



PLEASE TYPE.

DATE 14 July 2016

ACADEMIC UNIT Natural Science Division FACULTY Elizabeth K. Sutton

Discipline	Course # Section	Title of Course	Credit Hours	Cross Reference (if applicable)
CHE	451-01	Physical Chemistry I	3	n / a

TEXTBOOK Required Not Required
 "Physical Chemistry: Thermodynamics,
 Author Atkins, Peter Title Structure and Change", 10th ed.
 Publisher MacMillan Date of Publication 2016

WORKBOOK Required Not Required
 Author _____ Title _____
 Publisher _____ Date of Publication _____

PLEASE ANSWER THE FOLLOWING QUESTIONS ON A SEPARATE SHEET OF PAPER AND ATTACH TO THIS FORM.

1. DESCRIPTION OF COURSE: Develop a brief description of the course as it will appear in the Catalog.
2. STUDENT LEARNING OBJECTIVES: List the student learning objectives for the course. Please relate these objectives to the mission and goals of the University and the Academic Unit. For general education courses, please indicate which student learning objectives address general education goals and the intended method of assessment. A minimum of four of the seven general education goals must be included.

Example: Students will demonstrate their ability to compare and contrast two types of basket weaving. (Goal: Oral and Written Communication; Evidence: research paper and class presentation)
3. COURSE OUTLINE: Outline the topics/units that are to be taught.
4. EVALUATION: How do you plan to determine the grade in the course? Please include grading scale.
5. REQUIREMENTS:
 - a. Examinations: State when tests are to be administered, including unit, mid-term, and final examinations.
 - b. Reports: How many, length required, and what type (Oral, term and/or research, book critiques).
 - c. Supplemental reading assignments or outside work required.
 - d. Supplemental instruction aids: Audio visual aids, field trips, guest speakers, etc.
6. BOOKLIST

DEAN Date Copy Received _____

VICE PRESIDENT FOR ACADEMIC AFFAIRS Date Copy Received _____

- I. **TITLE:** CHE 451 Physical Chemistry I, three credit hours.
- II. **DESCRIPTION OF COURSE:** An introduction to the theoretical foundations of chemistry including thermodynamic properties of physicochemical systems; free energy and equilibria; electrochemical processes; and solutions. Prerequisites: PHY 241; PHY 242; MTH 210; MTH 211 (or concurrent enrollment).
- III. **COURSE OBJECTIVES**
- A. **General Education Curriculum Objectives (GECO):** (numbered to correspond to the listing in the University catalog)
2. Critical Thinking: Students will demonstrate the ability to reflect on theories and issues in a systematic fashion.
 4. Ethics: Students will demonstrate an understanding of Christian values and ethical standards in order to make mature and informed decisions concerning moral issues.
 5. Oral and Written Communication: Students will demonstrate the ability to express ideas, beliefs, and information in an organized, precise, and persuasive manner.
 6. Quantitative Literacy: Students will demonstrate the ability to understand and utilize mathematical and/or logical relationships to analyze data, to construct and assess arguments, and to make sound judgments in quantitative situations that arise in daily life.
 7. Social Responsibility and Citizenship: Students will demonstrate an understanding of personal and social responsibility in a changing global environment so that students can make contributions to their respective discipline and to society as a whole.
- B. **Student Learning Outcomes (SLO):** Students will demonstrate the following outcomes and problem solving abilities in this course. (numbered to correspond to the pertinent General Education Curriculum Objective [GECO])
1. Students will understand and be able to explain the basic principles of physical chemistry. (GECO 2, 6; Evidence: homework, exams)
 2. Students will execute calculations related to quantitative aspects in physical chemistry. (GECO 2, 6; Evidence: homework, exams)
 3. The student will recognize how chemistry provides solutions to contemporary, historical, technological, and societal issues. (GECO 2, 4, 6, 7; Evidence: homework, exams, term project)
 4. Students will follow ethical practices when conducting research, writing reports, using sources and when working with others. (GECO 4; Evidence: exams, term project)
 5. Students will develop an awareness of how a basic understanding of chemistry, the proper application of that knowledge, and the interaction between chemistry and other fields of study and careers is important to personal and social issues. (GECO 4, 6, 7; Evidence: exams, term project)
 6. Students should be able to read, understand, and apply scientific information through thinking more critically, discussing more meaningfully, arguing more persuasively, and writing more effectively. (GECO 2,5; Evidence: homework, exams, term project)
- C. **Program Learning Outcomes (PLO):** (numbered to correspond to the program learning outcomes listed in the program assessment document)
1. The student will be able to demonstrate a solid understanding of the core principles in the traditional subdivisions of chemistry: Analytical, Inorganic, Organic, and Physical.
 4. The student will be able to articulate chemical information/data/ideas clearly and effectively in speech and in writing in an acceptable presentation format.
 6. The student will demonstrate critical thinking skills in chemistry: interpretation, evaluation, explanation, and scientific inquiry; how to ask appropriate questions, gather relevant information effectively and creatively, and reason logically from this information to make reliable conclusions.
- D. **Course Specific Objectives(CSO)**
(Numbered to correspond to the pertinent Program Learning Outcome [PLO])
1. The student will review needed mathematical methods and will learn the basic concepts of statistical mechanics as they apply to physical chemistry. (PLO 1,4,6; Evidence: homework, exams)

