Chemistry 1411
Fall 2018

Instructor: Neil Pratt
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E-mail: np Pratt@frenship.us
Office Hours: Mon-Fri. 7:45AM -8:24AM (except Mon.) and 3:20PM – 4:30PM

Course Description
In this class, you will study the fundamental laws and theories of chemistry, chemical nomenclature, chemical equilibrium, metals and non-metals and their compounds, nuclear chemistry and the quantum theory of structure. This study will include atomic structure, chemical bonding and molecular geometry, stoichiometry, chemical nomenclature, the periodic table, properties of solutions and gases, and thermochemistry. The laboratory will be quantitative in nature.

Prerequisites: Chemistry 1411 is to be completed before Chemistry 1412. Proficiency in algebra required. Only students eligible to take college-level mathematics courses may take Chemistry 1411.

Course Implementation:
CREDIT: Four semester hours.

Concerning this excellent textbook: Each of the chapters we’ll cover contains short (1/2-1 page) articles titled “Chemical connections” concerning the influence of chemical understanding or research on society or technology. You are expected to read these, as they will at times inspire questions for your tests. Also, at year’s end, you’ll be called upon to conduct literature research and present concerning a particular advance in chemical understanding (of your choice) and its expected influence on future products, technologies, or medicine. [CR4]

Attendance Policy: You are expected to attend all class meetings. You are expected to arrive on time and to stay until the end of the lecture. If you have the flu, please stay home. Do not help spread the flu to everyone else. Keep your professor informed as to your status by email (preferred) or telephone (if necessary). Your faculty will work with you to keep up to date in the class. Students are responsible for all class work covered during absences from class, even in cases for which they are able to satisfy the instructor that the absence was unavoidable.

Angelo State University grades for this class will be assigned on the following basis:

<table>
<thead>
<tr>
<th>%</th>
<th>Grade*</th>
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<tbody>
<tr>
<td>93+</td>
<td>A</td>
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<tr>
<td>85-92.9</td>
<td>B</td>
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<tr>
<td>77-84.9</td>
<td>C</td>
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<tr>
<td>70-76.9</td>
<td>D</td>
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<tr>
<td>&lt; 70</td>
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*Dual-credit students who do not achieve at least a grade of C in each dual-credit class will not be allowed to enroll in further ASU dual-credit courses. Because of the different constraints between the two institutions, grades at Frenship may not match ASU grades.

Note: The final exam for this course will be in 2 parts – free response (December 11-12) and multiple choice (December 13-14), administered December 11-14, and cannot be exempted.
The content of this course will revolve around the following major concepts: [CR2]

**Big Idea 1:** The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.

**Big Idea 2:** Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.

**Big Idea 3:** Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.

**Big Idea 4:** Rates of chemical reactions are determined by details of the molecular collisions.

**Big Idea 5:** The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

**Big Idea 6:** Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.

The lab portion of this course will hold the student to the following standards:

**Science Practice 1:** The student can use representations and models to communicate scientific phenomena and solve scientific problems.

**Science Practice 2:** The student can use mathematics appropriately.

**Science Practice 3:** The student can engage in scientific questioning to extend thinking or to guide investigations within the context of this college-level course.

**Science Practice 4:** The student can plan and implement data collection strategies in relation to a particular scientific question. [Note: Data may be collected from many different sources, e.g., investigations, scientific observations, the findings of others, historic reconstruction, and/or archived data.]

**Science Practice 5:** The student can perform data analysis and evaluation of evidence.

**Science Practice 6:** The student can work with scientific explanations and theories.

**Science Practice 7:** The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

Your grade for this course will be calculated using the following values for assessments:

- Exams 40%
- Quizzes 25%
- Daily Work 10%
- Labs 25%

**Tests** will be comprehensive and may consist of both multiple choice and free-response questions.

**Labs** [CR5a] frequently require more time than has been allotted during the scheduled 90 minute class period. You may complete these labs during the morning activity periods (about 2 activity periods per week) prior to the start of classes for the day. You must observe all posted and stated safety rules, as well as rules of common sense and sound chemical judgment. Labs require your best attention to detail and best efforts at proper lab technique. Your thorough lab report that should include the following sections:

**Introduction/Overview** - Describes the reason/intent for the investigation and any background information related to the investigation. This is where one would lay out a hypothesis.

**Experimental Method** - Consists of a narrative of the experimental apparatus and procedure. It should be written in the third person and should describe what was done (not what one should do). The reader should be able by reading this section to perform the identical experiment in order to verify your observations and results.

