LSC Use Only Proposal No: LSC Action-Date:	UWUCC Use Only Proposal No: 12-24f UWUCC Action-Date: App - 10/16/12 Senate Action Date: App-11/6/12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Anne Kondo**	Email Address **akondo@iup.edu**
Proposing Department/Unit **Chemistry**	Phone 74595

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

_____ New Course _____ Course Prefix Change _____ Course Deletion

__X__ Course Revision _____ Course Number and/or Title Change __X__ Catalog Description Change

Current course prefix, number and full title: CHEM 342 Physical Chemistry II

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

_____ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

_____ Learning Skills _____ Knowledge Area _____ Global and Multicultural Awareness _____ Writing Intensive (include W cover sheet)

_____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

_____ Global Citizenship _____ Information Literacy _____ Oral Communication

_____ Quantitative Reasoning _____ Scientific Literacy _____ Technological Literacy

3. Other Designations, as appropriate

_____ Honors College Course _____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

_____ Catalog Description Change _____ Program Revision _____ Program Title Change _____ New Track

_____ New Degree Program _____ New Minor Program _____ Liberal Studies Requirement Changes _____ Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)		4/12/11
Department Chairperson(s)		4/12/12
College Curriculum Committee Chair		4/20/12
College Dean		4/20/12
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	10/16/12

Received
APR 20 2012
Liberal Studies

REVISED SYLLABUS OF RECORD FOR CHEM 342
PHYSICAL CHEMISTRY II

I. CATALOG DESCRIPTION

COURSE TITLE:	CHEM 342, Physical Chemistry II
NUMBER OF CREDITS:	3 cr (3c-0l-3cr)
PREQUISITES:	CHEM 341, MATH 225 (may be taken concurrently)
COURSE DESCRIPTION:	In-depth exploration and applications of chemical thermodynamics, equilibria, kinetics, quantum mechanics, and spectroscopy.

II. COURSE OBJECTIVES

After completion of the course, students will be able to:

1. analyze and compare the thermodynamics of ideal vs. real chemical systems on microscopic and macroscopic scales
2. perform calculations of enthalpy, entropy, free energy and chemical potential for complex chemical systems, and interpret the results
3. analyze phase diagrams of pure substances and mixtures
4. apply chemical kinetic analysis using collision theory, absolute rate theory, transition state theory; explain kinetic isotope effects
5. describe molecular reaction dynamics including molecular beams, trajectories, and lasers.
6. explain and apply the postulates of Quantum Mechanics to derive and solve simple Schrodinger equations for model systems and explain/interpret the solutions for complex systems
7. explain the origins and meanings of quantum numbers, and relate these to atomic and molecular structure and spectra

III. DETAILED COURSE OUTLINE

LECTURE

1.	Applications of the First Law of Thermodynamics (Enthalpy, non-ideal systems; standard states)	3 hours
2.	Applications of the Second and Third Laws of Thermodynamics (Entropy, Gibbs Free Energy and applications. Statistical origin of entropy.)	4 hours
3.	Chemical Potential and Chemical Equilibria(Gibbs chemical potential applied to chemical and phase equilibria; activities; Debye-Huckel limiting law. Gibbs phase rule; thermodynamics of electrochemical cells.)	4 hours
4.	Chemical Potential and Physical Equilibria (phase equilibria; phase diagrams; active and passive transport)	3 hours
5.	Exam #1	1 hour
6.	Molecular Motion and Transport Properties (Kinetic theory, origin of Boltzmann distribution, equipartition of energy, molecular collisions, mean free path, diffusion, viscosity)	5 hours

7.	Theories of Chemical Kinetics (Relaxation processes. Microscopic reversibility. Expressing mechanisms in rate laws. Steady state approximation for complex reactions. Collision theory; transition state theory. Isotope effect. Molecular reaction dynamics including molecular beams, trajectories, and lasers)	4 hours
8.	Exam # 2	1 hour
9.	Deriving and Solving the Schrodinger Equation for Simple systems (Particle in a box, rigid rotor, harmonic oscillator, hydrogen atoms)	3 hours
10.	Quantum Mechanics and Atoms (angular momentum. Hydrogen atom; hydrogenic wave functions. Spin; Pauli principle. Quantum numbers, Approximate methods. Helium atom. Hydrogen molecule ion; hydrogen molecule, Diatomic molecules. LCAO method. Computational chemistry.)	5 hours
11.	Spectroscopy (Light-matter interaction; stationary states, dipole selection rules. Rotational spectra of linear molecules. Vibrational spectra. Term symbols. Electronic spectra of atoms and molecules. Raman spectroscopy; multiphoton selection rules. Lasers.)	8 hours
12.	Exam #3	1 hour
	Final Exam - during scheduled final exam period	2 hours

IV. EVALUATION METHODS

Evaluation consists of three lecture exams, regular quizzes and homework assignments, and a comprehensive final exam.

