THE
UNIVERSITY
OF
TEXAS
AT TYLER

Dr. Jason Smee

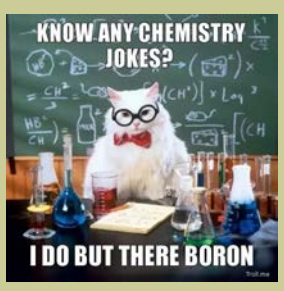
Contact Info

- jsmee@uttyler.edu
- 903.566.7069
- RBS 3030

Office Hours

- MWF 10:30-11:30
- TR 9-10 am
- and by appointment
- Zoom link to office hours (please email in advance if meeting by Zoom so I can get my Zoom up and running)

Inside the Syllabus

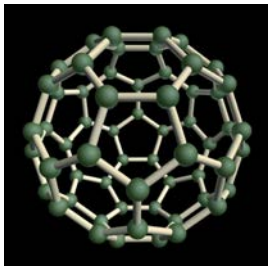


CHEM 4330.001Adv. Inorganic Chemistry

Syllabus—Fall 2024 **RBS 2015, MWF 9:05—10:00 AM**

Course Description

This course will focus primarily on symmetry and group theory, molecular orbital theory, acid-base theories, electronic spectroscopy of transition metals, organometallic chemistry and catalysis, metal-metal bonds, the isolobal analogy and cluster compounds, and bioinorganic chemistry.

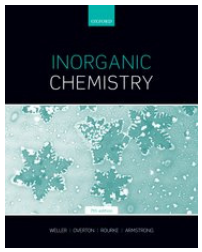


"...To awaken an interest in chemistry in students we mustn't make the courses consist entirely of explanations, forgetting to mention what there is to be explained."

~Linus Pauling (Nobel Prize winning chemist)

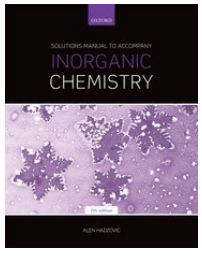
In other words, we did not "lie" to you in General Chemistry and subsequent courses, it's that we did not tell you the whole story because you didn't have the tools to understand the nitty gritty details. We will learn some of those "tools" in this class!

Required & Recommended Materials

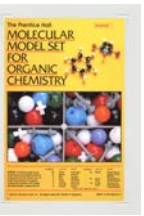


The **recommended** text: *Inorganic Chemistry* 7/e by Weller et al. ISBN-13: 9780198768128

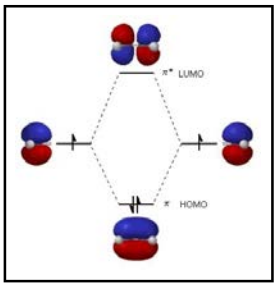
A scientific calculator (capable of exponents and logarithms) is **required**.



Solutions Manual to Accompany Inorganic Chemistry 6/e is **recommended**, but not required. ISBN-13: 9780198814689.
All assignments are written by Dr. Smee. No Achieve codes are required nor will any end-of-chapter problems be assigned



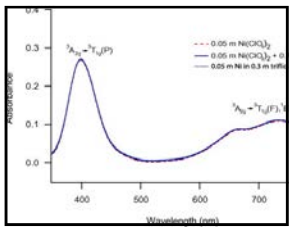
An organic/inorganic model kit (see example at left) is **recommended**, but not required. The kit should have a minimum of two six-coordinate atoms.



The molecular orbital diagram showing the pi bonding and antibonding interactions in a molecule of ethylene.

"The mathematical sciences particularly exhibit order, symmetry, and limitation; and these are the greatest forms of the beautiful."

~Aristotle (philosopher)



Visible electronic spectrum of $Ni^{2+}(aq)$ with the two major peaks labeled according by the symmetry of the allowed transition. A third peak, arising from the third allowed transition, is too low in energy to be seen in this spectrum.

Student Learning Outcomes

By the end of this course, students should be able to

1) apply group theory concepts to a variety of chemical topics,
2) prepare and analyze molecular orbital diagrams for simple compounds,
3) demonstrate a mastery of the basic concepts of electronic spectroscopy,
4) recognize common ligands and reactions in organometallic chemistry,
5) use Wade's rules to classify metal carbonyl and main group clusters, and
6) describe specific examples/applications of bioinorganic chemistry.