2. The student will learn the mathematical foundations of the gas laws, thermodynamics, phase changes, equilibrium, and electrochemistry. (PLO 1,4,6; Evidence: homework, exams)
3. The student will learn the kinetic-molecular theory of gases, liquids, and solids, and learn to predict and understand various properties. (PLO 1,4,6; Evidence: homework, exams)
4. The student will learn to apply what you learn to solve relevant problems, both on homework and on regular exams. (PLO 1,4,6; Evidence: homework, exams)
5. The student will learn how the principles of physical chemistry are applied in real-world situations, devices, and instrumentation. (PLO 1,4,6; Evidence: homework, exams)

E. Specific Course Competencies:

1. Students will demonstrate the use of the first law of thermodynamics to equilibrium, enthalpy and heat capacity.
2. Students will demonstrate the use of the second and third laws of thermodynamics to entropy, entropy changes and absolute entropies.
3. Students will demonstrate the use of the thermodynamic laws with free energy, equilibrium, fugacity and activity.
4. Students will demonstrate the relationships between vapor pressure, distillation and equilibria.
5. Students will demonstrate the effects of solutes in solution.
6. Students will demonstrate the principles of the phase rule in one, two and multi-component systems.
7. Students will demonstrate the use of the principles of phase and chemical equilibria.
8. Students will demonstrate the use of electrochemical cells and electrodes.
9. Students will demonstrate the use of rate laws in chemical reactions.

IV. COURSE OUTLINE

- A. Mathematics Review/Tutorial - The basics of multivariable calculus as it applies to thermodynamics
- B. Properties of Gases
 1. Relationships between temperature, pressure & volume
 2. Ideal gas law
 3. Kinetic theory of gases
- C. The First Law of Thermodynamics
 1. Work, Heat and Internal Energy
 2. The First Law
 3. Enthalpy
 4. Thermochemistry
- D. The Second Law of Thermodynamics
 1. Gibbs Equations
 2. Maxwell Relations and other relations
 3. The Carnot Cycle
 4. The Second Law
 5. Calculation of Entropy
 6. Third Law of Thermodynamics
 7. Free energy and Temperature effects
 8. Fugacity
 9. Open Systems
 10. Thermodynamics of Mixing
- E. Phase Equilibria
 1. One Component Systems
 2. Two (or more) Component Systems
- F. Chemical Equilibria
 1. Relation of the equilibrium constant to thermodynamic variables
 2. Variation of the equilibrium constant with temperature and pressure
 3. Choices of Standard States
- G. Electrochemistry
 1. Nernst Equation and Chemical Cells
 2. Activity of Electrolytes
 3. Determination of Activity Coefficients
 4. Solutions of Electrolytes
- H. Kinetic Theory

- I. Chemical Kinetics--Gas Phase
 - 1. Reaction Rate--Rate Law
 - 2. Orders of Chemical Reactions
 - 3. Determination of Reaction Order
 - 4. Mechanism of Chemical Reactions
 - 5. Reversible or Opposing Reactions
 - 6. Consecutive and Parallel Reactions
 - 7. Effect of Temperature on Reaction Rate
 - 8. Kinetic Theories
- J. Liquid Phase Kinetics
- K. Surface Chemistry

V. COURSE EVALUATION

The evaluation for this course will be distributed as follows:

