LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		04-13f	Appr 10/26/04	Appr 12/7/04

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person	Email Address
Dr. Roberta Eddy	rmeddy@iup.edu
Proposing Department/Unit SDR/Science for Disaster Response	Phone 724-357-4482

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

1. Course Proposals (check all that apply)

__X__ New Course _____ Course Prefix Change _____ Course Deletion

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

	SDR 221 Chemistry of Precursor Compounds
***Current* Course prefix, number and full title**	***Proposed* course prefix, number and full title, if changing**

2. Additional Course Designations: check if appropriate

_____ This course is also proposed as a Liberal Studies Course.

_____ This course is also proposed as an Honors College Course.

_____ Other: (e.g., Women's Studies, Pan-African)

3. Program Proposals

_____ Catalog Description Change _____ Program Revision

_____ New Degree Program _____ Program Title Change _____ Other

_____ New Minor Program _____ New Track

***Current* program name**	***Proposed* program name, if changing**

4. Approvals		**Date**
Department Curriculum Committee Chair(s)	Wendy Lou Elcesser	4-06-04
Department Chair(s)	Ruess Van Tassell Ramsey*	4-06-04
College Curriculum Committee Chair		08/10/04
College Dean	John D. Eck	8/19/04
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate:		
(include title)		
UWUCC Co-Chairs	Gail Skelnick	10-26-04

* where applicable

* see letter

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RECEIVED OCT 29 2004 LIBERAL STUDIES

SYLLABUS OF RECORD

I. Catalog Description

SDR 221 Chemistry of Precursor Compounds — 3 class hours, 4 lab hours, 5 credit hours (3c-4l-5cr)

Prerequisites: SDR 121 and permission of instructor and local, state or federal agency/organization authorization.

Level 2 chemistry designed to lay the foundation for understanding the modes of action and preparation of various chemical agents. Topics include the basic organic chemistry of the alkanes, alkenes, alkynes, alcohols, and aromatics (the major TICs and TIMs); free radical chemistry; explosives; the vesicants and lachrymators; and stereochemistry. Laboratory exercises include synthetic techniques to aid the student in quick identification of clandestine drug activities or agent synthesis.

II. Course Objectives

Students successfully completing this course will be able to

1. Name an organic compound when given the structural formula of the organic compound. (This is key at an incident site because usually there are several agencies present and communication is a key problem.)
2. Assess the information from an incident involving hazardous organic compounds by applying the basic concepts of organic chemistry.
3. Assess an incident for hazards by applying knowledge of the spatial relationships among molecules. (This is particularly important because the nerve agents are optically active.)
4. Evaluate the hazards associated with cycloalkanes with respect to their strain energy.

5. Evaluate the hazards of an incident with respect to the properties and reactions of alkanes.
6. Evaluate an incident for hazards associated with S_N1 and S_N2 nucleophilic substitution reactions.
7. Assess an incident site for hazards associated with mustards.
8. Assess an incident site for hazards associated with elimination reactions.
9. Assess an incident site for hazards associated with alkenes.
10. Assess an incident site for hazards associated with alkynes.
11. Assess an incident site for hazards associated with alcohols.
12. Assess an incident site for hazards associated with ethers.
13. Assess an incident site for hazards associated with aromatics and polycyclic aromatic hydrocarbons (PAHs), particularly those PAHs that are powerful carcinogens.
14. Assess an incident site with respect to the hazards associated with chemical explosives.

III. Detailed Course Outline

Lecture (42 hours total)

A. Communication of Chemical Information – Nomenclature (2 hours)

As previously stated, the responders to a chemical incident must be able to recognize the compounds present no matter if the molecular formula is written out in IUPAC nomenclature, a structural formula is represented, or a commercial name is used. They must be able to give correct information to other agencies on site.