Course Requirements

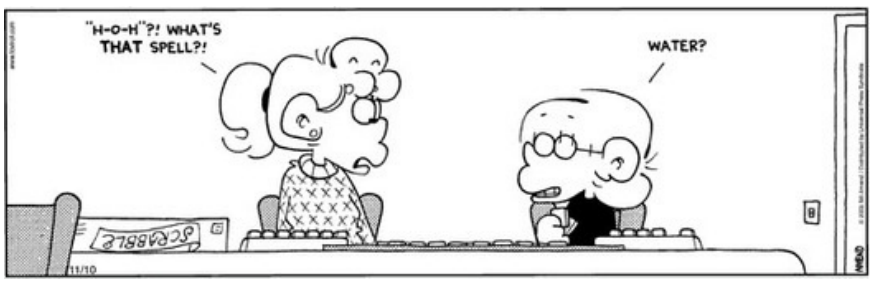
1) CHEM 3320/3121 (Inorganic Chemistry and Lab) is a pre-requisite
2) CHEM 3344/3145 (Organic Chemistry II and Lab) is a pre-requisite
3) Class meets MWF from Aug 26 — Dec 6 (except Labor Day, Sept 2, and during Thanksgiving week, Nov 25—29). Attendance **will be taken** and class participation will be sought throughout the semester in various forms to nurture student communication and presentation skills. Participation will not be graded *per se*, but will be taken into account in the final grade.
4) You must take the final exam in order to pass the class. You will the second-semester, standardized, inorganic ACS exam on **December 9 (Mon) 8 – 10 am.**

Canvas

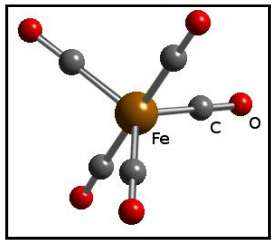
I will utilize Canvas to post the following items

1) syllabus
2) lecture notes
3) grades (the Excel file on my desktop PC is the official grade book)
4) homework assignments
5) links to interesting websites

I recommend that you are set to receive notifications daily.



Homework



Pentcarbonyliron(0) or $[Fe(CO)_5]$. A common organometallic compound that is the classical example of the Berry mechanism of pseudo-rotation.

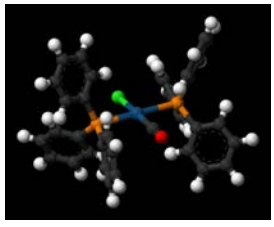
1) Homework counts for 20% of your overall grade.
2) Paper assignments for each chapter will be assigned during the semester. There will be some short, in-class, group assignments too.
3) Due dates will be posted on Canvas.
4) A penalty of 5 percentage points will be deducted each day for all problems not completed by the due date.
5) Please don't wait until the night before to start on your homework because some of the topics simply cannot be mastered overnight.

Exams

"There's so much plastic in this culture that vinyl leopard skin is becoming an endangered synthetic."

~Lily Tomlin (comedienne/ actress)

1) Four exams will be given during class time and are collectively worth 60% of your overall grade. They will be mostly short answer/calculation questions and some multiple choice.
2) The final exam will be a standardized ACS exam. It will cover material from Inorganic Chemistry and even a little Gen Chem too! ☺
3) Missed exams due to an unexcused absence will result in a grade of zero. In the event of an excusable situation, please give me at least two days' notice (if possible) to schedule an alternate time.
4) Cell phones, smart watches, and any similar electronic devices must be turned off and put away during exams. If they observed out in a visually accessible place (i.e. between legs, on the floor, etc.), it will be assumed that they are being used to cheat; your exam will taken away, you will receive a zero score (0 points) for the test, and you will be referred to the Office of Judicial Affairs.



The $[IrCl(CO)(PPh_3)_2]$ complex, Vaska's complex, is used as a catalyst in many homogeneous catalytic reactions due to its tendency to undergo oxidative-addition.

Grading

In-class exams	60%
Cumulative final exam	20%
Homework	20%*
Total	100%**

*The homework grade shown on Canvas will be the cumulative percentage score for all of your homework assignments.

