September 14, 2005

Course: CHMC21H3F, Topics in Biophysical Chemistry

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Lectures: Room BV 526 Wednesday 12:00–14:00

Required Text: I. Tinoco, K. Sauer, J. C. Wang, and J. D. Puglisi, *Physical Chemistry: Principles and Applications in Biological Sciences*, 4th Edition (Prentice-Hall, Upper Saddle River, New Jersey, 2002).

Marking Scheme for CHMC21H3F, 2005

Problem Sets	30%
1 Term Test	30%
Final Exam	40%
TOTAL	100%

Course Description in Calendar: Advanced topics in Physical Chemistry with emphasis on biochemical systems. Spectroscopic methods for (bio) molecular structure determination, including IR, NMR, UV/VIS; colloid chemistry; polymers and biopolymers, bonding structure and statistical mechanics; physical chemistry of membranes, active transport and diffusion; oscillatory (bio)chemical reactions.

Course Outline: *The Course Description in the UTSC Calendar does not follow the order in which the corresponding topics appear in the text book. In lectures I will follow the order in which the topics appear in the text book. Also, it is clear that we will not have time to cover all of the text book so I shall select/compress topic accordingly.*

The course will consist of selected portions of the textbook. I have indicated much of this material below with some topics left open—I will discuss these with you regarding preferences.

At later stages in the course I use selected thermodynamic biochemical examples from Chapters 1–5, e.g. cooperative binding where they fit in with enzyme kinetics for example.

You might find it helpful to look through the material in these first five chapters as revision. However, I will assume that you have done the prerequisites for this course and so that you will have

covered Chemical Thermodynamics. You can, of course, ask me questions about Thermodynamics.

I recommend that you read Chapter 6 carefully. But you might also read Chapters 7 and 8.

Chapter 6: *Molecular Motion and Transport Properties*
I will do: Kinetic Theory; Molecular Collisions; Mean Free path; Diffusion. I will give a brief account of Sedimentation, Molecular Weight Determination by Sedimentation, Viscosity and Electrophoresis. I will also briefly discuss the size and shapes of molecules.

Chapter 7: *Kinetics: Rates of Chemical Reactions*
I will go through the elementary parts of kinetics fairly quickly, e.g., the definition of the order of a reaction, on the grounds that you have already had some background in kinetics. I will discuss Transition State Theory and Diffusion Controlled Reactions.

Chapter 8: *Enzyme Kinetics*
I will discuss enzyme kinetics in detail since it is a fascinating topic. My approach may differ from the books in part and in mathematical details.

I will also discuss some aspects of oscillatory chemical reactions but the amount of this material will depend on the time available.

Chapter 9–12:
I will deal with selected topics from these chapters. I need to check the following with you. This concerns the material you covered with Professor Jamie Donaldson. (I should comment that I personally prefer Quantum Mechanics to Spectroscopy—the former is the theoretical basis for the latter.)

1. Regarding Quantum Mechanics (Chapter 9)

   (a) Did you discuss the Time-Dependent Schrödinger Equation (TDSE)? The TDSE is

   $$i\hbar\frac{\partial}{\partial t}\Psi = \hat{H}\Psi\,,$$

   where Ψ depends on time, t, and coordinates, e.g., x, y, etc.

   (b) Did you derive the Time-Independent Schrödinger Equation (TISE) from the TDSE? The TISE, i.e., $\hat{H}\psi = E\psi$ where ψ depends on the coordinates, is most often used in Chemical Quantum Mechanics.

   (c) Did you discuss the mathematical fundamentals of chemical bonding—Valence Bond Theory and Molecular Orbital Theory?

2. Regarding Spectroscopy (Chapter 10), how much and what kind of spectroscopy did you cover?

3. I will cover Statistical Thermodynamics (Chapter 11) as much as time permits. There are some very interesting examples on biochemical systems.