**Data** - Details ALL measurements taken during the investigation. These should be recorded in a clear, neat manner that follows the sequence of the procedure. It should show calculations that were conducted using the data. Also, it should show statistical treatments of the data (e.g. % yield, % error, standard deviation) as well as helpful graphical representations. Many of these data items can be carried out in a spreadsheet (i.e. Microsoft Excel), which should be incorporated into the lab report document.

**Results/Conclusion** – Addresses whether or not (or to what extent) the data support the hypothesis. If a hypothesis was not involved, it should describe the meaning of the investigation's findings. Your completed lab reports should be saved and submitted as pdf files, in Schoology, to preserve formatting. It would be wise for you to keep a file containing electronic copies of your graded lab reports for later reference. Some universities may want to see hardcopies of these before awarding credit to you.
Quizzes may be daily and will likely consist of a question or questions similar to problems assigned for homework.

Daily problems will be assigned for nearly every class day. Many of these assignments will need to be completed online. For hardcopy problems you will earn a grade upon showing work in an orderly, legible, and logical sequence that leads to the solutions. Note that what is most important is not just whether the correct answer is supplied, but that you understand how to solve the problem and can show that you do.

Lab Safety Training All students enrolled in lab courses are required to take a Mandatory Laboratory Safety Training and Quiz on Blackboard. Instructions for completing the quiz are given at right:

1. Login to Blackboard, and choose the course: entitled “Lab Safety Training.”
2. Under the left hand menu, choose: “Get Started Here”.
3. There are three sections:
   a. Welcome to Lab Safety Training — There are your instructions.
   b. Lab safety training — Click on “Lab Safety — Click here to begin”. This will download a PowerPoint slide show which will cover the safety training.
   c. The lab safety quiz. You must score 90% or higher. You can take it again in 24 hours.

The Lab Safety Training must be completed by the evening of Sunday, September 9.

<table>
<thead>
<tr>
<th>Course Content</th>
<th>AP Chem Topics</th>
<th>Dates</th>
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<tbody>
<tr>
<td>I. Review of groups and periods- names and sections on the periodic table</td>
<td>None</td>
<td>Aug. 20-27</td>
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<tr>
<td>II. Chemical Nomenclature writing names from the formulas and vice versa (Problems 2.71-2.87, 2.95) (2 periods)</td>
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<tr>
<td>A. Naming ionic compounds – polyatomic ions, when to use Roman numerals, writing formulas for neutral compounds</td>
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<td>B. Naming covalent compounds – prefixes</td>
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<td>C. Naming acids by converting the names of the appropriate anions</td>
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<tr>
<td>D. Naming of simple organic compounds – alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, organic acids, ethers, esters</td>
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<tr>
<td>(Lab 1 – Determination of KOH concentration via titration of various HCl solutions– intro to quantitative analysis – Guided Inquiry.)</td>
<td>BI 1, BI 2, BI 3</td>
<td>Aug. 28-Sept 5</td>
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<tr>
<td>(1 period) LO 1.17, 1.20, 3.9, SP 2.1, 4.2.5.1</td>
<td>[CR3a], [CR3b], [CR3c]</td>
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<tr>
<td>III. Atomic Theory of Matter, Stoichiometry, and Chemical Calculations (11 periods)</td>
<td>BI 1</td>
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<tr>
<td>A. Mole concept, atomic number, atomic mass (including isotopes), molar mass Problems 3.23-3.25, 3.37-3.47</td>
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<tr>
<td>B. Dalton and the laws of definite and multiple proportions - percent composition, empirical formulas, molecular formulas Problems 2.17-2.23, 2.35-2.43; Problems 3.27-3.35, 3.49-61, 3.73-89, 4.123</td>
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<tr>
<td>[LO 1.2 Select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures.</td>
<td>BI 1</td>
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</table>
LO 1.3 Select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance.

**Activity:** Students solve various problems from the book, class worksheets, and online electronic assignments. Provided data concerning mass percent composition of samples and experimentally determined molar masses, students determine both the empirical and molecular formulas of various compounds. [CR3a]

c. Lavoisier and the law of conservation of mass – balancing equations

[ LO 3.3 The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or to analyze deviations from the expected results.