1. Acyclic hydrocarbons
2. Cyclic hydrocarbons
3. Alkenes
4. Alkynes
5. Bicyclic compounds
6. Enantiomers

B. Basic Concepts of Organic Chemistry (4 hours)

1. Chemical calculations

2. Classification of organic compounds, general hazards that may be associated with each functional group, and which can be used as weapons easily
    i. Alkanes
    ii. Alkenes
    iii. Alkynes and alkynes that may be used as explosive precursors
    iv. Alcohols
    v. Carboxylic acids and the carboxylic acids that are important Toxic Industrial Compounds (TICs)
    vi. Esters and phosphate esters used as nerve agents
    vii. Amides
    viii. Amines and the amines that are used as chemical weapons
3. Lewis dot structures of organic molecules
4. Chemical bonding and atomic orbital theory
5. Structural formulas of organic compounds
6. Complex alkanes
7. Bond lengths and bond strengths for single, double, and triple bonds
8. Polarity of organic molecules
9. Molecular interactions
10. Effects of intermolecular forces of attraction on physical properties of organic compounds
11. Acidic and basic organic compounds, special hazards associated with organic bases, and bases that are used as chemical weapons
12. Resonance
13. Predicting melting and boiling point temperatures of the following in order to take the appropriate containment action more rapidly:
    i. Alkanes
    ii. Structural isomers
    iii. Alcohols
    iv. Functional isomers
    v. Primary, secondary, and tertiary amines

vi. Thiols versus the corresponding alcohols and precursors to mustard agent

14. Predicting hazards associated with widely used compounds that are representative of familiar functional groups
15. Classifying hydrocarbons as aliphatic, cyclic, or aromatic based on the characteristics of the hydrocarbon
16. Calculating units of unsaturation

C. Natural Gas, LPG and Gasoline (2 hours)
   1. IUPAC Rules of Nomenclature for Alkanes
   2. Unbranched alkanes
   3. Cycloalkanes
   4. Branched alkanes
   5. Special dangers associated with refineries

D. Spatial Relationships Among Molecules: One of the Keys to Understanding Organic Reactions (5 hours)
   1. Definition of isomers
   2. Constitutional isomers
   3. Functional isomers
   4. Stereoisomers
   5. Geometric isomers
      i. Nomenclature
      ii. Melting and boiling point temperature differences between E and Z isomers
      iii. Relative stabilities of E and Z isomers
   6. Conformational isomers
   7. Interpreting Newman projections for stereochemical relationships
   8. Optical Activity and Stereoisomers with a focus on the optically active nerve agents, resolution of optically active nerve agents and how resolution greatly changes their effect
      i. Enantiomers
         1. Definition

2. Interaction with plane polarized light
3. Predicting the resolution of enantiomers

ii. Chirality

1. Achiral molecules vs chiral molecules
2. Importance of some chiral molecules found in nature
3. Allenes and chirality
4. Interpreting the "normal 3-D" structural formula and Fischer Projection of a molecule
5. Cahn-Ingold-Prelog Method for Absolute Configuration
6. Meaning of absolute configuration of a molecule
7. Using the Cahn-Ingold-Prelog Method to determine the absolute configuration of a molecule
8. Comparison of the interaction of tyrosine with acetylcholine with the interaction of the nerve agents with acetylcholine
9. Absolute configuration of the α-amino acids using (*R*) and (*S*) or *D* and *L* notation

iii. Diastereomers

iv. Distinguishing between enantiomers and diastereomers

v. Meso compounds

vi. Optical resolution.

