Course	**BMEN 3315: Thermodynamics and Physical Chemistry in Biomedical Engineering**
Professors	Stuart Cogan
Term	Spring 2015
Meetings	Monday, Wednesday 10:00 am – 11:15 am, ATC 2.302

Professor Cogan's Contact Information

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Office Hours **TBA**

General Course Information

Pre-& Co-requisites; Other restrictions	BMEN 1208, CHEM 1312, CHEM 1112, and MATH 2420.
Course Description	An introduction to the fundamentals of thermodynamics and physical chemistry including acid-base equilibria, buffers, chemical kinetics and reaction equilibria. Topics also include the structure and properties of biomolecules from amino acids to proteins.
ABET CLOs (Course-learning Objectives)	1. Apply the first, second, and third laws of thermodynamics to macroscopic ideal and non-ideal systems, including gases, liquids, and solids [ABET SO (a)] 2. Relate thermodynamic principles to the operation and performance of engines such as Carnot and internal-combustion engines [ABET SO (e)] 3. Interpret and manipulate thermodynamic identities to mathematically derive quantities of interest and relate these quantities to experimental observables [ABET SO (b)]
Additional Learning Objectives	4. Identify structures of amino acids, peptides, proteins, and nucleic acids; relate these structures and their properties to biophysical behavior. 5. Apply basic principles of statistical thermodynamics to biomolecular structure, recognition, and stability 6. Apply basic principles of chemical kinetics, particularly as they relate to the kinetics of enzyme-catalyzed reactions
Texts & Materials	Physical Chemistry: Principles and Applications in Biological Sciences (5th Ed) with Mastering Chemistry/eText Package by I. Tinoco Jr., K. Sauer, J. C. Wang, J.D. Puglisi, G. Harbison, D. Rovnyak. ISBN-10: 0321883314; ISBN-13: 978-0321883315 (Textbook required; Mastering Chemistry package recommended). Peptides and Proteins, by S. Doonan, ISBN 0-85404-692-5; Royal Society of Chemistry 2002 (recommended). Other readings assigned as appropriate. This material will be distributed through the eLearning web site. **A hand-held calculator will be needed for all quizzes, problem sets and exams. Use of calculator programs on PDAs or similar devices is not permitted.** **This course will require the use of a "clicker," an audience-response device that resembles a hand calculator. The clicker allows you to provide real-time feedback to the instructor during class. Class summary results are displayed graphically, providing students and instructor a gauge of how well the class is grasping the material. Clickers can be purchased (and resold) at the UTD Bookstore.**

Assignments & Academic Calendar

[Topics, Reading Assignments, Due Dates, Exam Dates. Note D = Doonan, T = Tinoco et al.]