**Grades will be tentatively based on a 90/80/70 scale, but they may be adjusted based upon my evaluation of the class's overall performance.

Important Dates (exam dates and the material on exams are tentative)

- September 2 (Monday): Labor Day – no classes
- September 9 (Friday!): Census date – grade replacement, add, drop without a W
- **September 30 (Monday): Exam 1 (Chapters 3A and 3B)**
- **October 1 (Tuesday): FINAL deadline for Fall graduation**
- **October 21 (Monday): Exam 2 (Chapters 20B and 20C)**
- **November 4 (Monday): Last day to drop with a "W"**
- **November 11 (Monday): Exam 3 (Chapters 22A, 22B, and 25)**
- November 25—29 (Mon—Fri): Thanksgiving holiday – no classes
- **December 4 (Wednesday): Exam 4 (Chapters 22C and 26)**
- **December 9 (Monday): FINAL EXAM 8:00–10:00 am (day/time is negotiable)**

Topics to Be Covered (listed by chapter in the textbook)

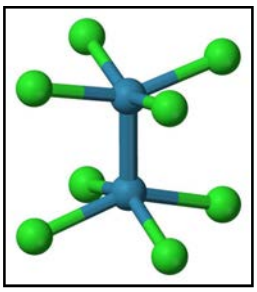
- Symmetry and Group Theory: Chapter 3.1 – 3.5, 3.9 + handouts (Chapter 3A)
- Molecular Orbital Theory: 3.6, 3.7, 3.10 + handouts (Chapter 3B)
- Electronic Structure: Chapter 20.2 + handouts (Chapter 20B)
- Electronic Spectroscopy: Chapter 20.2 – 20.7 (Chapter 20C)
- Intro to Organometallics: Chapter 22.1 – 22.19 + handouts (Chapter 22A)
- Organometallic Reactions: Chapter 22.21 – 22.26 + handouts (Chapter 22B)
- Catalysis: Chapter 25.1 – 25.15, 25.18 + handouts (Chapter 25)
- M-M Bonds, Clusters, Isolobality: Chapter 22.20 + handouts (Chapter 22C)
- Bioinorganic Chemistry: Chapter 26.1 – 26.14 (Chapter 26)
- Lanthanides/Actinides (time permitting): Chapter 23.1 – 23.13 (Chapter 23)

Classroom Courtesy

- Be as quiet as possible if arriving late or leaving early.
- Silencing all cell phones, pagers, iPods, etc. during class.
- Do not text or call during class. Please leave quietly if you must do either.
- Use electronic devices for taking notes, not doing homework or playing games.
- Refrain from derogatory remarks and profanity in class.
- Do not talk during class presentations or over top of another person during discussions. The room is designed for sound to travel; you are not as quiet as you think when you whisper in class.

Email Policy

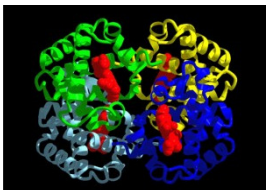
- I will respond to email regularly throughout normal business hours.
- After hours and on week-ends I will respond as my life activities allow. Please don't expect responses to email sent after 11 pm until at least 9 or 10 am the next day.



The $[Re_2Cl_8]^{2-}$ ion. The first quadruple-bonded species characterized by X-ray crystallography.

"I try to show the public that chemistry, biology, physics, astrophysics is life.

~Neil deGrasse Tyson (physicist)



Hemoglobin tetramer (For clarity, the heme groups are shown in red.) One of many important examples of bio-inorganic chemistry!