**Activity:** Student pairs solve problems in class. Given data concerning the composition of sample of dolomite, students must calculate the expected mass loss upon thermal decomposition at temperatures that could be attainable with a Bunsen burner as the heat source. [CR3c]

D. Limiting reagent and percent yield Problems 3.105, 3.111-3.123
E. Solution concentration units – molarity, molality, percentage mass/volume and volume/volume – precision glassware and how to prepare solutions of given concentrations.

**Problems 4.23-4.39**

Exam 1 – units and dimensional analysis, significant figures, naming (ionic, covalent, organic and acids), percent composition, empirical and molecular formulas, limiting reagent, percent yield, molarity, molality, atomic number and mass implications, identification and appropriate choice of precision glassware, conversions between grams, moles, and/or particle amounts,

Comprehensive Pretest

*(Lab 2 – Hydrates and thermal decomposition - – Expt.7 in lab manual - Guided Inquiry -) (2 periods) LO 3.5 SP 2.1, 4.2 [CR5] [CR6]*

IV. The Structure of an Atom *(5 periods)*

A. The photoelectric effect and photoelectron spectroscopy (PES). Methods and evidence for the various models of atomic structure. J.J. Thomson, Rutherford, the Rydberg equation (Lyman, Balmer, Paschen, Brackett, and Pfund series for hydrogen), the Bohr model, de Broglie.

**Problems 2.45-2.47, 7.19-7.29, 7.39-7.63, 7.99**
(Lab 3 - Determining atomic emission by spectroscopy) (1 period) LO 1.16, 3.11 SP 1.5, 2.2, 5.1 5.3, 6.1, 7.1, 7.3 [CR5] [CR6]

1. Ionization energy, electron affinity, and atomic and ionic radii Problems 7.31, 7.105, 7.115-7.119, 7.147-7.151, 7.165
2. Rationalization of periodic trends via Coulomb’s law

3. Orbital shapes and properties as predicted by Schrodinger’s equations and confirmed by evidence.

Exam 2 – photoelectron spectroscopy, energy associated with atomic absorption and emission, Coulomb’s law justifications for periodic trends for ionization energy, electron affinity, atomic and ionic radii, electron affinity, Bohr diagrams, electron configuration, orbital filling diagrams

(Lab 4 – Energy Levels and Electron Transitions – Expt. 1 in lab manual - Spectrophotometric analysis of copper(II) and nickel(II) salt solutions. Extended to require students to relate absorbance data to energy of electron transitions.) (1 period) LO 1.16, SP 2.1-3, 5.1-3 [CR5] [CR6]

B. Trend of nuclear stability; nuclear equations, half-lives, radioactivity and chemical applications of radioisotopic analysis Problems 19.11-19,23

(Lab 4 - The Percentage of Copper in Brass, a colorimetric determination – Expt. 8 in lab manual - Guided Inquiry.) (2 period) LO 1.16, SP 4.2, 5.1 [CR5] [CR6]

V. Types of Chemical Reactions (4 periods)

A. Synthesis and decomposition reactions Problems 3.97, 3.103, 3.107, 4.45-4.63

(Lab 6 – Identifying six ionic solutions by their reactions with each other – and writing equations in molecular, ionic, and net ionic forms.) (1 period) LO 2.23, 2.24, 3.2 SP 4.1, 5.1, 6.1 [CR5] [CR6]

B. Redox reactions Problems 4.79-4.87

1. Oxidation number and the half reaction method for solving redox reactions
2. Electron transfer

(Lab 7 - Analysis by Oxidation-Reduction Titration – Expt. 8 in lab manual - Guided Inquiry.) (1 period) LO 3.9, SP 4.2, 5.1 [CR5] [CR6]
Exam 3 – trend of nuclear stability, nuclear equations, Beer-Lambert law and spectrophotometry, solubility rules and predicting the products of ionic reactions, redox reactions

--- Insertion --- Le Chatelier’s principle and equilibrium constant expressions

3. Electrochemistry: Galvanic and electrolytic cells, standard reduction potentials, standard cell potentials, predicting the direction and rate of electron transfer Problems 18.29-31, 35-55, 67-73

C. Acid-base chemistry Problems 4.65
1. Arrhenius, Bronsted-Lowry and Lewis definitions and amphotericism
2. Acid and base strength
3. pH
4. pH of aqueous solutions of strong acids and strong bases
5. pH of aqueous solutions of weak acids and weak bases

Exam 4 – Le Chatelier’s principle, electrochemical cells, acid and base definitions, strong vs. weak acids and bases, pH of solutions of strong acids and bases

