing patterns of equal size spheres. **READ:** 12.2  
**DO:** 12.8

## Department Policies:

1. Students must independently pass the Laboratory portion of the course. Passing is considered 65% or greater. Failing the laboratory portion of the course will result in an automatic Failing grade for the entire course.
2. Students who have missed 3 labs will automatically fail the Laboratory portion of the course which also means automatically failing the entire course. This also applies to fully online labs.
3. The chemistry department requires the use of Brookdale email. Upon registration all students receive a Brookdale email that remains active for months even after a student has finished courses. It is expected that all students will use their Brookdale email account or Canvas when communicating with instructors. Messages from personal email accounts will not be replied to once a class has started as it is impossible to authenticate identity.
4. Your final grade is not negotiable. Instructors will not engage in a repetitive back and forth conversation (either in person or electronically) with students at the end of or after the semester has ended. If you believe your final letter grade is in error, there is an appeals process that you can initiate a formal grade appeal.
5. The use of generative Artificial Intelligence (AI) in any chemistry course is strictly prohibited. The use of generative Artificial Intelligence will be considered a violation of Brookdale's academic integrity code and may result in severe penalties including automatic failure for the course.
6. Violations of the Academic integrity code will be prosecuted to the highest extent possible which includes the potential of an automatic failure for the course. High ethical standards are required in the Scientific, Medical, and Health Care fields and are taken very seriously. It is your responsibility to know and understand the academic integrity code; ignorance is not an excuse for an academic integrity violation. (The academic Integrity code can be found in the student handbook) ·
7. Students are at all times expected to abide by the student conduct code.
8. Students are required to either on paper or electronically acknowledge that they have reviewed both the department syllabus as well as their instructor's syllabus.
9. Students enrolled in remote or online sections are expected to have basic computer and technology equipment and skills that include but are not limited to: reliable internet, working web camera, ability to download Respondus lockdown browser and other programs, ability to save, edit, and submit documents in common file types.
10. Online students who repeat a course with a lab kit are required to have a full lab kit for the course

**Grading Standard:**

**A = 92 - 100%**

**A- = 89 - 91%**

**B+ = 86 - 88%**

**B = 82 - 85%**

**B- = 79 - 81%**

**C+ = 76 - 78%**

**C = 70 - 75%**

**D = 65 - 69%**

**F = <65%**

These grades are weighed according to course grading policy. In calculating the course grade, 0.5 will round up to the next numerical grade and 0.4 will round down to the next lower numerical grade.

**College Policies:**

As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student's disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit [www.brookdalecc.edu/support](http://www.brookdalecc.edu/support).

For information regarding:

- Academic Integrity Code
- Student Conduct Code
- Student Grade Appeal Process

Please refer to the [student handbook](#) and [catalog](#).

**Notification for Students with Disabilities:**

Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Accessibility Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

**Mental Health:**

24/7/365 Resources:

- Monmouth Medical Center Psychiatric Emergency Services at **(732) 923-6999**
- 2nd Floor Youth Helpline – Available to talk with you about any problem, distress, or hardship you are experiencing. Call or text at **888-222-2228** or visit the website at <https://www.2ndfloor.org/>

Faculty Counselors:

- Students who need to make an appointment with a faculty counselor can do so by calling 732-224-1822 (non-emergency line) during business hours. Faculty counselors are licensed mental health professionals who can assist students and refer them to other mental health resources.

**Diversity Statement:**

Brookdale Community College fosters an environment of inclusion and belonging. We promote a safe and open culture, encourage dialogue respecting diverse perspectives informed by credible sources, and uphold the virtues of civil discourse. We celebrate all identities with the understanding that ultimately, diversity, equity, and inclusion cultivate belonging and make us a stronger Brookdale community.

*\*The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arise.*