

**BSE 3154: Thermodynamics of Biological Systems
Fall 2016**

CRN: 81437
Location: Smyth 146
Time: Tuesdays and Thursdays, 8:00 - 9:15 am
Instructor: Dr. Christan Whyson
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Office Hours: Mondays 4:30 to 6 pm; Wednesdays 8 to 9:15 am; other times by appointment

Additional office hours will be held by Teaching Assistants. Please see the course Canvas site for details.

Catalog Description:

Fundamental concepts, first and second laws, psychrometrics applied to plant and animal environments, introduction to Gibbs energy, and application of calorimetry to gain basic understanding of energy flow in a biological system.

Corequisite:

Fluid Mechanics (CEE 3304 or CHE 3114 or ESM 3234 or ESM 3024 or ME 3404)

Prerequisites:

Dynamics (ESM 2304) and Differential Equations (MATH 2214, MATH 2224, MATH 2224H, MATH 2204, or MATH 2204H)

Textbook:

Thermodynamics: An Engineering Approach, Eighth Edition, by Yunus A. Cengel and Michael A. Boles, 2015, McGraw-Hill Education, New York, NY. Some supplemental materials may also be used by the instructor.

Course Website:

Check the course website (Canvas, <https://vt.instructure.com>, "Thermo Biol Systems") regularly for course materials, assignments, and announcements.

Learning Objectives:

Upon successful completion of this course, the student will be able to:

1. Apply the first law of thermodynamics to analyze energy flows.
2. State the second law of thermodynamics and explain that energy in different forms has different utility.
3. Use the properties defined by the first and second laws to analyze thermodynamic cycles.
4. Explain Gibbs free energy and describe obtainable work from a system.
5. Describe how systems reach equilibrium using thermodynamic parameters.

Course Outline:

This is an introductory thermodynamics course for students in engineering disciplines that focus on biological systems. The tentative class schedule is below. It is subject to change at the instructor's discretion.

Week	Dates	Topic	Book Chapter
1	Aug 23 & 25	Introductory Principles & Use of Units	1
2	Aug 30 & Sept 1	Energy & the First Law of Thermodynamics	2
September 5: Labor Day Holiday (No Classes)			
3	Sept 6 & 8	Properties of Substances; P-V-T Diagrams	3
4	Sept 13 & 15	Enthalpy, Equations of State, Energy Balances	3 & 4
5	Sept 20 & 22	Energy Balances; Exam 1 (Chap. 1–4)	4
6	Sept 27 & 29	Mass Balances	5
7	Oct 4 & 6	Steady-State Flow	5
8	Oct 11 & 13	Second Law of Thermodynamics	6
October 14: Fall Break (No Classes)			
9	Oct 18 & 20	Second Law of Thermodynamics; Carnot Cycle	6
10	Oct 25 & 27	Entropy & Second Law Processes; Exam 2 (Chap. 5–7)	7
11	Nov 1 & 3	Auxiliary Functions; Gibbs Free Energy	12
12	Nov 8 & 10	Gibbs Free Energy	
13	Nov 15 & 17	Chemical and Phase Equilibria	16
November 19 – 27: Thanksgiving Break			
14	Nov 29 & Dec 1	Chemical and Phase Equilibria	16
15	Dec 6	Psychrometrics	14
December 7: Last Day of Classes			
December 8: Reading Day (No Classes)			
December 12: BSE 3154 Final Exam: 3:25 pm to 5:25 pm (08T)			

Grades:

Grades will be assigned according to the following grading scheme:

Numerical Grade	Letter Grade
93 – 100%	A
90 – 92.99%	A-
87 – 89.99%	B+
83 – 86.99%	B
80 – 82.99%	B-
77 – 79.99%	C+
73 – 76.99%	C
70 – 72.99%	C-
67 – 69.99%	D+
63 – 66.99%	D
60 – 62.99%	D-
<60%	F

Your course grade will be determined according to the following weights:

Grade Category	Weight
Homework Assignments	10%
Exam 1	30%
Exam 2	30%
Final Exam	30%
Total Grade	100%

The instructional team will work to return graded work within one week of submission. Any dispute over grading, beyond a simple mathematical error, must be submitted to the instructor in writing, with a copy of the contested graded work, within one week of its return. The instructor will make all final decisions regarding grade changes.