VI. Thermodynamics (6 periods)

A. Specific heat, heat capacity, and calorimetry Problems 6.51-61, 67.

(Lab 8 – Analysis by Calorimetry – Expt. 12 in lab manual - Guided Inquiry.) (1 period) LO 5.7, SP 4.2, 5.1 [CR5] [CR6]

B. State functions Problems 6.13
C. 1st law of thermodynamics – change in enthalpy, heats of: formation, reaction, vaporization and fusion; Hess’s law Problems 6.13-21, 29-39, 41-49

(Lab 9 – Hess’ law determination of the molar enthalpy for the rxn. of NaOH with HCl.) (1 period) LO 5.4, 5.5, 5.7, 5.8 SP 2.1, 2.2, 4.1, 4.2, 4.3 [CR5] [CR6]

D. 2nd law of thermodynamics - entropy, free energies of formation and reaction; dependence of Gibbs free energy on enthalpy and entropy changes Problems 17.11-61

[LO 5.13 The student is able to predict whether or not a physical or chemical process is thermodynamically favored by determination of (either quantitatively or qualitatively) the signs of both $\Delta H^\circ$ and $\Delta S^\circ$, and calculation or estimation of $\Delta G^\circ$ when needed.
**Activity:** Students solve various problems from the book, class worksheets, and online electronic assignments. Given data concerning heat gained or lost during a particular reaction and given the balanced equation for the reaction, students calculate the enthalpy change per mole of given reactants. Coupling the enthalpy changes thus determined with entropy change data (from tables) students calculate the free-energy change for each reaction.\[^{CR3e}\]

<table>
<thead>
<tr>
<th>VIII. Chemical Bonds and Molecular Structure (6 periods)</th>
<th>BI 2</th>
<th>Nov.16, 26</th>
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<tbody>
<tr>
<td>A. Electronegativity differences Problems 8.1</td>
<td>[CR3b]</td>
<td>Nov.27-30</td>
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<tr>
<td>B. Relating ionic, covalent and metallic bond characteristics to the periodic table Problems 8.15-39</td>
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<td>Dec.3-4</td>
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<tr>
<td>C. Lewis structures and valence bond theory: formal charge, VSEPR, hybridization of orbitals (including expanded octets), resonance, sigma and pi bonds Problems 8.81-8.91, 8.99-8.121, 9.17-29, 9.39</td>
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<tr>
<td>D. Molecular orbital theory</td>
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<tr>
<td>E. Intermolecular forces of attraction – hydrogen bonds, ion-dipole, dipole-dipole, London dispersion forces – and their effects on physical properties</td>
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<tr>
<th>VII. Gases (5 periods)</th>
<th>BI 2</th>
<th>Dec.5-6</th>
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<tbody>
<tr>
<td>A. Boyle’s law, Charles law, Gay-Lussac law and the ideal gas law with its assumptions Problems 5.23-5.31, 5.37, 5.43-5.75</td>
<td>[CR3b]</td>
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<tr>
<td>B. Dalton’s law of partial pressures Problems 5.117</td>
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<tr>
<td>C. Kinetic molecular theory Problems 5.30, 32, 33</td>
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<tr>
<td>1. Avogadro’s hypothesis concerning molar volume of a gas</td>
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<tr>
<td>2. Dependence of molecular kinetic energy on absolute temperature Problems 5.101-5.113</td>
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<tr>
<td>3. Non-ideal behaviors of real gases and the conditions under which they are observed. Problems 5.33-35</td>
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*(Lab 10 – Testing Charles’s law.)* (1 period) LO 2.5, 2.12 SP 2.1, 2.2, 2.3 [CR5] [CR6]

|  |  |  |
|  |  | Dec.7-10 |
### Topics for final exams

- **Units and dimensional analysis**, **significant figures**, **naming** (ionic, covalent, organic, and acids), **percent composition**, **empirical and molecular formulas**, **limiting reagent**, **percent yield**, **molarity**, **molality**, **% w/v**, **ppm**, **ppb**, **atomic number and mass implications**, **identification** and appropriate **choice** of precision glassware, **conversions** between grams, moles, and/or particle amounts, photoelectron spectroscopy, **energy** associated with atomic absorption and emission, Coulomb's law justifications for periodic trends for ionization energy, electron affinity, atomic and ionic radii, electron affinity, Bohr diagrams, electron configuration, orbital filling diagrams, trend of nuclear stability, nuclear equations, Beer-Lambert law and spectrophotometry, solubility rules and predicting the products of ionic reactions, redox reactions, Le Chatelier’s principle, electrochemical cells, Nernst equation, acid and base definitions, strong vs. weak acids and bases, **pH** of solutions of strong acids and bases, ionic, covalent, and polar covalent bonds, formal charge, VSEPR predictions for numbers and types of bonds and for molecular geometry, **specific heat capacity and calorimetry**, **enthalpy**, **entropy**, **standard free energy**, Hess’ law, predicting “spontaneity,” ideal gas law assumptions,