TENTATIVE SCHEDULE

Week	Day	Topic
	M (8/26)	Syllabus, talk about course in general
1	W (8/28)	Start Chapter 3A (Molecular Symmetry); Symmetry definitions, start w/ symmetry operations
	F (8/30)	**3A**: Finish symmetry operations, start point groups
	M (9/2)	Labor Day—no classes
2	W (9/4)	**3A**: Finish point groups, practice identifying point groups common objects
	F (9/6)	**3A**: Practice identifying point groups of molecules
	M (9/9)	**3A**: Symmetry vs geometry, symmetry and polarity, symmetry and chirality, transformation matrices ***Census Date***
3	W (9/11)	**3A**: Finish transformation matrices, characters, character tables, practice getting information from character tables
	F (9/13)	**3A**: Symbols used in character tables, orthogonality
	M (9/16)	**3A**: Intro to molecular motions, degrees of freedom, reducible representations, reducing reducible representations
4	W (9/18)	**3A**: Selection rules for IR and Raman spectroscopies, assigning vibrational bands as IR or Raman, predicting bands from symmetry
	F (9/20)	Start Chapter 3B (MO Theory); Review basic MO theory from Inorganic Chem; requirements for orbital overlap, orbital mixing
	M (9/23)	**3B**: Photoelectron Spectroscopy, heteronuclear diatomics, SALCS, start MO diagram of NH_3
5	W (9/25)	**3B**: Finish MO diagram of NH_3, look at MO diagram with out atom *p* orbitals involved, hybrid orbitals and expanded octets
	F (9/27)	Start 20B (Electronic Structure); Ligand Field Theory (MO approach to Crystal Field Theory)
	M (9/30)	**Exam 1 (Ch 3A and part or all of Ch 3B), ***Tues Oct 1—last day to file for Fall 2024 graduation***
6	W (10/2)	**20B**: Finish Ligand Field Theory, Angular Overlap Method
	F (10/4)	Start 20C (Electronic Spectra), Spectroscopic Terms and coupling
	M (10/7)	**20C**: Term symbols and practice identifying ground state term symbols
7	W (10/9)	**20C**: Which coupling to use, spectra of complexes, molecular term symbols, orbital occupation symmetry
	F (10/11)	**20C**: Tanabe-Sugano diagrams, non-crossing rule, identifying ground and excited states, hole formalism, Δ_o from T-S diagrams
	M (10/14)	**20C**: Jahn-Teller, charge transfer, selection rules, luminescence
8	W (10/16)	Start 22A (Organometallic Chemistry); Intro to Organometallics, 18-electron rule, LXZ method, Donor Pair method of e^- counting
	F (10/18)	**22A**: electron counting miscellany, CO as a ligand and reporter on relative electron density on metals
	M (10/21)	**Exam 2 (Ch 20B and 20C)**
9	W (10/23)	**22A**: PR_3 as a ligand, cone angle/percent buried volume, dihydrogen and hydride as ligands, C as ligand, aromatic ligands
	F (10/25)	**22A**: Cumulenes, polyenes/polyenes as ligands, agostic interactions, N_2 and NO as ligands, metal carbonyls, IR spectroscopy
	M (10/28)	**22A**: Metallocenes, fluxional behavior, fullerene complexes; Start 22B (Organometallic Reactions); dissociation, OA and RE
10	W (10/30)	**22B**: Finish RE, σ bond metathesis, insertion, hydride elimination, abstraction; Start 25 (Catalysis); definitions, olefin metathesis
	F (11/1)	**25**: Hydrogenation, hydroformylation, Wacker process, asymmetric oxidation, methanol cabonylation
	M (11/4)	**25**: Deuteration, heterogeneous catalysis: hydrogenation, cracking/isomerization, Ziegler Natta ***Last day to drop w/ a W***
11	W (11/6)	Start 22C (M-M bonds, Borane and Carbonyl Clusters, Isolobality); M-M bonds, main group elements w/quadruple bonds
	F (11/8)	**22C**: Boron clusters, 3-center-2-electron bonds, semitopological diagrams
	M (11/11)	**Exam 3 (Ch 22A, 22B, and 25)**
12	W (11/13)	**22C**: Wades Rules, Alternate Wade's Rules, *mno*(*p*) Rule
	F (11/15)	**22C:** Wade-Mingos-Lauher Rules, carbon with 5+ bonds, introduce isolobal analogy
	M (11/18)	**22C**: Extensions of the isolobal analogy, applications of isolobality
13	W (11/20)	Start 26 (Bioinorganic Chemistry); background, biological ligands, Zn transcription, iron transport, myoglobin, hemoglobin
	F (11/22)	**26**: O_2 transport, electron transfer, hydrolytic enzymes, isomerases, redox proteins, vitamin B12, O atom transfer, N_2ase
14	11/25-11/29	**Thanksgiving Week—no classes**
	M (12/2)	**26**: N_2O reductase, H_2ase, Cu transport/storage, nitrile hydratase, urease, SOD, lanthanide dependent MeOH dehydrogenase
15	W (12/4)	**Exam 4 (Ch 22C and 26)**
	F (12/6)	Review for final exam
16	M (12/9)	**Final Exam, 8—10 am, RBS 2015**