E. Small Ring Molecules and Their Potential for a Vigorous Reaction (2 hours)

1. Angle strain
2. Comparison of the heat of combustion per CH_2 group of a given cycloalkane to the heat of combustion of cyclohexane
3. Strain energy of small cycloalkanes

i. Cyclopropane

ii. Cyclobutane

iii. Cyclopentane

iv. Unsubstituted cyclohexane

v. Monosubstituted cyclohexane

F. Alkanes: Properties and Reactions (3 hours)

1. Physical properties and hazards of alkanes
2. Major source of the alkanes in relation to the hazards of alkanes
3. Laboratory preparations of alkanes
4. Organometallic compounds and their use as possible weapons
5. Leaving groups
6. Nucleophiles
7. Hazards of the hydrogenolysis reaction and its use in clandestine drug labs
8. Hazards associated with the common reducing reagents, lithium aluminum hydride and sodium borohydride, and their possible use as weapons
9. Reactions of alkanes
10. Radical stability
11. The free radical halogenation reaction of alkanes and the possible use of this reaction as a weapon
12. The relative reactivity of the halogens in the free radical halogenation reaction of alkanes

G. Nucleophilic Substitution Reactions (3 hours)

1. Description of nucleophilic substitution reactions
2. Definitions of electrophile, nucleophile, and leaving group and the relationship to the reactivity of nerve, blister and chocking agents
3. The bimolecular nucleophilic substitution (S_N2) mechanism and the long life of mustard agent
4. The unimolecular nucleophilic substitution (S_N1) mechanism
5. Basic principles of kinetics applied to nucleophilic substitution reactions
6. Basic principles of thermodynamics applied to nucleophilic substitution reactions
7. Predicting the order of a nucleophilic substitution reaction
8. Predicting the effect that the structure of an alkyl halide has on nucleophilic substitution reactions
9. The nature of the leaving group and its effect on the nucleophilic substitution reactions

10. Classification of nucleophiles as excellent, good, or fair
11. General trends of nucleophilicity.
12. S_N2 reactions
    i. Nucleophilicity effects
    ii. Appropriate solvents
    iii. Stereochemistry effects.
13. Polar protic solvents versus polar aprotic solvents and the use of aprotic solvents in terror operations
14. The heavy metal ion effect on the rate of an S_N1 reaction

H. Blister Agents (2 hours)
1. Physical properties of sulfur mustards
2. Preparation of sulfur mustard
3. Sulfur mustard HT (Agent T
4. Nitrogen mustards
5. Sulfur and nitrogen mustards as vesicants
6. How sulfur and nitrogen alter the properties of the alkyl halide
7. Health effects of mustards
8. Hydrolysis of sulfur mustard
9. Oxidation of sulfur mustard

I. Elimination Reactions (3 hours)
1. The general concepts of elimination reactions
2. Predicting the most likely alkene produced in an elimination reaction
3. Mechanism of the E_2 elimination reaction
4. Structural effects in the E_2 elimination reaction
5. Base strength and nucleophilicity
6. Driving forces of the E_2 elimination reaction
7. Regioselectivity of the E_2 elimination reaction
8. Hofmann's Rule
9. Predicting the type of reaction that has occurred

Exam 1 (1 hour)

J. Alkenes (3 hours)

1. Characterization of alkenes
2. The IUPAC rules of nomenclature for alkenes
3. Physical properties alkenes.
4. Preparation of alkenes.
5. Reactions of alkenes.

K. Alkynes (3 hours)

1. Characterization of alkynes
2. The IUPAC rules of nomenclature for alkynes.
3. Physical properties of alkynes.
4. Hybridization of alkynes
5. Preparation of alkynes and their use as precursors of explosives
6. Allenes.
7. Reactions of alkynes

L. Alcohols (3 hours)

1. The IUPAC rules of nomenclature for alcohols
2. Structure of the alcohols
3. Physical properties of the alcohols
4. Preparation of the alcohols
5. Reactions of the alcohols
6. Wet chemical tests for alcohols that can also be used at an incident site
7. Preparation of diols
8. Thiols and other organic compounds containing sulfur andf their role as blister agent precursers

M. Ethers (2 hours)

1. The IUPAC rules of nomenclature for ethers
2. Characterization of the ethers
3. Preparation of ethers industrially and in clandestine drug labs
4. Reactions of ethers and the dangers of peroxide formation

