If Texas Tech University campus operations are required to change because of health concerns related to the COVID-19 pandemic, it is possible that this course will move to a fully online delivery format. Should that be necessary, students will need to have access to a webcam and microphone for remote delivery of the class. Additionally, students will need to have access to Rhino & Grasshopper, Ladybug Tools, as well as other design representation software.

ARCH 5304: Advanced Architectural Representation
College of Architecture, Texas Tech University
Fall, 2020

Instructor: Assistant Professor Dr. Peng Du (peng.du@ttu.edu)
Time: Tuesdays, 5:30-6:50pm
Location: ARCH 802
Attributes: Face to Face + Online

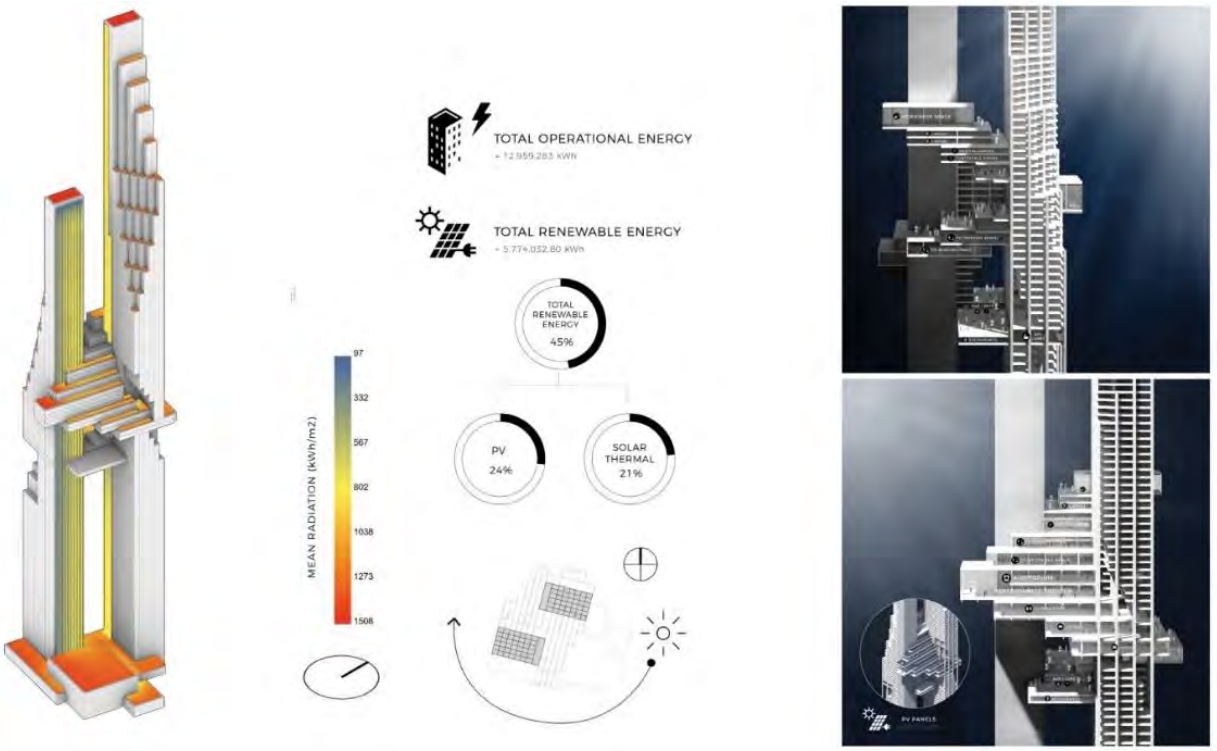

Figure: Energy simulation / analysis by students in the Net-Zero Skyscrapers Studio at IIT, taught by Prof. Peng Du.

I. COURSE INFORMATION

Course Title: Simulation for Building Performance and Urban Sustainability

Catalog Description:

Explores and examines emerging methods of computation as generative tools of the design process, in which design intent is captured through algorithmic processes and parametric ideas.