Hourly Exams (3)	60%	91-100	A
Homework & Quizzes	25%	81-90	B
Final Exam (comprehensive)	15%	71-80	C
		61-70	D
TOTAL	100%	Below 60	F
If, for any reason, you cannot continue to attend this class, be certain you DROP IT OFFICIALLY . Otherwise you will automatically receive a failing grade.			
Dates to Remember:			
Evening classes begin	Aug 29	Fall Break-No Classes	Oct 20-21
Day classes begin	Aug 30	First Bi-term ends	Oct 22
Last day add /register for Fall term	Sep 2	Second Bi-term begins	Oct 24
Labor Day-No Class	Sep 5	Last day to drop a semester class with W	Nov 18
Last day to drop 1 st Bi-term class with W	Oct 7	Thanksgiving Break-No Classes	Nov 23-25
Midterm Week	Oct 17-21	Finals Week	Dec 12-16

VI. COURSE REQUIREMENTS

A. Attendance: The attendance policy of the University will be strictly enforced in this class. An attendance sheet will be passed around at each class meeting. If a student is more than 15 minutes late (by my watch), then that student will be counted as absent.

B. Numbers to Remember:

1. Campus Security Cell Phone: 270-403-3611
2. Campus Security Office Phone: 270-789-5555
3. Natural Science Division Office Phone: 270-789-5065

C. Examinations

Three or four hourly exams (100 points each) will be given throughout the semester, with exam dates being announced in class approximately a week in advance. A COMPREHENSIVE two hour final valued at 100-400 points will be given at the end of the semester according to the exam schedule furnished by the Academic Dean's office. NO MAKE-UP EXAMS WILL BE GIVEN. If an exam is missed throughout the semester, the value of the final exam will increase in proportion to the number of exams missed. The maximum number of hourly exams which may be missed is two. (The final exam may not be missed.) Cases of prolonged absence, severe illness, or death in the immediate family will be handled on an individual basis.

Students will be administered the American Chemical Society (ACS) standardized exam during the final week of class to aid in the assessment of the chemistry program. Every student who completes Physical Chemistry is required to take this exam. The exam will consist of multiple choice questions. If your score on the ACS exam exceeds certain thresholds, you will receive bonus points added to your final exam score. Details will be provided in class early in the semester. Thus, the ACS exam can only help a student's grade and you are encouraged to strive for perfection on this exam.

D. Homework

In order to succeed in any course, it is necessary to be able to apply the theory learned. One method of doing this is by working problems which deal with the topics discussed. Throughout the semester, homework assignments will be assigned, turned in and graded. LATE PAPERS ARE NOT ACCEPTED unless you have a very valid reason for a PROLONGED ABSENCE.

E. Classroom Behavior

1. Guests are only allowed in class at the discretion of and with prior approval from the instructor.
2. Electronic recording devices of any kind are not permitted except in special circumstances and with the specific permission of the instructor.
3. While you are expected to attend and participate in this class, your cell phone, computer, and MP3 players are **not**. Pagers, cell phones, and similar items are disruptive to the entire class and **must be turned off** during class. **The owner of any such device that activates during class will be immediately excused from class and counted as absent for the entire period.**
4. Use of cell phones, computers, and MP3 players during examinations and quizzes will be considered academic dishonesty, which will result in a zero being awarded for the quiz or examination (No exceptions!).
5. Hats and caps are to be removed prior to entering the classroom.
6. Take care of any physiological needs *before* coming into the classroom.
7. Unacceptable student behaviors:
 - a. Sleeping during class
 - b. Chronic tardiness. Be here ready to learn when class begins.
 - c. Reading, studying or working on materials for other classes.
 - d. Chatting with your classmates when the instructor or other classmates are speaking.
 - e. Prematurely packing up your books and bags before class has been dismissed.

- F. **Academic Misconduct/Integrity:** Students in this course will be working toward mastery of the material to satisfy the course objectives. ***This class is held to an honor system, meaning that cheating, allowing someone to cheat, or failing to report known cases of cheating are all considered academic misconduct.*** Cheating includes, but is not limited to, any attempt to present the work of another as your own; discussing or copying exams, quizzes, or homework with students who have not yet completed them; using "cheat sheets" on exams or quizzes; altering a test for re-grade, plagiarism of primary or secondary sources of information or using programmable calculators to store and/or recall prohibited information for an exam. Any student who refuses to allow a calculator to be inspected by the instructor upon request will not be allowed to use that calculator on the exam/quiz. Be aware that aggressive methods are used to protect the majority of you who are honest. Violations will be dealt with according to the University and Divisional policies. A copy of the Division of Natural Sciences (DNS) policy on Academic Integrity will be available on the course TigerNet page. Please read this policy and take it very seriously. For information about plagiarism and how to avoid it, consult the following website: <https://www.indiana.edu/~academy/firstPrinciples/>. Students will be asked to sign an integrity statement on each examination and quiz. The following statement reads as follows:

"I pledge on my honor that on this assignment/examination/quiz I have neither received nor given nor have I seen any dishonest work.

