THERMO: LIVING SYS BSEN244 SEC 001 Spring 2023

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Biological Systems Engineering 244

Thermodynamics for Living Systems

Syllabus—Spring Semester 2023
University of Nebraska-Lincoln
East Campus - 116 Chase Hall

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Office Hours: Wednesdays, 1:30–2:30pm or by CANVAS/email anytime

INSTRUCTIONAL CONTINUITY PLAN

In case of a campus shutdown (due to weather, health alert, etc.), check Canvas.

COURSE DESCRIPTION

This course is an introduction to the laws of thermodynamics and their application to physical, biological, and environmental engineering systems. Topics include first, second, and third laws, open and closed systems, pure substances, specific heat, enthalpy, entropy, Gibb's free energy for selected biological and environmental systems. Applications include manometers, metabolic energy, psychrometrics, introductory heat transfer, biomechanical work, blood flow work, refrigerator and heat pump efficiencies, entropy production, water potential, surface tension, osmosis, and selected biochemical reactions. Important thermodynamic cycles are also presented as they apply to physical and living systems.

COURSE OBJECTIVES

Having successfully completed this course, students should be able to:

1. Comfortably apply problem-solving skills to engineering-based questions (ABET Outcome 1, 2, 7)
2. Identify and apply basic thermodynamic concepts
    - Formulate and solve problems involving both closed and open physical or biological systems utilizing the nature of heat and work. (ABET 1, 2)
    - Apply the first law to solve energy flow problems for physical, biological and environmental systems and their surroundings. (ABET 1, 2)
    - Recognize when to apply the second law to solve problems, and that energy in different forms has different utility. (ABET 1, 2, 7)
    - Identify cycles in the broader context of heat engines and heat production in biological systems. (ABET 1, 2, 7)
    - Use psychrometrics to calculate sensible and latent heat exchanges between living organisms and their aerial environment. (ABET 1, 6, 7)
    - Recognize the concept of Gibb's free energy as it applies to biological and agricultural systems. (ABET 1)
3. Apply thermodynamic concepts to biological and agricultural systems (ABEN 1, 2, 7)

ABET Criterion 3 outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

PREREQUISITES

CHEM 110 or 114, MATH 107, PHYS 211, and LIFE 120 or BIOS 101 or parallel.

FORMAT AND MEETING TIMES

3 credit hours: 3 hours of lecture per week.

Lectures: Monday/Wednesday/Friday: 3:00 - 3:50 p.m., 116 Chase, East Campus.

Cell phones, laptops, and tablets may be used for note taking during lecture, but should not be a distraction.

TEXTBOOK AND CONTENT

The textbooks to be used for this class are a combination of different open access texts since textbook prices have become quite ridiculous. They are available for download in files (be sure to download the Thermo Textbook Tables as well - an yes, actually download the files onto your device so when you need it for a quiz and the internet isn't working you won't be left without needed information).

Introduction-to-Engineering-Thermodynamics-1662608237.pdf (https://canvas.unl.edu/courses/144584/files/14130145?wrap=1) (https://canvas.unl.edu/courses/144584/files/14130145/download?download_frd=1) (This might be easier to read from the online version: **https://pressbooks.bccampus.ca/thermo1/ (https://pressbooks.bccampus.ca/thermo1/)**)

Thermo_Textbook_Tables.pdf (https://canvas.unl.edu/courses/144584/files/14111138?wrap=1) (https://canvas.unl.edu/courses/144584/files/14111138/download?download_frd=1)

Cengel_Boles_CH14.pdf (https://canvas.unl.edu/courses/144584/files/14130143?wrap=1) (https://canvas.unl.edu/courses/144584/files/14130143/download?download_frd=1)

haynie2008_Gibbs_Chapters.pdf (https://canvas.unl.edu/courses/144584/files/14130144?wrap=1) (https://canvas.unl.edu/courses/144584/files/14130144/download?download_frd=1)

All readings are expected to be done before the designated lecture. This is always best practice so that you can use time in class to ask questions about concepts that aren't yet completely clear from your readings.

CANVAS LEARNING SYSTEM

Each student has been assigned an account on the CANVAS Learning System at https://my.unl.edu/webapps/portal/frameset.jsp. Each student is also expected to have a current e-mail address listed on CANVAS. Be sure to check that your email address is correctly listed. During the semester, homework assignments with due dates and times, quiz schedules, general announcements, website links, and supplemental handouts will be posted on Canvas. The CANVAS calendar will be used to announce lecture topics and other significant events. Be sure to check the calendar regularly for supplemental materials including lecture slides. Students may also check their current numerical grade scores on Canvas. Letter grades will not be assigned until the end of the course.