Course Description:

This course aims to provide students with an understanding of principles, methods and applications of environmental performance analysis at both the building and urban scales, through weekly lectures and hands-on simulation software tutorials. The course will also explore building and urban sustainability in terms of new trends, design strategies, technologies, and materials. Specifically, the simulation for environmental performance will include energy consumption / generation, carbon emission, solar radiation, daylighting, outdoor thermal comfort, urban heat island, etc. This course will lean heavily on digital modeling within the Rhinoceros 3D modeling environment, mainly using Grasshopper, Ladybug, Honeybee, Dragonfly and DIVA-for-Rhino, among other tools, to perform simulations and analyses.

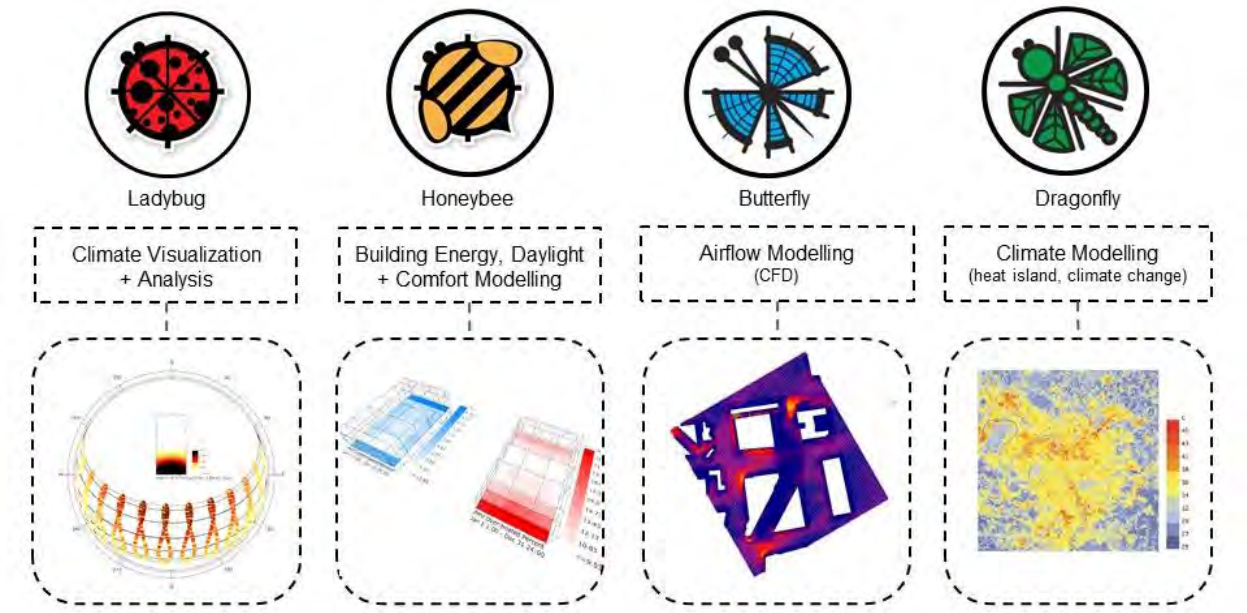

Figure: Ladybug Analysis Tools.

Each week a topic related to environmental performance and analysis in the built environment will be introduced in a lecture / presentation format, followed by software tutorial and discussion in a workshop / seminar format. Course deliverables include a series of assignments and a final research + design project, with a focus on high-performance buildings / cities.

Students are required to bring their laptop computers to the both in-person and virtual classes throughout the whole semester.