Assignments:

Assignments will be primarily weekly homework assignments. Homework will be assigned each Thursday by 5:00 pm and due the following Tuesday by 5:00 pm. The due date and time are firm. Homework can only be submitted via the BSE 3154 Canvas site. It will not be accepted via email or on paper. Assignments must be completed according to the “BSE 3154 Assignment Preparation Instructions.” Any assignment not completed using these policies and procedures will receive a grade of zero.

Electronic Devices:

Unless otherwise instructed, a calculator is the only electronic device that may be used during exams. Examples of unacceptable electronic devices include laptops, cell phones, and tablets. If your class notes are on such a device, please transfer them to paper copies for the exam. You may not use those devices as your calculator.

Additionally, it is expected that students will not disturb or distract others or in any way interfere with the ability of other students to learn the course material. Thus, cell phones and other

electronic devices may not be used during the class period, since they are distracting to the instructor and other students. The one exception is laptops which may only be used to take notes. Individuals whose actions create a distraction or disturb other students will be asked to cease the disrupting activity or leave the classroom.

Special Needs:

Students are encouraged to address any special needs or accommodations with the instructor during the first two weeks of the semester, or as soon as you become aware of your needs. Those seeking accommodations based on disabilities should obtain a Faculty Letter from the Services for Students with Disabilities (SSD) office (540-231-0858) located in Lavery Hall, Suite 310, <http://www.ssd.vt.edu/>. Testing for students with disabilities will be conducted by SSD. Alternative times and locations will be determined prior to the exams and in conjunction with SSD.

Procedure for Excused Absences:

Class attendance and participation are essential for success in this class. Please be prepared for each class by reading and studying the assigned material prior to coming to class. Students are expected to be at lecture. If you miss a lecture, assignment, or an exam and would like to make it up, the instructor will not determine whether or not your reason is acceptable. Students should not share personal information with the instructor in order to facilitate an excused absence. Instead, to protect students' personal information, students should receive a valid excused absence from either the Dean of Students (109 East Eggleston Hall; 540/231-3787) or the Academic Affairs Office of the College of Engineering (212 Hancock Hall). This is the only acceptable procedure for an excused absence and making up missed or late work. If an assignment or exam is missed and properly excused, the student will have one week upon return to complete the assignment or exam.

Honor Code:

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states: "As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code. For additional information about the Honor Code, please visit: <https://www.honorsystem.vt.edu/>

Commission of any of the following acts shall constitute academic misconduct. This listing is not, however, exclusive of other acts that may reasonably be said to constitute academic misconduct. Clarification is provided for each definition with some examples of prohibited behaviors in the Undergraduate Honor Code Manual located at <https://www.honorsystem.vt.edu/>

1. **Cheating.** Cheating includes the intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.
2. **Plagiarism.** Plagiarism includes the copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.
3. **Falsification.** Falsification includes the statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.
4. **Fabrication.** Fabrication includes making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.
5. **Multiple Submission.** Multiple submission involves the submission for credit—without authorization of the instructor receiving the work—of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution, or attempts thereof.
6. **Complicity.** Complicity includes intentionally helping another to engage in an act of academic misconduct, or attempts thereof.
7. **Violation of University, College, Departmental, Program, Course, or Faculty Rules.** The violation of any University, College, Departmental, Program, Course, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

In BSE 3154, you may confer with your colleagues on interpretation and approach to homework problems, but the solution should be your own. Copying solutions from any source is a violation of the honor code, as is sharing or re-using any full or partial computer file. All submitted work must include the honor code pledge. All assignments must include the “BSE 3154 Required Assignment Coversheet.” Any assignment submitted without the coversheet will receive a grade of zero.

If you have questions or are unclear about what constitutes academic misconduct on an assignment, please speak with me. I take the Honor Code very seriously in this course. The normal sanction I will recommend for a violation of the Honor Code is an F* sanction as your final course grade. The F represents failure in the course. The “*” is intended to identify a student who has failed to uphold the values of academic integrity at Virginia Tech. A student who receives a sanction of F* as their final course grade shall have it documented on their transcript with the notation “FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION.” You would be required to complete an education program administered by the Honor System in order to have the “*” and notation “FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION” removed from your transcript. The “F” however would be permanently on your transcript.

Principles of Community Statement:

Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the world community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

- We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
- We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
- We affirm the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.
- We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
- We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of Ut Prosim (That I May Serve).

The Virginia Tech Principles of Community are intended to increase access and inclusion and to create a community that nurtures learning and growth for all of its members. They are defined at: <https://www.vt.edu/about/diversity.html>