University Policies and Information (Last Update – 5/30/2024)

Withdrawing from Class

Students may withdraw (drop) from this course using the Withdrawal Portal. Withdrawing (dropping) this course can impact your Financial Aid, Scholarships, Veteran Benefits, Exemptions, Waivers, International Student Status, housing, and degree progress. Please speak with your instructors, consider your options, speak with your advisor, and visit the One-Stop Service Center (STE 230) or email enroll@uttyler.edu to get a complete review of your student account and the possible impacts to withdrawing. We want you to make an informed decision. UT Tyler faculty and staff are here for you and often can provide additional support options or assistance. Make sure to carefully read the implications for withdrawing from a course and the instructions on using the Withdrawal portal.

Texas law prohibits students from dropping more than six courses during their entire undergraduate career.* The six courses dropped include those from other 2-year or 4-year Texas public colleges and universities. Consider the impact withdrawing from this class has on your academic progress and other areas, such as financial implications. We encourage you to consult your advisor(s) and Enrollment Services for additional guidance. CAUTION #1: Withdrawing before census day does not mean you get a full refund. Please see the Tuition and Fee Refund Schedule. CAUTION #2: All international students must check with the Office of International Programs before withdrawing. All international students are required to enroll full-time for fall and spring terms. CAUTION #3: All UT Tyler Athletes must check with the Athletic Academic Coordinator before withdrawing from a course. CAUTION #4: All veterans or military-affiliated students should consult with the Military and Veterans Success Center.

*Students who began college for the first time before 2007 are exempt from this law.

Artificial Intelligence Statement

UT Tyler is committed to exploring and using artificial intelligence (AI) tools as appropriate for the discipline and task undertaken. We encourage discussing AI tools' ethical, societal, philosophical, and disciplinary implications. All uses of AI should be acknowledged as this aligns with our commitment to honor and integrity, as noted in UT Tyler's Honor Code. Faculty and students must not use protected information, data, or copyrighted materials when using any AI tool. Additionally, users should be aware that AI tools rely on predictive models to generate content that may appear correct but is sometimes shown to be incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research. You are ultimately responsible for the quality and content of the information you submit. Misusing AI tools that violate the guidelines specified for this course is considered a breach of academic integrity. The student will be subject to disciplinary actions as outlined in UT Tyler's Academic Integrity Policy. Refer to the About This Course section of the UT Tyler Syllabus Module for specific information on appropriate use of AI in your course(s), or see below.

For this course, you can use AI programs (ChatGPT, Copilot, etc.) for exam preparation (e.g., generating flashcards and sample test questions). Be aware that in cases where information provided by AI conflicts with the lecture material, the lecture material will take priority. You will NOT be permitted AI on exams. Remember, AI does make mistakes, so I recommend the "trust but verify" policy when it comes to using AI.

Final Exam Policy

Final examinations are administered as scheduled. If unusual circumstances require that special arrangements be made for an individual student or class, the Dean of the appropriate college, after consultation with the faculty member involved, may authorize an exception to the schedule. Faculty members must maintain student final examination papers for a minimum of three months following the examination date.

Incomplete Grade Policy

If a student, because of extenuating circumstances, is unable to complete all the requirements for a course by the end of the semester, then the instructor may recommend an Incomplete (I) for the course. The "I" may be assigned in place of a grade only when all of the following conditions are met: (a) the student has been making satisfactory progress in the course; (b) the student is unable to complete all coursework or final exam due to unusual circumstances that are beyond personal control and are acceptable to the instructor, and (c) the student presents these reasons before the time that the final grade roster is due. The semester credit hours for an Incomplete will not be used to calculate the grade point average.

The student and the instructor must submit an Incomplete Form detailing the work required and the time by which the work must be completed to their respective department chair or college dean for approval. The time limit established must not exceed one year. Should the student fail to meet all the work for the course within the time limit, then the instructor may assign zeros to the unfinished work, compute the course average for the student, and assign the appropriate grade. If a grade has yet to be assigned within one year, then the Incomplete will be changed to an F, or NC. If the course was initially taken under the CR/NC grading basis, this may adversely affect the student's academic standing.