HOMEWORK

Homework problems are there to help you get comfortable working with the equations we learn in class and solving many interesting problems in thermodynamics of biological systems. These are assigned to give you practice with the concepts, not as a comprehension check. Plus, you get points for doing this practice - how exciting is that!

Homework problems are announced both on CANVAS and during class. Typically, approximately 100 homework problems will be given during the semester with another 50 solved as examples during class. Therefore, weekly homework assignments will consist of 5–15 problems, depending on the length, scope, and complexity of the problems.

EXAMINATIONS

For this class, examinations consist of approximately weekly scheduled quizzes and a final exam. Quizzes will be approximately 20 minutes in length. Prior to each quiz, students will have an opportunity to ask review questions or to clarify the material previously covered. The quizzes may be either closed or open book depending on the content. **There will be no make-up quizzes**, but your lowest quiz score will be dropped in case one needs to be missed.

The final two hour examination (scheduled for 1:00 to 3:00 p.m., Tuesday, May 16, 2023 in 116 Chase Hall) will be open book and will cover the entire material for the semester.

PROFESSIONALISM

Students will be graded on professionalism during class time and in interacting with the instructor and TAs and includes attendance, punctuality, participation, activities during class time, **respecting those around you**, etc. This does not mean you cannot have fun during class, but this fun should be appropriate and respectful. Attendance is always expected and may be taken at anytime, unless a prior arrangement for an absence has been made with the instructor. If you have an upcoming excused absence planned, please notify the instructor prior to the absence. **Make-up quizzes will not be given even if you notified me of your absence**.

GRADING

Grading consists of earned numerical points, which are tabulated for each student assignment, quiz, and the final exam during the semester. An approximate overall percentage breakdown for homework, quizzes, final exam, and professionalism points is given below. However, for the purposes of assigning the student's final letter grade, the student's total earned score will be divided by the total number of possible points to arrive at a final percentage score (based on 100%).

	Approximate Percent of Final Grade

Homework Assignments	10%
Quizzes	50%
Final Exam	30%
Professionalism	10%

Assignment of letter grades:

Percentage of total points (x)	Final Grade
x ~> 90, rarely makes minor mistakes in HW and exams	A range (A-, A, A+)
80 ~< x ~< 90, rarely makes major mistakes in HW and exams	B range (B-, B, B+)
70 ~< x ~< 80, often makes major mistakes in HW and exams	C range (C-, C, C+)
60 ~< x ~< 70, major mistakes are dominant in HW and exams	D range (D-, D, D+)
x ~< 60, showed minimal effort	F

STUDENTS WITH DISABILITIES

Students with disabilities are encouraged to contact Dr. Kievit for a confidential discussion of their individual needs for academic accommodation as determined by Services for Students with Disabilities (SSD). This includes students with mental health disabilities like depression and anxiety. It is the policy of the University of Nebraska-Lincoln to provide individualized accommodations to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with SSD which is located in 232 Canfield Administration (472-3787).

ACADEMIC HONESTY

Academic honesty is essential to the existence and integrity of an academic institution. The responsibility for maintaining that integrity is shared by all members of the academic community. The University's **Student Code of Conduct (http://stuafs.unl.edu/DeanofStudents/Student%20Code%20of%20Conduct%20May%20Rev%202014%20a.pdf** addresses academic dishonesty. Students who commit acts of academic dishonesty are subject to disciplinary action and are granted due process and the right to appeal any decision. The BSE

Department process for grade and academic dishonesty appeals can be found at **http://bse.unl.edu/academicadvising-index (http://bse.unl.edu/academicadvising-index)** . Students are encouraged to contact the instructor for clarification of these guidelines if they have questions or concerns.

BACKGROUND OF YOUR INSTRUCTOR

Dr. Forrest Kievit is an Associate Professor of Biological Systems Engineering (40% teaching, 50% research, 10% service) and started at the University of Nebraska in 2016. Dr. Kievit earned his B.S. in Bioengineering (2007) and Ph.D. in Materials Science and Engineering (2011), both at the University of Washington, followed by postdoctoral and research faculty positions in the Neurological Surgery Department. His research involves developing nanoparticle-based delivery vehicles for transport into the brain for more effective brain cancer and brain injury treatments. This stems from his career goal to help translate a nanomedicine into clinical use to improve the survival and quality of life of neurosurgery patients. The vast majority of Kievit's research has focused on nanoparticle-mediated delivery of nucleic acids into brain tumors. Looking forward, he plans to continue developing nanoparticles that will allow for greater flexibility in therapeutic payload and disease targeting, including brain injury.