Quizzes –	15%
Assignments –	15%
Semester Exams –	50%
Final Exam	20%

V. GRADING SCALE:

$x \geq 90$	A
$90 > x \geq 80$	B
$80 > x \geq 70$	C
$70 > x \geq 60$	D
$60 > x$	F

VI. UNDERGRADUATE COURSE ATTENDANCE POLICY:

Attendance is expected for all classes. Individual faculty will include in their syllabus an attendance policy consistent with the Undergraduate Course Attendance Polity in the IUP Undergraduate Catalog.

VII. REQUIRED TEXTBOOK

P. Atkins and J. de Paula, *Physical Chemistry*, ninth edition, WH Freeman, New York, 2010.

VIII. SPECIAL RESOURCE REQUIREMENTS

Students may be expected to have their own programming calculators and to use the software available in the Chemistry Department Computer Classroom. In addition students should have access to a computer to use web sites that provide supplementary information.

Bibliography

P. Atkins and J. de Paula, *Physical Chemistry*, ninth edition, WH Freeman, New York, 2010.
P. Atkins and J. de Paula, *Physical Chemistry for Life Sciences*, 1st edition, WH Freeman, New York, 2006.
G.M. Barrows, *Physical Chemistry*, sixth edition, McGraw- Hill, New York, 1996.
R. Chang, *Physical Chemistry for the Biosciences,* University Science Books, 2005
T. Engel, P. Reid, Physical Chemistry, second ed., Prentice Hall, 2010
H. Kuhn, H.D. Forsterlin, D.H Waldeck, Principles of Physical Chemistry, second edition, J. Wiley & sons, 2009
I. Levine, Physical Chemistry, sixth edition, McGraw-Hill, 2009.
J.H. Noggle, *Physical Chemistry*, third edition, Harper Collins, New York, 1996.
I. Rinoco, Jr., I., K. Sauer, J.C. Wang, J.D. Puglisis, Physical Chemistry: Principles and Applications in Biological Sciences, fourth edition, Prentice Hall, 2002
R. J. Silbey, R. A. Alberty, M. G. Bawendi *Physical Chemistry*, fourth edition, John Wiley and Sons, 2004

Course Analysis Questionnaire

Section A: Details of the Course

A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

The B.S. Chemistry degree is certified by our professional organization, The American Chemical Society (ACS). The ACS has recently rewritten its requirements for a certified degree, recommending sequences of foundation and in-depth courses beyond the introductory freshman courses. Currently, B.S. Chemistry majors and B.S. Chemistry/Pre-Med majors are required to take CHEM 341 (Physical Chemistry I, covering the two major topics of thermodynamics and kinetics) and CHEM 342 (Physical Chemistry II, covering the two major topics of spectroscopy and quantum mechanics), while B.A. Chemistry and B.S. Education/Chemistry majors take only CHEM 341. B.S. Biochemistry majors take a separate course, CHEM 340 (Physical Chemistry for the Biological Sciences) that surveys all four primary physical chemistry topics covered in CHEM 341 and CHEM 342. To streamline our offerings, to increase enrollment in our upper level courses, and to increase the exposure of Chemical Education and B.A. Chemistry students to more physical chemistry concepts, CHEM 341 will become a foundation Physical Chemistry course required of all chemistry and biochemistry majors, covering all four topics at the intermediate level, with chemical and biochemical applications. CHEM 342 will become an in-depth course, required for the BS Chemistry and BS Chemistry/PreMed majors, discussing more detailed and complex problems and applications in all four topic areas.

A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.

Yes, the revisions to CHEM 342 (Physical Chemistry II) are prompted by changes to CHEM 341 (Physical Chemistry I). The revised course proposal for CHEM 341 accompanies this package.

A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).

The course has not been offered at IUP on a trial basis.

A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.

The course is not a dual-level course.

A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?

The course is not variable credit.

A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).

All universities with certified B.S. degrees offer at least two courses in Physical Chemistry. Examples include:
University of Pittsburgh, CHEM 1420 Physical Chemistry 2
Duquesne University CHEM 322 Physical Chemistry II
Youngstown State University CHEM 3740 Physical Chemistry 2

A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.
The American Chemical Society Committee for Professional Training, publishes requirement and recommendations for certified degrees. Their documentation is available at: www.acs.org ⇒ Education, Professional Training (CPT) ⇒ ACS Guidelines and Supplements.

Section B: Interdisciplinary Implications

B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.
This course will be taught by faculty from the chemistry department.

B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant *memoranda from these departments that clarify their attitudes toward the proposed change(s).*
The course content is unique to the chemistry department.

B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.
The course will not be cross-listed with other departments.

Section C: Implementation

C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.
Faculty resources are adequate. The course has been, and will continue to be, taught once per year.

C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy?
No additional space, equipment, laboratory supplies and other consumable goods, library materials and travel funds are required by this revision.

C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)
The resources for this course are not funded by a grant.