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**Exam 5 – Free response - Comprehensive Final Exam**

**Exam 6 – Multiple choice – Comprehensive Final Exam**

**FHS Semester final exam – comprehensive (1 period)**

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### Student Learning Outcomes 1411.1412

**Learning Goal 1:** Students will be able to analyze complex chemical problems and draw logical conclusions.

- Students will be able to use an understanding of atomic structure at the basic and atomic levels to analyze the structure and reactivity of substances and chemical species.
- Students will be able to use an understanding of how energy interacts with matter to predict stable chemical species, and perform thermodynamic calculations describing chemical reactions.

**Learning Goal 2a:** Students will be able to understand and apply scientific reasoning in the chemical sciences.

- Students will be able to use an understanding of ions and molecules at the atomic level to predict the behavior of reactions in aqueous solutions.
- Students will be able to use the basic ideas of quantum mechanics to describe how molecular bonds form and to predict molecular shape and polarity. Molecular structure and polarity will be used to predict the forces between molecules and relate those forces to the states of matter and phase changes.
Learning Goal 2b: Students will be able to employ mathematics in the analysis of chemical problems.
   The mole concept, chemical formulas and balanced chemical equations will be used to do chemical calculations that relate macroscopic measurements to numbers of atoms, ions or molecules.
   Students will be able to do calculations involving solution concentration and know how to prepare solutions of given concentrations.
   Students will be able to quantitatively predict gas properties using gas law calculations.

Learning Goal 3: Students will be able to demonstrate technical and analytical skills in chemistry.
   Students will be able to use the periodic table to determine basic atomic information and to predict trends in atomic properties.
   Students will be able to interconvert between chemical names and formulas to the extent that they can work problems given only one of those pieces of information.
   Students will be able to classify common types of chemical reactions and predict the outcomes of reactions.

Evaluation of Student Learning Outcomes
Student learning outcomes will be evaluated by test questions or by the grading of in-classroom activities, as described by your instructor.

Texas Higher Education Coordinating Board Natural Sciences Objectives
The objective of the study of a natural sciences component of a core curriculum is to enable the student to understand, construct, and evaluate relationships in the natural sciences, and to enable the student to understand the basis for building and testing theories.

Exemplary Educational Objectives
1. To understand and apply method and appropriate technology to the study of natural sciences.
2. To recognize scientific and quantitative methods and the differences between these approaches and other methods of inquiry and to communicate findings, analyses, and interpretation both orally and in writing.
3. To identify and recognize the differences among competing scientific theories.
4. To demonstrate knowledge of the major issues and problems facing modern science, including issues that touch upon ethics, values, and public policies.
5. To demonstrate knowledge of the interdependence of science and technology and their influence on, and contribution to, modern culture.

Student Disability Services
ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA), and subsequent legislation.

The Office of Student Affairs is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability, and it is the student’s responsibility to initiate such a request by contacting:

Ms. Dallas A. Swafford Director of Student Disability Services
325-942-2047
dallas.swafford@angelo.edu
Houston Harte University Center
Title IX Statement

Angelo State University is committed to the safety and security of all students. If you or someone you know experience sexual harassment, sexual assault, domestic or dating violence, stalking, or discrimination, you may contact ASU’s Title IX Coordinator:

Michelle Nicole Boone, J.D.
Director of Title IX Compliance
Michelle.boone@angelo.edu
325-486-6357
Mayer Administration Building 204

Student Absence for Observance of Religious Holy Days

A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day for more information.

Incomplete Grade Policy

It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 Grading Procedures for more information.

Student Conduct Policies

Academic Integrity

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject of disciplinary action and possible expulsion from ASU.

Plagiarism

Plagiarism is a serious topic covered in ASU’s Academic Integrity policy in the Student Handbook. Plagiarism is the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own.

Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality via Turnitin. Resources to help you understand this policy better are available at the ASU Writing Center.

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