We are always looking for enthusiastic students to join our research team to gain valuable research experience and contribute to our scientific endeavors.

https://kievit.unl.edu/welcome (https://kievit.unl.edu/welcome)

BACKGROUND FOR THE COURSE

Biological and Biomedical Engineers need to fully understand and utilize various sources of free energy in their analyses and design applications, which often involve dynamic and non-equilibrium processes. These include interactions between a resource sector (also referred to as the natural resources base typically withdrawn from the air, land, and water) and a storage, processing, or manufacturing sector. The two pieces fit together to form a single discipline. Ultimately, both physical and biological materials must return from storage, processing, or manufacturing back to the resource sector as the ultimate repository. Biological engineers are concerned with the issues associated with the sustainable operation of this and similar cycles. Biological, biomedical, and environmental applications always use the laws of classical thermodynamics, but the subject matter goes beyond thermostatics. Such approach is not an entirely new concept at the undergraduate engineering level, since chemical engineering thermodynamics and physical chemistry probe into their respective application areas, as well. Applications and energy cycles, involving biological and environmental systems have been addressed by prominent scientists and engineers over the last seventy years. It is now the time to introduce this material at the undergraduate level in an efficient, but single introductory course. "Thermodynamics of Living Systems" is, therefore, a foundation course for the Biological Engineer. Plants, animals, humans,

and biological systems require a continual input of free energy. If sources of free energy are removed, organisms and other related biological processes drive toward equilibrium or consequent cessation of life. In order to understand biological and environmental processes, students must apply the Gibb's free energy function, which is the combination of the first and second laws of thermodynamics. Most classical treatments of thermodynamics are better-named "thermostatics." Those concepts are usually covered in only a few weeks. However, most biological and environmental systems, non-equilibrium and dynamic conditions require an understanding of not only thermal, but also chemical, electrical, and diffusion potentials, as well.

The realm of thermodynamic equilibria for biological systems encompasses interactions between environmental and living systems. For bioprocessing, students study the thermal, chemical, and processing of biological materials. The study of plant growth and development is also a key part of the water and environment emphasis. Water quality and aquatic life (algae, microorganisms, and plant populations in riparian zones and wetlands) are likewise important. Bioprocesses include cell culture (microorganisms, plants, or animals) to manufacture a product. Biological engineering is a logical extension of engineering principles to the analysis of biological phenomena, and includes the area of biomedical engineering. Bioengineering resides at the interface of biological sciences, engineering sciences, mathematics and computational sciences. It focuses on biological systems for enhancing the quality and diversity of life. Health and safety of workers in industrial environments, animals in confinement, plant culture in controlled environments, and analysis of the mechanics of various physiological activities in higher level organisms are examples of topics studied. Bioinstrumentation applies to quantitative measurement of the welfare of humans and animals and enhancement of plant growth. The use of synthetic materials or biomaterials to the reconstruction of biological parts may be an important alternative to cloning. Construction of synthetic parts must include the study of mechanics, strength of materials, and thermodynamics (work).

Course Topics are subject to change according to the pace of the class. The current schedule will be updated and posted on the CANVAS calendar.

Course Summary:

Date	Details	Due
Mon Jan 23, 2023	**BSEN 244 Introductory Lecture** (https://canvas.unl.edu/calendar?event_id=411946&include_contexts=course_144584)	3pm to 3:50pm
Wed Jan 25, 2023	**Closed and Open Systems, States, and Equilibrium**	3pm to 3:50pm