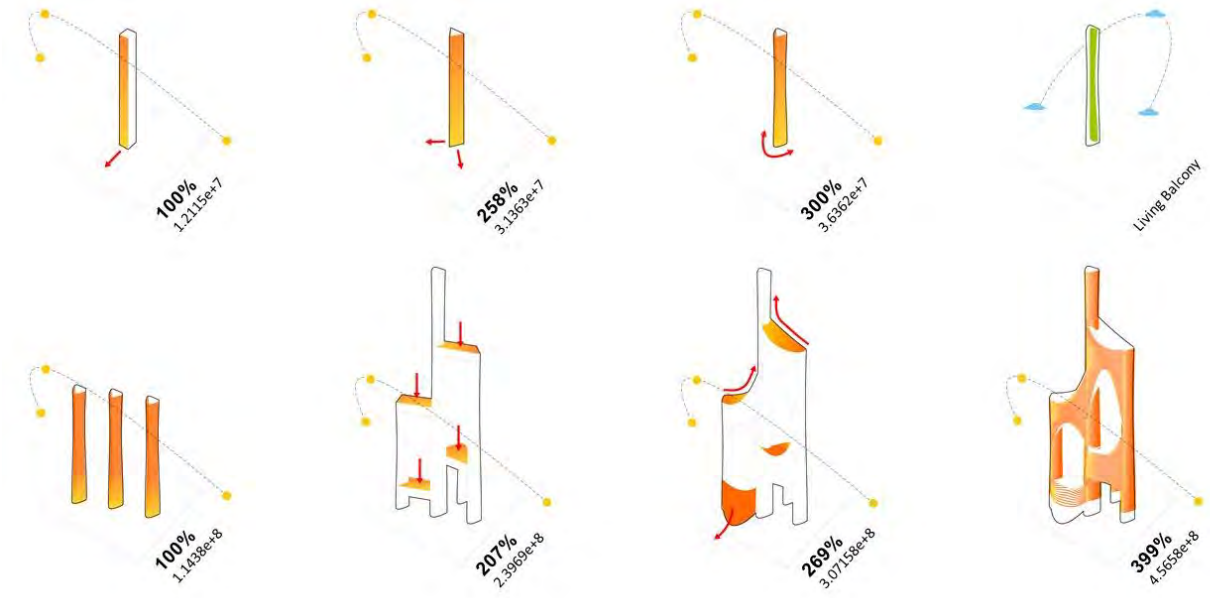

Figure: Energy simulation / analysis by students in the Net-Zero Cities Studio at IIT, taught by Prof. Peng Du.

Student Learning Objectives

Disciplinary knowledge objectives to be achieved by the successful completion of this course:

1. Introduce computation-based representational tools and techniques.
2. Encourage form-making, surface delineation, potential tectonic goals through the use of advanced design software.
3. Ability to simulate relationships using data and the visualization of data.

Student Performance Objectives

Professional knowledge objectives to be achieved by the successful completion of this course:

1. Acquire the understanding and knowledge required to critically discuss / present the environmental concepts of buildings and cities;
2. Understand the purpose and benefits of climate-responsive design, and apply climate and place analysis to the design process;
3. Learn and manage to conduct an environmental design analysis during different stages of the design in a parametric environment;
4. Understand the various physical effects that generate urban microclimates and their impact on building energy use, carbon emissions and thermal/luminous comfort in cities;

Means of Evaluation:

Deliverables. Course deliverables include three assignments and a final research + design project with a focus on high-performance buildings / cities (see below for details). Extensions to due dates will not be granted unless there are approved extenuating circumstances. Substantial grade reduction will occur if work is received late or incomplete.

1. Assignment 1: Climate Analysis and Data Visualization
2. Assignment 2: Urban Heat Island and Outdoor Thermal Comfort Modeling
3. Assignment 3: High-Performance Façade Design
4. Final Presentation + Submission: Research + Design Project on High-Performance Buildings / City

Methods of Assessment. Expectations of the deliverables set forth above shall be completed in a timely manner, assessed through regular interaction, participation, and criticism of the output with the instructors. Students will be required to present the final projects at the final reviews, and also submit a research + design report. There will be unscheduled discussions, presentations, and critiques as needed to facilitate work progress.

Teaching Methods

Each week a topic related to environmental performance and analysis in the built environment will be introduced in a lecture / presentation format, followed by software tutorial and discussion in a workshop / seminar format. The knowledge and skills needed for the final research + design project will be gained through weekly presentations, software tutorials, discussion / critiques, and assignments. Specifically, the simulation for environment performance will include energy consumption / generation, carbon emission, solar radiation, daylighting, outdoor thermal comfort, urban heat island, etc. This course will lean heavily on digital modeling within the Rhinoceros 3D modeling environment, mainly using Grasshopper, Ladybug, Honeybee, Dragonfly and DIVA-for-Rhino, among other tools, to perform simulations and analyses.