Signature _____ Date _____"

G. Teaching Methods

Students will be taught concepts, applications and problem-solving techniques through lecture, demonstrations, class discussion and actual problem solving.

VII. BOOK LIST

- A. *Elements of Physical Chemistry*, 5th ed, Atkins and dePaula, (2009), ISBN: 978-1-4292-1813-9
- B. *Physical Chemistry*, 9th ed., Atkins and dePaula, (2010) ISBN: 978-1-4292-5513-4
- C. *Physical Chemistry*, 3rd ed., by Silbey and Alberty, ISBN 0-471-38311-2
- D. *Applied Mathematics for Physical Chemistry*, 2nd ed., by J. R. Barrante, ISBN 0-13-741737-3
- E. Adamson, Arthur W; A Textbook of Physical Chemistry, 2nd ed., Academic Press, Inc., (1979).
- F. Alberty, Robert A; Physical Chemistry, 7th ed., John Wiley & Sons, Inc., (1987)
- G. Lippincott, W. T., ed.; Essays in Physical Chemistry, American Chemical Society, (1988).

VIII. DISABILITIES

Campbellsville University is committed to reasonable accommodations for students who have documented physical and learning disabilities, as well as medical and emotional conditions. If you have a documented disability or condition of this nature, you may be eligible for disability services. Documentation must be from a licensed professional and current in terms of assessment. Please contact the Coordinator of Disability Services at 270-789-5192 to inquire about services.

IX. ACADEMIC SUPPORT

The Academic Support area, located in the Badgett Academic Support Center (BASC), exists to help students. At certain times, most students need some help with studying, choosing a career, major/minor, or assistance in a difficult course. The following services are available Career Services, Disability Services, tutoring, and the Citizens Bank & Trust Writing Center. *These services are provided at no extra cost to the student.* Space is also available for individual and group study, and laptop computers are available for students to check-out and use within the building. Information about these services is accessible by clicking on the "Current Students" tab on the University website at www.campbellsville.edu. Information is also available by calling the Office of Academic Support at (270) 789-5064.

X. TITLE IX

Campbellsville University and its faculty are committed to assuring a safe and productive environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office of Civil Rights, the University requires all responsible employees, which includes faculty members, to report incidents of sexual misconduct shared by students to the University's Title IX Coordinator.

Title IX Coordinator:

Terry VanMeter

1 University Drive

UPO Box 944

Campbellsville, KY 42718

Administration Office 8A

Phone: 270-789-5016

Email: twvanmeter@campbellsville.edu

Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: www.campbellsville.edu/titleIX

TENTATIVE COURSE SCHEDULE

WEEK OF

TOPIC/TEXT

AUG 29	Introduction, Mathematical Review
SEP 5	Monday-Labor Day-No Class
	Zeroth Law of Thermodynamics, Equations of State, Properties of Gases
12	First Law of Thermodynamics
19	First Law of Thermodynamics--con't.
	EXAM 1 (given during lab time)
26	Second Law of Thermodynamics, Third Law of Thermodynamics
OCT 3	Second & Third Laws--con't., Gibbs Energy and Helmholtz Energy
10	Gibbs Energy & Helmholtz Energy--con't.
17	EXAM 2 (during lab time)
	Chemical Equilibrium
	Friday-Oct. 21-Fall Break-No Class
24	Chemical Equilibrium--con't., Phase Equilibrium-One Component Systems
31	Phase Equilibrium- One Component Systems--con't.
NOV 7	Phase Equilibrium-Two and Three Component Systems
14	Electrochemical Equilibrium
	EXAM 3 (during lab)
21	Kinetic Theory of Gases
	Wed/Fri [Nov. 23 & 25] Thanksgiving Break-No Class
28	Kinetic Theory of Gases--con't
DEC 5	Experimental Kinetics, Chemical Kinetics and Rate Laws
	General Review
12	FINALS WEEK

CHE 451-01: Physical Chemistry

Student's Acceptance of Course Policies

Please fill out and sign the following form and **return it no later than** _____ to the instructor.

Use a blue or black pen (no pencil).

I, _____, have read the entire syllabus describing the course
(Print your name neatly)

policies for CHE 451, Physical Chemistry, taught by Ms. E. Kay Sutton. I fully understand these policies and I agree to comply with them during the entire _____ term.

Signature: _____ Date: _____