Date	Details	Due
	(https://canvas.unl.edu/calendar?event_id=411956&include_contexts=course_144584)	
Fri Jan 27, 2023	Closed and Open Systems, States, and Equilibrium (https://canvas.unl.edu/calendar?event_id=411976&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 1 (https://canvas.unl.edu/courses/144584/assignments/1383669)	due by 3pm
Mon Jan 30, 2023	Processes and Cycles. Forms of Energy. Energy and Environment (https://canvas.unl.edu/calendar?event_id=411957&include_contexts=course_144584)	3pm to 3:50pm
Wed Feb 1, 2023	Temperature and Pressure (https://canvas.unl.edu/calendar?event_id=411933&include_contexts=course_144584)	3pm to 3:50pm
Fri Feb 3, 2023	Manometers (https://canvas.unl.edu/calendar?event_id=411958&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 2 (https://canvas.unl.edu/courses/144584/assignments/1383675)	due by 3pm
Mon Feb 6, 2023	Food and Exercise (https://canvas.unl.edu/calendar?event_id=411940&include_contexts=course_144584)	3pm to 3:50pm
Wed Feb 8, 2023	Pure Substances, Saturation Vapor, Saturation Temperature and Pressure (https://canvas.unl.edu/calendar?event_id=411959&include_contexts=course_144584)	3pm to 3:50pm
Fri Feb 10, 2023	Property Diagrams Property Tables (https://canvas.unl.edu/calendar?event_id=411960&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 3	due by 3pm

Date	Details	Due
	(https://canvas.unl.edu/courses/144584/assignments/1383676)	
	Assignment 1 (https://canvas.unl.edu/courses/144584/assignments/1383599)	due by 10:14pm
Mon Feb 13, 2023	Equations of State Ideal Gas Law Internal Energy, Enthalpy, Specific Heat (https://canvas.unl.edu/calendar?event_id=411973&include_contexts=course_144584)	3pm to 3:50pm
Wed Feb 15, 2023	Mechanical and Non-mechanical Work (https://canvas.unl.edu/calendar?event_id=411947&include_contexts=course_144584)	3pm to 3:50pm
Fri Feb 17, 2023	Biological Work and Heat Special Topics (https://canvas.unl.edu/calendar?event_id=411941&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 4 (https://canvas.unl.edu/courses/144584/assignments/1383677)	due by 3pm
Mon Feb 20, 2023	Three Mechanisms of Heat Transfer (https://canvas.unl.edu/calendar?event_id=411934&include_contexts=course_144584)	3pm to 3:50pm
Wed Feb 22, 2023	Mechanisms of Heat Transfer (https://canvas.unl.edu/calendar?event_id=411944&include_contexts=course_144584)	3pm to 3:50pm
	Assignment 2 (https://canvas.unl.edu/courses/144584/assignments/1383593)	due by 11:51pm
Fri Feb 24, 2023	First law of Thermodynamics Energy balance of closed system (https://canvas.unl.edu/calendar?event_id=411945&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 5 (https://canvas.unl.edu/courses/144584/assignments/1383678)	due by 3pm

Date	Details	Due
Mon Feb 27, 2023	Energy Balance for Steady-Flow Processes (https://canvas.unl.edu/calendar?event_id=411955&include_contexts=course_144584)	3pm to 3:50pm
Wed Mar 1, 2023	Energy Balance for Steady-Flow Processes (https://canvas.unl.edu/calendar?event_id=411952&include_contexts=course_144584)	3pm to 3:50pm
Fri Mar 3, 2023	Energy Balance for Steady-Flow Processes (https://canvas.unl.edu/calendar?event_id=411974&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 6 (https://canvas.unl.edu/courses/144584/assignments/1383679)	due by 3pm
	Quiz 6 (https://canvas.unl.edu/courses/144584/assignments/1383600)	due by 4pm
Mon Mar 6, 2023	Non-Steady-State Flow (https://canvas.unl.edu/calendar?event_id=411961&include_contexts=course_144584)	3pm to 3:50pm
Wed Mar 8, 2023	Thermal Properties of Foods (https://canvas.unl.edu/calendar?event_id=411962&include_contexts=course_144584)	3pm to 3:50pm
Thu Mar 9, 2023	Assignment 3 (https://canvas.unl.edu/courses/144584/assignments/1383602)	due by 8:13pm
Fri Mar 10, 2023	Second Law of Thermodynamics (https://canvas.unl.edu/calendar?event_id=411948&include_contexts=course_144584)	3pm to 3:50pm
	Keep-Start-Stop (https://canvas.unl.edu/courses/144584/assignments/1383613)	due by 3pm
	Quiz 7 (https://canvas.unl.edu/courses/144584/assignments/1383680)	due by 3pm