Course Schedule

- Week 1 (Tuesday, August 25) – Online
  Course Introduction + Lecture: Sustainable Buildings and Cities

- Week 2 (Tuesday, September 1) – In Person
  Software Overview / Installation + Climate Analysis I – Open Source

- Week 3 (Tuesday, September 8) – Online
  Climate Analysis II – Ladybug
  Assignment 1: Climate Analysis and Data Visualization

Submission Deadline: 8am @ Tuesday, September 15

- Week 4 (Tuesday, September 15) – Online
  Expanding Climate Data Sources – Dragonfly

- Week 5 (Tuesday, September 22) – Online
  Urban Heat Island Modeling – Dragonfly

- Week 6 (Tuesday, September 29) – Online
  Outdoor Thermal Comfort – Dragonfly
  Assignment 2: Urban Heat Island and Outdoor Thermal Comfort Modeling
  Submission Deadline: 8am @ Tuesday, October 6

- Week 7 (Tuesday, October 6) – In Person
  Solar Radiation: Renewable Energy – DIVA

- Week 8 (Tuesday, October 13) – Online
  Solar Radiation: Façade Design – DIVA
  Guest Tutorial: Ali Irani, Sustainable Engineering Professional, SOM

- Week 9 (Tuesday, October 20) – Online
  Guest Lecture: "Façade", Abdulmajid Karanouh, Director, Drees & Sommer

- Week 10 (Tuesday, October 27) – Online
  Daylight and Glare – DIVA
  Assignment 3: High-Performance Façade Design
  Submission Deadline: 8am @ Tuesday, November 3

- Week 11 (Tuesday, November 3) – In Person
  Introduction to Final Research + Design Project: High-Performance Buildings / City

- Week 12 (Tuesday, November 10) – Online
  Guest Lecture: "Decarbonization", Chris Drew, Director of Sustainability, AS + GG

- Week 13 (Tuesday, November 17) – Online
  Final Review I

- Week 14 (Tuesday, November 24) – Online
  Final Review II

- Week 15 (Tuesday, December 1) – Online

Individual Tutorial / Discussion

- Week 16 (Tuesday, December 8)
  Final Submission: Research + Design Report
  Submission Deadline: 5:30pm @ Tuesday, December 8

Note: These dates are subject to change at the discretion of the instructor, guest speakers, and/or the College of Architecture.

Recommended Texts

Books on Reserve COA Library. The resources below are by no means complete, but should give you a basis for supplementing your existing knowledge on architecture, structure, environmental systems, programming, detailing, and assemblies. Other readings may be assigned by the instructor throughout the semester.

1. Learning Resources @ Ladybug Tools
2. Publications @ Ladybug Tools
3. Presentations @ Ladybug Tools
4. Sonja Oliviera, Bill Gething, & Elena Marco (2020). Energy Modelling in Architecture: A Practice Guide
5. American Institute of Architects (AIA) (2019). Architect's Guide to Integrating Building Performance Simulation in the Design Process
6. Elizabeth J. Grant (2019). Integrating Building Performance with Design: An Architecture Student's Guidebook
7. Kjell Anderson (2014). Design Energy Simulation for Architects: Guide to 3-D Graphics
8. BIPV Design and Performance Modelling: Tools and Methods
9. ANSI/ASHRAE/IES Standard 90.1-2019

Course Requirements

Required Computer: Students must provide and maintain their own laptop computer in and after classes. See the college wiki for minimum specifications. Technical difficulties, viruses, corrupted files, crashes, server, or printing problems will not be accepted as excuses for not producing assigned work. All digital work should be regularly backed up.

Required Software. Using illegal copies of software violates ethical code and can cause unexpected results.

1. Rhino (and Grasshopper), Ladybug Tools (Ladybug, Dragonfly, etc.) and DIVA-for-Rhino are required for modeling and simulation.