N. Benzene, Arenes, Polycyclic Aromatic Hydrocarbons (PAHs) and Cancer (2 hours)

1. Characterization of aromatic compounds
2. Characterization of annulenes
3. Characterization of heterocyclic aromatic compounds and the use of pyridine as a weapon
4. General properties of the aromatic compounds and their use as explosives
5. IUPAC rules of nomenclature for substituted benzenes
6. Reactions of aromatic compounds likely to occur at an incident site

O. Explosives (2 hours)

1. Characterization of chemical explosions
2. Classification of chemical explosives as primary, secondary, or propellant
3. Primary explosives
4. Secondary explosives

Final Exam – (2 hours) During Final Exam Week or end of course depending on mode of delivery

Laboratory Exercises (56 hours total)

1. Introduction; Safety, and Check-In (4 hours)
2. Simple Distillation versus Fractional Distillation (4 hours)
3. Single Extraction versus Multiple Extraction (4 hours)
4. Melting Point and Boiling Point Determinations of Hazardous Chemicals (4 hours)
5. Isomers (4 hours)
6. The Synthesis and Analysis of 1-Bromobutane from Butan-1-ol via an S_N2 Reaction (8 hours)
7. The Synthesis and Analysis of *t*-Butyl Chloride from *t*-Butyl Alcohol via an S_N1 Reaction (8 hours)
8. The Synthesis and Analysis of Cyclohexene from Cyclohexanol via an E2 Reaction (8 hours)
9. Wet Chemical Tests for Alcohols (4 hours)
10. Identification of an Unknown Hydrocarbon Found at an Incident Site (4 hours)
11. Check-Out and Final Quiz (4 hours)

IV. Evaluation Methods

The final grade will be determined by the following methods and percent weights:

Written Exams (50%)

There will be two exams in the course, a mid-term during the middle of the semester and a comprehensive final during the final exam week. Typical questions are scenario based and require students to predict the hazards associated with given chemical substances and the reactivities of hazardous chemicals under given conditions.

Laboratory Component (25%)

Students write laboratory reports, which include experimental observations, data analysis, calculations, and conclusions. Laboratory experiments focus on synthetic techniques; spatial relationships among molecules; the major types of chemical reactions that organic compounds undergo; and the properties, reactions, and hazards associated with alkanes, alkenes, alkynes, alcohols, and aromatics. Additionally, there is a comprehensive final exam. Questions are based on the laboratory exercises.

Capstone Event (25%)

The capstone event is an equivalent of a term paper performed by the student outside of the regular class hours. The event is a simulation of a real-life incident involving WMD. Students will be evaluated on their ability to assess an "incident site" for possible unknown chemical hazards, predict the hazards associated with the unknown chemical(s), and conduct the proper response call. The students will apply prior training and education in response to chemical incidents. Each student will construct a portfolio that documents his or her response to the capstone event. The format for the portfolio report will be similar to the format used for real incident reports and training reports.

V. Grading Scale:

A: $\geq$90% B: 80-89% C: 70-79% D: 60-69% F: <60%

VI. Attendance Policy

Attendance in both lecture and laboratory is expected of all students in the class. The policy is governed by university rules and regulations. The students are strongly encouraged to attend all classes.

VII. Required Textbooks, Supplemental Books and Readings

Required Textbook:

Wood, J.T. and Eddy, R.M. *Weapons of Mass Destruction-Response Element Advanced Laboratory Integrated Training and Indoctrination (WMD-REALITI) Intermediate Level (Level 2) Chemistry Lesson Plans.* (Revised November 2003.)

Supplemental Books:

Volhart, K.P.C. and Schore, N.E. *Organic Chemistry: Structure and Function*, 4th ed.; W.H. Freeman and Company: New York, 2003.

VIII. Special Resource Requirements

Laboratory goggles.

IX. Bibliography

Note: WMD references are not listed due to the sensitive nature of their content.