Date	Details	Due
	Quiz 7 (https://canvas.unl.edu/courses/144584/assignments/1383617)	due by 5pm
Mon Mar 13, 2023	NO CLASS - Spring break! (https://canvas.unl.edu/calendar?event_id=411935&include_contexts=course_144584)	3pm to 3:50pm
Wed Mar 15, 2023	NO CLASS - Spring break! (https://canvas.unl.edu/calendar?event_id=411936&include_contexts=course_144584)	12am
Fri Mar 17, 2023	NO CLASS - Spring break! (https://canvas.unl.edu/calendar?event_id=411937&include_contexts=course_144584)	12am
Mon Mar 20, 2023	Thermal Efficiency Carnot Efficiency (https://canvas.unl.edu/calendar?event_id=411949&include_contexts=course_144584)	3pm to 3:50pm
Wed Mar 22, 2023	Refrigerators and Heat Pumps (https://canvas.unl.edu/calendar?event_id=411950&include_contexts=course_144584)	3pm to 3:50pm
Fri Mar 24, 2023	Carnot Cycles and Heat Engines (https://canvas.unl.edu/calendar?event_id=411975&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 8 (https://canvas.unl.edu/courses/144584/assignments/1383681)	due by 3pm
Sun Mar 26, 2023	Assignment 4 (https://canvas.unl.edu/courses/144584/assignments/1383608)	due by 11:59pm
Mon Mar 27, 2023	Entropy Production and Removal (https://canvas.unl.edu/calendar?event_id=411963&include_contexts=course_144584)	3pm to 3:50pm
Wed Mar 29, 2023	Entropy Change of Pure Substances	3pm to 3:50pm

Date	Details	Due
	(https://canvas.unl.edu/calendar?event_id=411964&include_contexts=course_144584)	
	Assignment 5 (https://canvas.unl.edu/courses/144584/assignments/1383658)	due by 11:50pm
Fri Mar 31, 2023	Isentropic Processes (https://canvas.unl.edu/calendar?event_id=411965&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 9 (https://canvas.unl.edu/courses/144584/assignments/1383682)	due by 3pm
Mon Apr 3, 2023	Entropy Change of Liquids, Solids and Gases (https://canvas.unl.edu/calendar?event_id=411953&include_contexts=course_144584)	3pm to 3:50pm
Tue Apr 4, 2023	Assignment 5 (https://canvas.unl.edu/courses/144584/assignments/1383596)	due by 11:59pm
Wed Apr 5, 2023	Entropy Change of Liquids, Solids and Gases (https://canvas.unl.edu/calendar?event_id=411954&include_contexts=course_144584)	3pm to 3:50pm
Fri Apr 7, 2023	Entropy Change of Liquids, Solids and Gases (https://canvas.unl.edu/calendar?event_id=411951&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 10 (https://canvas.unl.edu/courses/144584/assignments/1383670)	due by 5pm
	Assignment 9 (https://canvas.unl.edu/courses/144584/assignments/1383662)	due by 11:59pm
Mon Apr 10, 2023	Psychrometric Properties (https://canvas.unl.edu/calendar?event_id=411966&include_contexts=course_144584)	3pm to 3:50pm
Wed Apr 12, 2023	Psychrometric Processes (https://canvas.unl.edu/calendar?	3pm to 3:50pm

Date	Details	Due
	event_id=411967&include_contexts=course_144584)	
Fri Apr 14, 2023	More Psychrometrics (https://canvas.unl.edu/calendar?event_id=411939&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 11 (https://canvas.unl.edu/courses/144584/assignments/1383671)	due by 3pm
Mon Apr 17, 2023	NO CLASS - Dr. K in Boston (https://canvas.unl.edu/calendar?event_id=411943&include_contexts=course_144584)	3pm to 3:50pm
Wed Apr 19, 2023	Gibb's Free energy (https://canvas.unl.edu/calendar?event_id=411968&include_contexts=course_144584)	3pm to 3:50pm
	Assignment 6 (https://canvas.unl.edu/courses/144584/assignments/1383616)	due by 11:59pm
Fri Apr 21, 2023	Gibb's free energy (https://canvas.unl.edu/calendar?event_id=411969&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 12 (https://canvas.unl.edu/courses/144584/assignments/1383672)	due by 3pm
	Informed consent (https://canvas.unl.edu/courses/144584/assignments/1383665)	due by 11:59pm
Mon Apr 24, 2023	Free Energy and Chemical Potential (https://canvas.unl.edu/calendar?event_id=411938&include_contexts=course_144584)	3pm to 3:50pm
	Assignment 6 (https://canvas.unl.edu/courses/144584/assignments/1383659)	due by 11:59pm
Wed Apr 26, 2023	Gibb's free energy (https://canvas.unl.edu/calendar?event_id=411970&include_contexts=course_144584)	3pm to 3:50pm

