Chemistry 565, Biophysical Chemistry (Also Chemistry 665/Biochemistry 665 for graduate students)

Credits **4**

Canvas Course URL

https://canvas.wisc.edu/courses/125706

Course Designations and Attributes **Honors**

Meeting Times and Location

Spring Semester 2019 Lectures MTRF 9:55 – 10:45 AM in B371 Chemistry

Wednesday Discussion Sections:

Disc 301, 9:55 – 10:45 am	Chem 2373	Munish Chhabra
Disc 302, 11:00 – 11:50 am	Chem 2311	Dylan Plaskon
Disc 303, 12:05 – 12:55 am	Chem 2311	Hao-Che Wang

Instructional Mode **Lecture-Discussion (face-to-face)**

Specify how Credit Hours are met by the Course **Traditional Carnegie Definition**

INSTRUCTORS AND TEACHING ASSISTANTS

Instructor Title and Name: **Dr. Kate Henderson**

Instructor Availability: Office Hours: Tuesdays 2:00-4:00 pm BSB 6430, or by appointment

Instructor Email/Preferred Contact: **khenderson4@wisc.edu**

Teaching Assistants: Munish Chhabra, Dylan Plaskon, Hao-Che Wang, Claire Evensen

TA Office Hours:

Thurs 2:00 - 3:00 pm	Munish Chhabra	BSB 6430
Thurs 3:00 - 4:00 pm	Claire Evensen	BSB 6430
Mon. 2:30 - 3:30 pm	Dylan Plaskon	BSB 6430

TA Email/Preferred Contact

Dylan Plaskon plaskon@wisc.edu
Munish Chhabra chhabra3@wisc.edu
Hao-Che Wang hwang593@wisc.edu
Claire Evensen cevensen@wisc.edu

OFFICIAL COURSE DESCRIPTION

Course Description

Equilibrium thermodynamics, chemical kinetics, and transport properties, with emphasis on solution behavior and applications to biological macromolecules in solution. For students interested primarily in the biological applications of physical chemistry.

Requisites for Sections

CHEM 327 or CHEM 329; MATH 222; PHYSICS 201 or 207; BIOCORE 303 or BIOCHEM 501 or 507 or concurrent registration, or consent of instructor. Not for credit for those who have taken CHEM 561

Course organization:

1. **Lectures, handout materials and the weekly problem sets** define the course content. You should prepare for class by working through the relevant parts of the handout chapters, sample problems and/or papers. Questions and discussion are encouraged in all class meetings (lecture and discussion).

2. **Discussion section meetings** on Thursdays discuss methods of problem solving, work sample problems, and discuss current lecture material. It is important to prepare for discussion section and to participate actively in discussion; the "optional" listing for these sections means only that no quizzes are given.

3. **Problem sets** are assigned on a weekly basis, and usually are due on Friday. **Doing conscientious work on all the problem sets, and submitting them on or before the date due, is very important for many reasons** (e.g. understanding the material, getting a good grade). Many assigned problems are taken from previous years' exams. It is a very good idea to **form a study group** to discuss approaches to solving problems with others in the class, but do not copy answers from others or from previous years' handouts. **Demonstration of effort on all problem sets is expected.** No credit will be given for work which is not your own.

4. **Advice on the Problem Sets**: It is important that you attempt to work all the problem sets and turn in your work on time. It is equally important that you be able to do this efficiently, without spending too much time on false starts. Consequently, you should plan to start working the problems early in the week in which they are due. Ask for help after class or in office hours if you are confused. Bring your attempts with you. **We will not discuss solutions of problems with people who have not thought about them and attempted to work them.**

5. **Exams**: The three exams are given as proctored problem sets. You may use the printed chapters and handouts, as well as your handwritten notes and problem set answers, but not other textbooks, reference materials or photocopied parts thereof. Any single-purpose calculator can be used, but no other electronic devices are permitted and must be put away during the exam. Makeup exams are not given.

Exam dates are **Thursday 21 Feb., Thursday 4 April, and Thursday 9 May**. The first two exams will be from **7:15-9:15 PM**; the third exam will be from **10:05 AM – 12:05 PM.** Exams are cumulative, but will cover primarily the material since the cut-off date for the previous exam. Please let me know of any academic conflicts with these exam dates during the first week of the course.

LEARNING OUTCOMES Course Learning Outcomes

Specific: 565/665 develops the principles of chemical thermodynamics and chemical kinetics and applies these principles to understand the energetics and mechanisms of biochemical processes in aqueous solution. Processes include chemical reactions (enzyme catalyzed) and noncovalent interactions, including the self-assembly interactions which form functional structures of proteins, nucleic acids, carbohydrates, lipids and their complexes, and the ligand-binding interactions which regulate them.

This material is useful both at a practical level (in understanding the chemical basis of methods for the separation, purification, and characterization of biological molecules) and at a conceptual level (in understanding the thermodynamic and mechanistic principles of biopolymer processes). Although starting with the basics of thermodynamics and kinetics, 565/665 progresses to a level suitable as background for more advanced graduate courses or literature work in biophysical areas including protein and nucleic acid stability and interactions, enzyme catalysis and bioenergetics.

General: Development of Core Competencies Sought by Graduate Schools, Medical Schools and Employers

Science Competency: Apply knowledge and skill in the natural sciences to solve problems related to molecular or macroscopic systems.

***Thinking, Reasoning Competencies*:**

Critical Thinking: Use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.

Quantitative Reasoning: Apply quantitative reasoning and appropriate mathematics to describe or explain phenomena in the natural world.