1. Akhavan, J. *The Chemistry of Explosives*; The Royal Society of Chemistry, Cambridge, UK, 1998.
2. Beyer, H.; Walter, W. *Organic Chemistry*; Albion Publishing Limited: Chichester, West Sussex, England, 1997.
3. Bruice, P.Y. *Organic Chemistry*; Prentice Hall, Inc.: Upper Saddle River, NJ, 2001.
4. Ege, S. *Organic Chemistry: Structure and Reactivity*, 3rd ed.; D.C. Heath and Company: Lexington, MA, 1994.
5. Jones, Jr., M. *Organic Chemistry*, 2nd ed.; W. W. Norton & Company: New York, New York, 2000.
6. Panico, R.; Powell, W.H.; Richer, J-C. *A Guide to IUPAC Nomenclature of Organic Compounds: Recommendations 1993*; Blackwell Science: Oxford, 1993.
7. McLafferty, F.; Turecek, F. *Interpretation of Mass Spectra*, 4th Edition, University Science Books: Mill Valley, CA, 1993.
8. Sorell, T.N.; *Organic Chemistry*; University Science Books: Sausalito, CA, 1999.
9. Volhart, K.P.C.; Schore, N.E. *Organic Chemistry: Structure and Function*, 4th ed.; W.H. Freeman and Company: New York, 2003.

COURSE ANALYSIS QUESTIONNAIRE

A. Details of the Course

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

This course is a required course for students in the BS in Natural Science/Science for Disaster Response Track. It is not intended to be a Liberal Studies course. This course is designed for first responders – the emergency personnel who respond to any suspected incident of a chemical, biological, radiological and/or nuclear nature. The content and the intense material coverage are too specific to counterterrorism and first responders to be incorporated into an existing course such as CHEM 231 Organic Chemistry I.

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.

This course does not require changes in any other course in the department. A new track (Science for Disaster Response) of the existing program of the BS in Natural Science will include this course among the required courses.

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).

This course was offered as a pilot of an 11-day WMD-REALITI Chemical, Biological, Radiological and Nuclear Intermediate (Level 2) Module for the National Guard and other first responders in the WMD community in May 2003. There were 16 students enrolled in this course.

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

This 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?

This course is not to be taken for variable credit.

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

To the best of our knowledge, this course and its intended degree program are unique in the United States. This lack of specific scientific education for emergency first responders at an accredited institution was one of the primary motivating factors for the National Guard Bureau (NGB) to approach IUP to develop this course.

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 course objectives have been specifically developed under consultation with the NGB, the WMD-CSTs, the Federal Emergency Management Agency (FEMA), the Department of Defense (DoD), the Combating Terrorism Technology Support Office (CTTSO), and the Technical Support Working Group (TSWG) to meet the following standards:

- The Army Chemical Agent Safety Program,(AR 385-61)
- Toxic Chemical Agent Safety Standards (DA Pam 385-61)

- Occupational Safety and Health Standards, Chapter 29-Code of Federal Regulations 1910.120(e)(8)

B. Interdisciplinary Implications

B1. Will this course be taught by instructors from more than one department or team taught within the 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 one instructor or team taught by two instructors within the Chemistry Department. The instructor(s) must be associated with the WMD programs at IUP. Individual faculty workloads will likely dictate whether one or two instructors are assigned to the course. The course is a combination of lecture and laboratory.

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 intended audience of SDR 221 (active first responders in the WMD community) may require intensive delivery and specific educational objectives that are not met by existing IUP courses.

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.

This course is not cross-listed.

B4. Will seats in this course be made available to students in the School of Continuing Education?

Only if the Continuing Education students have been accepted in the SDR program.

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.

Yes, faculty resources are adequate because of external funding. If no external funding is available, then additional faculty resources will be required. This course will count as one preparation and seven (7) workload hours towards the workload for one faculty member, or as credits split appropriately among the workloads of each of two faculty members who team teach the course. Each contact hour in laboratories in chemistry, biology, and physics is assigned one (1) workload hour, so 3c + 4l = 7 workload hours.