C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?
The course has been, and will continue to be, taught once per year, in the fall semester.

C5 How many sections of this course do you anticipate offering in any single semester?
One section of this course will be taught in the fall semester.

C6 How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?
The capacity of this section will be determined by the size of the class room.

C7 Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents.
Our professional society does not recommend enrollment limits or parameters on this course.

C8 If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.
The course is not a distance education course.

Section D: Miscellaneous

Include any additional information valuable to those reviewing this new course proposal.
N/A.

2. Summary of Proposed Revisions

The original content of CHEM 341 and CHEM 342 has been reorganized from presenting two separate courses on four primary topics (thermodynamics and kinetics, and spectroscopy and quantum mechanics) to a foundation course plus an in-depth course, each covering all four topics, but to different degrees of depth and difficulty.

The MATH prerequisites have been updated to reflect current MATH offerings.

3. Justification/rationale for the revision

The B.S. Chemistry degree is certified by our professional organization, The American Chemical Society (ACS). The ACS has recently rewritten its requirements for a certified degree, recommending sequences of foundation and in-depth courses beyond the introductory freshman courses. Currently, B.S. Chemistry majors and B.S. Chemistry/Pre-Med majors are required to take CHEM 341 (Physical Chemistry I, covering the two major topics of thermodynamics and kinetics) and CHEM 342 (Physical Chemistry II, covering the two major topics of spectroscopy and quantum mechanics), while B.A. Chemistry and B.S. Education/Chemistry majors take only CHEM 341. B.S. Biochemistry majors take a separate course, CHEM 340 (Physical Chemistry for the Biological Sciences) that surveys all four primary physical chemistry topics covered in CHEM 341 and CHEM 342. To streamline our offerings, to increase enrollment in our upper level courses, and to increase the exposure of Chemical Education and B.A. Chemistry students to more physical chemistry concepts, CHEM 341 will become a foundation Physical Chemistry course required of all chemistry and biochemistry majors, covering all four topics at the intermediate level, with chemical and biochemical applications. CHEM 342 will become an in-depth course, required for the BS Chemistry and BS Chemistry/PreMed majors, discussing more detailed and complex problems and applications in all four topic areas.

4. Old Syllabus of Record – appended

5. Letters of support – N/A

OLD SYLLABUS FOR CHEM 342
PHYSICAL CHEMISTRY II

I. CATALOG DESCRIPTION

COURSE TITLE:	CHEM 342, Physical Chemistry II
NUMBER OF CREDITS:	3 cr (3c-0l-4sh)
PREQUISITES:	CHEM 341
COURSE DESCRIPTION:	A study of solids, liquids, surfaces, chemical kinetics, electrochemistry, atomic and molecular structure.

II. COURSE OBJECTIVES

The students are expected to understand and to be able to apply quantum mechanics and molecular statistics to solids, liquids, surfaces, chemical kinetics, electrochemistry and atomic and molecular structure.

III. DETAILED COURSE OUTLINE

LECTURE Since this course is closely connected with Physical Chemistry Laboratory II (CHEM 344) many of the examples used to illustrate physical principles are related to actual experiments conducted in the laboratory course.

1. Quantum Mechanics and Atomic Structure — 10 lectures
   Electromagnetic Radiation, Atomic Spectra and the Old Quantum Theory, The Nature of Electrons, The Schrodinger Wave Equation, Postulates of Quantum Mechanics, Quantum Mechanics of Simple Systems, Quantum Mechanics of Hydrogen-like Atoms, The Quantum Numbers, The Spin Quantum Number, Many Electron Atoms
2. Quantum Mechanics and Molecules — 8 lectures
   The Hydrogen Molecule, Valence Bond Theory, Approximation Methods, Symmetry in Chemistry, Molecular Orbitals
3. Application of Quantum Theory – Chemical Spectroscopy — 10 lectures
   Emission and Absorption Spectra, Atomic Spectra, Rotational Spectra of Molecules, Vibrational-Rotational Spectra of Molecules, Electronic Spectra, ESR and NMR
4. Molecular Statistics — 9 lectures
   Forms of Molecular Energy, Statistical Mechanics, The Maxwell-Boltzmann Distribution Law, Partition Functions, Molecular Thermodynamics, Equilibrium, Rate Constants

LABORATORY – The laboratory is CHEM 343, a one credit course. The material covered in CHEM 341 is closely related to the experiments in CHEM 343.

IV. EVALUATION METHODS

Evaluation consists of lecture exams, 7-8 homework assignments and a comprehensive final exam, which is 1/3 of the final grade.

V. REQUIRED TEXTBOOK

Lecture: Silbey, R. J. *Physical Chemistry*, 3rd Edit., John Wiley & Sons, New York, NY, 2001.

VI. SPECIAL RESOURCE REQUIREMENTS

Students are expected to have their own programming calculators and to use the software available in the Chemistry Department Computer Classroom. In addition students should have access to a computer to use web sites that provide supplementary information.