2. Adobe Photoshop, Illustrator, InDesign, Acrobat, and Illustrator are required for all 2D drawing and diagram output.
3. PowerPoint is required for the final presentations.

Dimension / Measurement. Students must use International System of Units for this course, e.g., meter or square meter, instead of the Imperial (English) system, e.g., foot or square foot.

Grading

Grading for this course is not an exact mathematical assessment. It is based on years of experience and expertise in the criticism and judgment of 1.) student learning process; 2.) the completion and quality of the assignments and final project. Productivity and hard work lead to improvement, and demonstrated improvement is a key component in final grading. Students' final grades will be given based on the following phases:

1. Attendance / Participation in Class = 15%
2. Assignments = 45%
3. Final Presentation + Submission = 40%

Grade definitions:

1. A (excellent) exceptional work, exceeding the requirements of the course, showing strong understanding, skills, effort, initiative, and independent resourcefulness.
2. B (good) performance above the norm; work demonstrates adequate understanding, skills, effort, initiative, and improvement beyond the minimum requirements of the course.
3. C (average) work that meets minimum requirements and demonstrates satisfactory understanding, skills, and effort; little initiative to investigate the problem without substantial prodding from the instructor; work shows minimal improvement.
4. D (inferior) work that does not satisfy minimum requirements, understanding, skills, and effort; initiative lacking; improvement not noticeable.
5. F (failure) does not meet requirements, to the extent that the student must repeat the course.

More on grading: TTU OP. 34.12 on Grading https://www.depts.ttu.edu/opmanual/OP34.12.pdf

Retention of Student Work. The College of Architecture reserves the right to retain, exhibit, and reproduce work submitted by students. Work submitted for a grade is the property of the college.

NAAB Criteria Met (use 2018 SPC's)

C.3 Integrative Design: Ability to make design decisions within a complex architectural project while demonstrating broad integration and consideration of environmental stewardship, technical documentation, accessibility, site conditions, life safety, environmental systems, structural systems, and building envelope systems and assemblies. (2018 SPC)

Attendance Policy

Each student will be allowed to have one unexcused absence during the semester. Any additional absences will affect the final grade at the instructor's discretion. Arriving late to class, working on anything other than class work and departing early will be considered as absences. Absences are only for reasonable unforeseen circumstances such as getting sick or emergencies. If you are sick, please stay home, and inform the instructor directly. Whether an absence is excused or unexcused is determined solely by the instructor,` except for absences due to religious observance and officially approved trips described above. Students are responsible for attending class.

Absence due to religious observance: The Texas Tech University Catalog states that a student who is absent from classes for the observance of a religious holy day will be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. Notification must be made in writing and delivered in person no later than the 15th class day of the semester.

Absence due to officially approved trips: The Texas Tech University Catalog states that the person responsible for a student missing class due to a trip should notify the instructor of the departure and return schedule in advance of the trip. The student may not be penalized and is responsible for the material missed.

II. COVID-19 INFORMATION

Face coverings are required. Texas Tech University requires that students wear face coverings while in classes, while otherwise in campus buildings, and when social distancing cannot be maintained outdoors on campus.

Signage. Be attentive to signage posted at external and some classroom doorways that indicates entry and exit ways, gathering and queuing spaces, and availability of masks and hand sanitizer.

Seating assignments. The purpose of assigned seating is to assist in contact tracing, if necessary, and to augment social distancing. Students are expected to sit at a minimum of six feet apart. A required seating chart will be created once everyone is positioned with appropriate social distancing. There will also be an orderly procedure, designed to ensure social distancing, for exiting the classroom.

Illness-Based Absence Policy
If at any time during this semester you feel ill, in the interest of your own health and safety as well as the health and safety of your instructors and classmates, you are encouraged not to attend face-to-face class meetings or events. Please review the steps outlined below that you should follow to ensure your absence for illness will be excused. These steps also apply to not participating in synchronous online class meetings if you feel too ill to do so and missing specified assignment due dates in asynchronous online classes because of illness.