Grade Appeal Policy

Disputes regarding grades must be initiated within sixty (60) days from the date of receiving the final course grade by filing a Grade Appeal Form with the instructor who assigned the grade. A grade appeal should be used when the student thinks the final course grade awarded does not reflect the grades earned on assessments or follow the grading scale as documented in the syllabus. The student should provide the rationale for the grade appeal and attach supporting document about the grades earned. The form should be sent via email to the faculty member who assigned the grade. The faculty member reviews the rationale and supporting documentation and completes the instruction section of the form. The instructor should return the form to the student, even if a grade change is made at this level. If the student is not satisfied with the decision, the student may appeal in writing to the Chairperson of the department from which the grade was issued. In situations where there is an allegation of capricious grading, discrimination, or unlawful actions, appeals may go beyond the Chairperson to the Dean or the Dean's designee of the college from which the grade was issued, with that decision being final. The Grade Appeal form is found in the Registrar's Form Library.

NOTE: The Grade Appeal Form is different from the Application for Appeal form submitted to the Student Appeals Committee, which does not rule on grade disputes as described in this policy.

University Policies and Information (cont.)

Disability/Accessibility Services

In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA), the University of Texas at Tyler offers accommodations to students with learning, physical, and/or psychological disabilities. If you have a disability, including a non-visible diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or a history of modifications or accommodations in a previous educational environment, you are encouraged to visit https://hood.accessiblelearning.com/UTTyler/ and fill out the New Student application. The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with the Assistant Director Student Accessibility and Resources/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at https://www.uttyler.edu/disability-services, the SAR office located in the Robert Muntz Library, LIB 460, email saroffice@uttyler.edu, or call 903.566.7079.

Military Affiliated Students

UT Tyler honors the service and sacrifices of our military-affiliated students. If you are a student who is a veteran, on active duty, in the reserves or National Guard, or a military spouse or dependent, please stay in contact with your faculty member if any aspect of your present or prior service or family situation makes it difficult for you to fulfill the requirements of a course or creates disruption in your academic progress. It is important to make your faculty member aware of any complications as far in advance as possible. Your faculty member is willing to work with you and, if needed, put you in contact with university staff who are trained to assist you. The Military and Veterans Success Center (MVSC) has campus resources for military-affiliated students. The MVSC can be reached at MVSC@uttyler.edu or via phone at 903.565.5972.

Students on an F-1 Visa

To remain in compliance with Federal Regulations requirements you must do the following:

- Traditional face-to-face classes: Attend classes on the regular meeting days/times.
- Hybrid Classes: Attend all face-to-face classes convened by the instructor according to the schedule set for your specific course.
- Online course: Only one online course can count toward your full-time enrollment. Students are expected to be fully engaged and meet all requirements for the online course.

Academic Honesty and Academic Misconduct

The UT Tyler community comes together to pledge that "Honor and integrity will not allow me to lie, cheat, or steal, nor to accept the actions of those who do." Therefore, we enforce the Student Conduct and Discipline policy in the Student Manual Of Operating Procedures (Section 8).

FERPA

UT Tyler follows the Family Educational Rights and Privacy Act (FERPA) as noted in University Policy 5.2.3. The course instructor will follow all requirements to protect your confidential information.

Absence for Official University Events or Activities

This course follows the practices related to Excused Absences for University Events or Activities as noted in the Catalog.

Absence for Religious Holidays

This course follows the practices related to Excused Absences for Religious Holy Days as noted in the Catalog.

Absence for Pregnant Students

This course follows the requirements of Texas Laws SB 412, SB 459, SB 597/HB 1361 to meet the needs of pregnant and parenting students. Part of the supports afforded pregnant students includes excused absences. Faculty who are informed by a student of needing this support should make a referral to the Parenting Student Liaison. NOTE: Students must work with the Parenting Student Liaison in order to receive these supports. Students should reach out to the Parenting Student Liaison at parents@uttyler.edu and also complete the Pregnant and Parenting Self-Reporting Form.

Campus Carry

We respect the right and privacy of students who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at http://www.uttyler.edu/about/campus-carry/index.php.