Date	Topics	Assigned Reading
M 01/12	Course introduction, Introduction to thermodynamics; Zeroth Law, temperature scales, Heat, and Work. Introduction to amino acids.	T Ch 1; D Ch. 1, 1-6; Lecture notes
W 01/14	Energy, The First Law, State variables. Acid base properties.	T. Ch 2. 13-26. D: Ch. 1, 7-11
W 01/21	The First Law & State variables (cont'd), The Peptide Linkage.	T. Ch 2. 26-30. D: Ch. 1, 11-12
M 01/26	Enthalpy. Peptides cont.	T Ch 2, 30-36, D 13-19. Lecture Notes
W 01/28	Thermochemistry, Peptides and proteins (cont.)	T: Ch. 2, pp. 37-47; D Ch 4 74-107
W 01/28	**Last Day to Drop without a "W"**	**N/A**
M 02/02	The Second Law: Spontaneity, Proteins (cont.)	T: Ch. 2, pp. 55-62; D Ch 4 74-107
W 02/11	The Carnot cycle, Entropy, Examples, Proteins cont.	T: Ch. 3, pp. 62-69; D Ch 4 74-107
M 02/16	The Second Law (cont'd): Phase transitions, Free-energy functions, Maxwell relations; Proteins: Primary structure	T: Ch. 3, pp. 70-95; D Ch 5, 108-142
W 02/18	Free-energy Functions and Chemical Equilibria; Introduction to nucleic acids	T: Ch. 4, pp. 101-126, Lecture notes
M 02/23	Free-energy Functions and Chemical Equilibria (cont'd);	T: Ch. 4, pp. 127-146, Lecture notes
W 02/25	Exam No. 1 Review (or additional lecture material)	Lecture notes
M 03/02	**Exam No. 1 (covers material from 01/12 to 02/23)**	**N/A**
W 03/04	Phase Equilibria	T: Ch. 6, 196-213
M 03/09	Interfacial Thermodynamics and Colligative Properties	T: Ch. 6, 214-231
W 03/11	Electrochemistry, Redox Reactions, Membrane Potentials	T. Ch 7, 238-254
	Spring Break March 16 to March 21 – no classes	
M 03/23	Statistical Thermodynamics: Concepts, The Maxwell-Boltzmann distribution, Partition functions	T: Ch. 5, 151-165
W 03/25	Statistical Thermodynamics (cont'd): Applications	T: Ch. 5, 166-180
M 03/30	Transport Properties: Fick's laws, Diffusion	T: Ch. 8, 264-278
M 03/30	**Last Day to Withdraw from an Undergraduate Course with WL**	**N/A**
W 04/01	Transport Properties (cont'd): Molecular size and shape, Sedimentation	T: Ch. 8, pp. 279-284; p. 294
M 04/06	Transport Properties (cont'd): Electrophoresis	T: Ch. 8, 287-294
W 04/08	Exam No. 2 Review (or additional lecture material)	N/A
M 04/13	**Exam No. 2 (covers material from 03/04 – 04/06)**	**N/A**
W 04/15	Chemical Kinetics: Concepts, Rate laws, Kinetic order, Molecularity	T: Ch. 9, 305-326
M 04/20	Chemical Kinetics (cont'd): Reaction mechanisms, Transition-state theory, Single-molecule kinetics	T: Ch. 9, 327-344
W 04/22	Enzyme Kinetics: Michaelis-Menten kinetics, Inhibition	T: Ch. 10, 378-400
M 04/27	Enzyme Kinetics: Complex reaction pathways	Lecture notes
W 04/29	Biomolecular Structure and Interactions: Inter- and intramolecular forces	T: Ch. 12, 453-480
TBA	**Final-exam Review**	**N/A**
TBA	**Final Exam (covers material from 01/12 to 04/29)**	**N/A**

Exam Dates and Times

03/02	**Exam No. 1, in class**
04/13	**Exam No. 2, in class**
TBA	**Final Exam, Time and Location TBD**

Course Policies

Grading (credit) Criteria	**In-class quizzes (10% of grade); homework (25%); in-class exams (2 at 20% each); final exam (cumulative, 25%)**
Make-up Exams	**There are no make ups for in-class quizzes under any circumstances. There will be no make-up for in-class exams except for the most extreme of documented emergencies.**
Extra Credit	**N/A**
Late Work	**Homework submitted after the due date will be subject to a 20% score deduction (e.g., a maximum of 80 points allowed for a 100-point assignment). No homework assignment will be accepted once an answer key has been posted.**
Special Assignments	**N/A**
Class Attendance	**Class attendance is highly recommended. There will be several short in-class quizzes. Students are responsible for obtaining all missed lecture material or assignments.**
Classroom Citizenship	***Cell-phone use*: Laptops, cellular telephones, and pagers must be turned off and put away during lectures and exams.**
Field Trip Policies	**N/A**
Student Conduct and Discipline	The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year. The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391). A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.
Academic Integrity	The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work. Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records (consult http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-AvoidDishonesty.html for further information). Students suspected of academic dishonesty are subject to disciplinary proceedings.
Academic Integrity (cont'd)	Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course

	will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.
Email Use	The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.
Withdrawal from Class	The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.
Student Grievance Procedures	Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*. In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.
Incomplete Grades	Per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.
Disability Services	The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m. The contact information for the Office of Disability Services is: The University of Texas at Dallas, SU 22 PO Box 830688 Richardson, Texas 75083-0688 (972) 883-2098 (voice or TTY)

	Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance. It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.
Religious Holy Days	The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.
Off-Campus Instruction and Course Activities	Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean.

These descriptions and timelines are subject to change at the discretion of the Instructor.