Date	Details	Due
	Assignment 8 (https://canvas.unl.edu/courses/144584/assignments/1383661)	due by 11:59pm
Fri Apr 28, 2023	Quiz 13 (https://canvas.unl.edu/courses/144584/assignments/1383673)	due by 3pm
	Assignment 10 (https://canvas.unl.edu/courses/144584/assignments/1383655)	due by 11:59pm
Wed May 3, 2023	Assignment 7 (https://canvas.unl.edu/courses/144584/assignments/1383595)	due by 11:59pm
Fri May 5, 2023	Assignment 11 (https://canvas.unl.edu/courses/144584/assignments/1383656)	due by 11:59pm
Mon May 8, 2023	Semester Review (https://canvas.unl.edu/calendar?event_id=411971&include_contexts=course_144584)	3pm to 3:50pm
	Assignment 7 (https://canvas.unl.edu/courses/144584/assignments/1383660)	due by 11:59pm
Wed May 10, 2023	Semester Review (https://canvas.unl.edu/calendar?event_id=411972&include_contexts=course_144584)	3pm to 3:50pm
Fri May 12, 2023	Semester Review (https://canvas.unl.edu/calendar?event_id=411942&include_contexts=course_144584)	3pm to 3:50pm
	Quiz 14 (https://canvas.unl.edu/courses/144584/assignments/1383674)	due by 3pm
	Assignment 12 (https://canvas.unl.edu/courses/144584/assignments/1383657)	due by 11:59pm
Tue May 16, 2023	Final Exam (https://canvas.unl.edu/courses/144584/assignments/1383609)	due by 10am
	Final Exam (https://canvas.unl.edu/courses/144584/assignments/1383664)	due by 1pm

Date	Details	Due
	Bonus Homework (https://canvas.unl.edu/courses/144584/assignments/1383663)	
	Professionalism (https://canvas.unl.edu/courses/144584/assignments/1383667)	
	Quiz 1 (https://canvas.unl.edu/courses/144584/assignments/1383597)	
	Quiz 1 (https://canvas.unl.edu/courses/144584/assignments/1383607)	
	Quiz 10 (https://canvas.unl.edu/courses/144584/assignments/1383606)	
	Quiz 11 (https://canvas.unl.edu/courses/144584/assignments/1383598)	
	Quiz 11 (https://canvas.unl.edu/courses/144584/assignments/1383611)	
	Quiz 12 (https://canvas.unl.edu/courses/144584/assignments/1383589)	
	Quiz 13 (https://canvas.unl.edu/courses/144584/assignments/1383586)	
	Quiz 2 (https://canvas.unl.edu/courses/144584/assignments/1383590)	
	Quiz 2 (https://canvas.unl.edu/courses/144584/assignments/1383601)	
	Quiz 3 (https://canvas.unl.edu/courses/144584/assignments/1383584)	
	Quiz 3 (https://canvas.unl.edu/courses/144584/assignments/1383605)	
	Quiz 4 (https://canvas.unl.edu/courses/144584/assignments/1383591)	

Date	Details	Due
	Quiz 4 (https://canvas.unl.edu/courses/144584/assignments/1383610)	
	Quiz 5 (https://canvas.unl.edu/courses/144584/assignments/1383588)	
	Quiz 5 (https://canvas.unl.edu/courses/144584/assignments/1383614)	
	Quiz 5 (https://canvas.unl.edu/courses/144584/assignments/1383618)	
	Quiz 6 (https://canvas.unl.edu/courses/144584/assignments/1383603)	
	Quiz 6 (https://canvas.unl.edu/courses/144584/assignments/1383612)	
	Quiz 7 (https://canvas.unl.edu/courses/144584/assignments/1383592)	
	Quiz 8 (https://canvas.unl.edu/courses/144584/assignments/1383585)	
	Quiz 8 (https://canvas.unl.edu/courses/144584/assignments/1383587)	
	Quiz 8 (https://canvas.unl.edu/courses/144584/assignments/1383604)	
	Quiz 9 (https://canvas.unl.edu/courses/144584/assignments/1383594)	
	Roll Call Attendance (https://canvas.unl.edu/courses/144584/assignments/1383683)	