1. If you are ill and think the symptoms might be COVID-19-related:
a. Call Student Health Services at 806.743.2848 or your health care provider. After hours and on weekends contact TTU COVID-19 Helpline at 806.743.2911.
b. Self-report as soon as possible using the Dean of Students COVID-19 webpage. This website has specific directions about how to upload documentation from a medical provider and what will happen if your illness renders you unable to participate in classes for more than one week.
c. If your illness is determined to be COVID-19-related, all remaining documentation and communication will be handled through the Office of the Dean of Students, including notification of your instructors of the period of time you may be absent from and may return to classes.
d. If your illness is determined not to be COVID-19-related, please follow steps 2.a-d below.

2. If you are ill and can attribute your symptoms to something other than COVID-19:
a. If your illness renders you unable to attend face-to-face classes, participate in synchronous online classes, or miss specified assignment due dates in asynchronous online classes, you are encouraged to visit with either Student Health Services at 806.743.2848 or your health care provider. Note that Student Health Services and your own and other health care providers may arrange virtual visits.
b. During the health provider visit, request a “return to school” note;
c. E-mail the instructor a picture of that note;

d. Return to class by the next class period after the date indicated on your note.

Following the steps outlined above helps to keep your instructors informed about your absences and ensures your absence or missing an assignment due date because of illness will be marked excused. You will still be responsible to complete within a week of returning to class any assignments, quizzes, or exams you miss because of illness.

If you have interacted with individual(s) who have tested positive for COVID-19:
Maintain a list of those persons and consult Student Health Services at 806-743-2911 or your primary care provider on next steps.

Do not return to class until you are medically cleared by your Health Care Provider.

III. UNIVERSITY REQUIRED STATEMENTS

ADA STATEMENT:
Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

ACADEMIC INTEGRITY STATEMENT:
Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010]

RELIGIOUS HOLY DAY STATEMENT:
"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

DISCRIMINATION, HARASSMENT, AND SEXUAL VIOLENCE STATEMENT:
Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights & Resolution, (806)-742-SAFE (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are: TTU Student Counseling Center, 806- 742-3674,

https://www.depts.ttu.edu/scc/(Provides confidential support on campus.) TTU 24-hour Crisis Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.) The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, https://www.depts.ttu.edu/rise/ (Provides a range of resources and support options focused on prevention education and student wellness.) Texas Tech Police Department, 806-742- 3931,http://www.depts.ttu.edu/ttpd/ (To report criminal activity that occurs on or near Texas Tech campus.)

CIVILITY IN THE CLASSROOM STATEMENT:
Texas Tech University is a community of faculty, students, and staff that enjoys an expectation of cooperation, professionalism, and civility during the conduct of all forms of university business, including the conduct of student–student and student–faculty interactions in and out of the classroom. Further, the classroom is a setting in which an exchange of ideas and creative thinking should be encouraged and where intellectual growth and development are fostered. Students who disrupt this classroom mission by rude, sarcastic, threatening, abusive or obscene language and/or behavior will be subject to appropriate sanctions according to university policy. Likewise, faculty members are expected to maintain the highest standards of professionalism in all interactions with all constituents of the university (www.depts.ttu.edu/ethics/matadorchallenge/ethicalprinciples.php).

LGBTQIA SUPPORT STATEMENT*:
I identify as an ally to the lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community, and I am available to listen and support you in an affirming manner. I can assist in connecting you with resources on campus to address problems you may face pertaining to sexual orientation and/or gender identity that could interfere with your success at Texas Tech. Please note that additional resources are available through the Office of LGBTQIA within the Center for Campus Life, Student Union Building Room 201, www.lgbtqia.ttu.edu, 806.742.5433."

*If you prefer to list campus resources rather than a statement about ally status, you might include the following among other campus resources you wish to share:

Office of LGBTQIA, Student Union Building Room 201, www.lgbtqia.ttu.edu, 806.742.5433
Within the Center for Campus Life, the Office serves the Texas Tech community through facilitation and leadership of programming and advocacy efforts. This work is aimed at strengthening the lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community and sustaining an inclusive campus that welcomes people of all sexual orientations, gender identities, and gender expressions.