Scientific Inquiry: Apply knowledge of the scientific process to integrate and synthesize information, solve problems and formulate research questions and hypotheses; be facile in the language of the sciences and use it to participate in the discourse of science and explain how scientific knowledge is discovered and validated.

Written Communication: Effectively convey information to others using written words and sentences.

Interpersonal Competencies

Social Skills: Demonstrate awareness of others' needs, goals, feelings, and the ways social and behavioral cues affect peoples' interactions and behaviors; adjust behaviors appropriately in response to these cues; and treats others with respect.

Teamwork: Work collaboratively with others to achieve shared goals; share information & knowledge with others and provide feedback; put team goals ahead of individual goals.

Oral Communication: Effectively convey information to others using spoken words and sentences; listen effectively; recognize potential communication barriers and adjust approach or clarify information as needed.

Intrapersonal Competencies

Ethical Responsibility to Self and Others: Behave in an honest and ethical manner; cultivate personal and academic integrity; adhere to ethical principles and follow rules and procedures; resist peer pressure to engage in unethical behavior and encourage others to behave in honest and ethical ways; and develop and demonstrate ethical and moral reasoning.

Reliability and Dependability: Consistently fulfill obligations in a timely and satisfactory manner; take responsibility for personal actions and performance.

Resilience and Adaptability: Demonstrate tolerance of stressful or changing environments or situations and adapts effectively to them; be persistent, even under difficult situations; recover from setbacks.

Capacity for Improvement: Set goals for continuous improvement and for learning new concepts and skills; engage in reflective practice for improvement; solicit and respond appropriately to feedback.

GRADING

Grading: Each of the three exams counts 30% of the course grade.

The assigned problem sets contribute in several ways toward your grade:

a) 10% of your course grade

b) if in any third of the course, your problem set average is higher than your grade on the corresponding exam, the problem sets will count toward your exam grade for that portion of the course; AND

c) if the raw exam scores are curved upwards, you must have shown conscientious effort on all 4 of the corresponding problem sets to receive the curved score

Approximate exam grade conversion scale: 87 and above: AB, A
75-86: BC, B
65-74: C
55-64: D

DISCUSSION SESSIONS

Discussion section meetings on Wednesdays discuss methods of problem solving, work sample problems, and discuss current lecture material. It is important to prepare for discussion section and to participate actively in discussion; the "optional" listing for these sections means only that no quizzes are given.

Discussion sections provide opportunities to ask questions about and discuss lecture concepts, sample problems from the chapters, and the current problem set. Most problem solving is done in discussion sections, not in lecture.

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

565/665 is taught from handouts (chapters, papers, problem sets and examples; a nominal charge is made to cover the cost of reproducing these handouts). *No additional textbook is required.*

Supplementary Readings

A) Reference Biophysical Text for September (Not Required for Purchase)

I. Klotz and R. Rosenberg, Chemical Thermodynamics (Benjamin-Cummings). (Numerous editions; any of them is OK.) Chapters 1-11 and 14 provide a detailed and very readable treatment of fundamentals of thermodynamics, at the math level of 565/665, and are very useful outside reading for the first month of the class.

B) Other Reference Books (Not Required)

J. Kuriyan, B. Konforti, D. Wemmer, The Molecules of Life; Physical and Chemical Principles (Garland, 2013). KKW is an advanced undergrad-beginning grad text from UC Berkeley that combines structural biology with chemical thermodynamics and kinetics at the level of 565/665. (The cover is a nice illustration of the attempt to combine these topics.)

K. Dill and S. Bromberg (2010 or 2003) Molecular Driving Forces (Garland). Excellent coverage of biophysical and polymer physical chemistry, from a statistical thermodynamic perspective. Moderately high math level.

T. Creighton, Proteins: Structure, Molecular Properties (2011; Freeman)

V. Bloomfield, D, Crothers and I. Tinoco, (2000) Nucleic Acids (USB);
also (1974) Physical Chemistry of Nucleic Acids (Harper Row)

C. Tanford (1980) Hydrophobic Effect; John Wiley & Sons.

K. van Holde, W. C. Johnson, P. S. Ho, Physical Biochemistry, Prentice-Hall

EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

Exams: The three exams are given as proctored problem sets. You may use the printed chapters and handouts, as well as your handwritten notes and problem set answers, but *not* other textbooks, reference materials or photocopied parts thereof. Any single-purpose calculator can be used, but no other electronic devices are permitted and must be put away during the exam. Makeup exams are not given.

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HOMEWORK & OTHER ASSIGNMENTS

Problem sets are assigned on a weekly basis, and usually are due in class before the start of class on Friday. **Doing conscientious work on all the problem sets, and submitting them on or before the date due, is very important for many reasons** (e.g. understanding the material, getting a good grade). Many assigned problems are representative of exam questions. It is a very good idea to **form a study group** to discuss approaches to solving problems with others in the class, but do not copy answers from others or from previous years' handouts. **Demonstration of effort on all problem sets is expected.** No credit will be given for work which is not your own.

Advice on the Problem Sets: It is important that you attempt to work all the problem sets and turn in your work on time. It is equally important that you be able to do this efficiently, without spending too much time on false starts. Consequently, you should plan to start working the problems early in the week in which they are due. Ask for help after class or in office hours if you are confused. Bring your attempts with you. **We will not discuss solutions of problems with people who have not thought about them and attempted to work them.**

OTHER COURSE INFORMATION

RULES, RIGHTS & RESPONSIBILITIES

- See the Guide's Rules, Rights and Responsibilities

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/