CHEM 773: Physical Biochemistry (3 credits)

Spring 2022

Class Meeting: MW 4:00 p.m. -5:15 p.m. in room CHE 101
Instructor: Dr. Ronald Gary (phone: 702-895-1687; e-mail: ronald.gary@unlv.edu)
Office Hours: Tues 3:00-4:00 p.m. in CHE 214B, and by appointment
Prerequisites: CHEM 475 (Biochemistry II) and graduate standing
Text: Physical Chemistry for the Biological Sciences, 2nd ed. (G. G. Hammes and S. Hammes-Schiffer; 2015)

Course Description: Theory and practice of physical chemistry as applied to the structure, properties, and interactions of biochemical macromolecules. Includes thermodynamics, spectroscopy, electrophoresis, ligand binding, and hydrodynamic methods (covering the theoretical aspects of diffusion, sedimentation, and viscosity).

Learning Outcomes: Students will learn physical chemistry concepts and theories that are relevant to biochemistry. Students will understand and use equations to calculate thermodynamic values, molecular attributes, and hydrodynamic parameters. By the end of this course, the following outcomes are expected.

1. Students will be able to explain the relationships between enthalpy, entropy, and Gibbs free energy, and calculate ΔH, ΔS, and ΔG values for biochemical reactions.
2. Students will be able to explain the temperature-dependence of chemical equilibria and calculate equilibrium constants at different temperatures using the van't Hoff equation and other equations.
3. Students will be able to explain the temperature-dependence of chemical kinetics and calculate rate constants using the Arrhenius equation and other equations.
4. Students will be able to explain the concepts of Stokes radius and frictional coefficient, and calculate values for these parameters from sedimentation and diffusion experimental data.
5. Students will be able to explain the relationship between Stokes radius and elution behavior during gel filtration chromatography, and will be able to critically evaluate different strategies for molecular weight estimation.
6. Students will be able to explain theoretical concepts in ligand binding, including the statistical relationship between micro and macro equilibrium constants. Students will be able to use Scatchard plots and various ligand-binding equations to calculate equilibrium constants, fractional saturation values, and Hill coefficients.
7. And much more!

Exams: Midterms will be on Mon. March 7, 2022 and Mon. April 18, 2022, during the usual class period (4:00 p.m.-5:15 p.m.). The Final Exam will be on Mon. May 9, 2022 (6:00 p.m.-8:00 p.m.).

Grading: There will be two midterm exams (100 points each), a final exam (150 points), and graded homework (150 points), for a total of 500 points possible. Grading Scale: > 90% = A or A-, > 80% = B+, B, or B-, > 70% = C+, C, or C-, > 60% = D, < 60% = F. This grading scale may be adjusted if necessary to produce an appropriate grade distribution.

Make-Up Exams: The following policies apply: (1) If a student must be absent during an exam, accommodations for make-up can be arranged only if the student notifies the instructor (by phone call or voice-mail message to 702-895-1687) prior to the start of the exam. Planned absences (due to scheduled travel, etc.) should be discussed as far in advance as possible. Failure to take the exam at its regularly scheduled time or make prior arrangements with the instructor may result in a score of zero for that exam. (2) Any make-up accommodations are solely at the discretion of the instructor. (3) The format and scoring system used for make-up exams may differ from those used for the regular exam.

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Class Schedule (subject to change):

	Date	Topic
Mon.	01/17/22	*No Class Meeting: Martin Luther King Day Holiday*
Wed.	01/19/22	Thermodynamics (Chaps. 1, 2, 3)
Mon.	01/24/22	Thermodynamics (Chaps. 1, 2, 3)
Wed.	01/26/22	Thermodynamics (Chaps. 1, 2, 3)
Mon.	01/31/22	Thermodynamics (Chaps. 1, 2, 3)
Wed.	02/02/22	Thermodynamics (Chaps. 1, 2, 3)
Mon.	02/07/22	Thermodynamics (literature)
Wed.	02/09/22	Kinetics (Chaps. 5, 6)
Mon.	02/14/22	Kinetics (Chaps. 5, 6)
Wed.	02/16/22	Kinetics (Chaps. 5, 6)
Mon.	02/21/22	*No Class Meeting: Presidents Day Holiday*
Wed.	02/23/22	Kinetics (literature)
Mon.	02/28/22	Micro-rate Constants (literature)
Wed.	03/02/22	Sedimentation (Chap. 18)
Mon.	**03/07/22**	**Midterm #1 (100 points)**
Wed.	03/09/22	Sedimentation (Chap. 18)
Mon.	03/14/22	*No Class Meeting: Spring Break*
Wed.	03/16/22	*No Class Meeting: Spring Break*
Mon.	03/21/22	Sedimentation (literature)
Wed.	03/23/22	Sedimentation (literature)
Mon.	03/28/22	Diffusion (Chap. 18)
Wed.	03/30/22	Viscosity (Chap. 18)
Mon.	04/04/22	Electrophoresis (Chap. 18)
Wed.	04/06/22	Electrophoresis (literature)
Mon.	04/11/22	Ligand Binding/Scatchard Plots (Chap. 17)
Wed.	04/13/22	Ligand Binding/Scatchard Plots (Chap. 17)
Mon.	**04/18/22**	**Midterm #2 (100 points)**
Wed.	04/20/22	Ligand Binding/Scatchard Plots (Chap. 17)
Mon.	04/25/22	Ligand Binding/Scatchard Plots (Chap. 17)
Wed.	04/27/22	Ligand Binding (literature)
Mon.	05/02/22	Spectroscopy (selected topics from Chaps. 10, 11)
Wed.	05/04/22	Spectroscopy (selected topics from Chaps. 10, 11)

Mon. 05/09/22 FINAL EXAM [6:00 p.m. - 8:00 p.m.] (150 points)