The faculty credentials include possession of a Ph.D. in organic chemistry and a minimum of five years teaching experience, balanced with three to five years of professional work experience in the following areas, skill sets, and certificates. The qualified faculty member will have:

- Experience in general organic chemistry; environmental sample techniques; analytical techniques; spectroscopic methods of molecular structure determination using gas chromatography/mass spectrometry and infrared spectroscopy; recognition, evaluation, and management of nuclear, biological, and chemical weapons.

- A thorough understanding of laboratory safety procedures and national laboratory standards to meet chemical surety standards as delineated by respective government standard operating procedures (SOPs).

- A Chemical Hygiene Officer certificate issued by the National Registry in Clinical Chemistry to ensure competent, safe laboratory operations, appropriate decontamination protocols, and compliance with chemical surety SOPs.

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? Reply in terms of the following:

*Space
*Equipment
*Laboratory Supplies and other Consumable Goods
*Library Materials
*Travel Funds

Space: Presently, this degree program is being conducted using the facilities in IUP's science building, Weyandt Hall. However, plans are underway to renovate the second floor of Walsh Hall for the WMD programs. This renovation is scheduled to begin at the end of the Spring 2004 semester. The WMD programs are under the umbrella of IUP's John P. Murtha Institute of Homeland Security. The WMD programs are designated to have space in this building when it is constructed.

Equipment: Specialized equipment, including the HAPSITE GC/MS and the TravelIR, has been provided by the DoD through the WMD-REALITI contracts. In the event that contract money is not available to purchase equipment, ESF funds will be used to purchase equipment, or the WMD faculty will write grant proposals for specialized equipment.

Laboratory Supplies: Laboratory supplies have been provided by the DoD through the WMD-REALITI contracts. In the event that contract money is not available to purchase laboratory supplies, funds from the WMD operating budget will be used to purchase the laboratory supplies. This money will be generated from the indirect funds acquired by contracted offerings of the WMD courses or by funds generated by tuition and student fees.

Library: When this course is funded by external money, Concurrent Technologies Corporation (CTC), will package the materials needed by the students. In the event that the course is not funded by external money, students will purchase the required text at a local copying business. Students may purchase the optional supplemental text at the Co-op Store or online.

Travel Funds: not applicable

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.)

Yes. So far, all resources for this course have been funded by the DoD and the National Guard Bureau (NGB). Contracts with these agencies are expected to continue for several years. However, IUP is prepared to support this course through ESF funds and tuition if external funds are not available. Additionally, IUP has actively sought and acquired funds for a facility to house the WMD courses.

C4. How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?

We expect this course to be offered every Fall depending on student demand and faculty availability.

C5. How many sections of this course do you anticipate offering in any single semester?

One section will be offered at a time.

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?

A maximum of 24 students can be accommodated in this class in which students do a considerable amount of laboratory work which limits the enrollment.

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.

No professional society recommends enrollment limits or parameters for this course. However, the DoD recommends an Instructor to Student ratio of 1:15 and has set the parameters for 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.

This course is not a distance education course.

D. Miscellaneous

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

Justification for 3c, 4l, 5cr:

Typically in the College of Natural Sciences and Mathematics, 4 credits are assigned to a class with 3 hours of class and 3 or 4 hours of lab. That is, usually a lab is valued as 1 credit towards the total course credits. In this course, the lab is valued as 2 credits due to the special nature of the laboratory exercises, which are more intensive in content and require the students to work

with more dangerous and/or high-risk materials. Because very little trial and error can be tolerated, students must be better prepared for the laboratory exercises and perform at a higher level. The intensive content and levels of preparation and performance are unlike that for the laboratory exercises in 1 credit laboratory courses. The 5 credits for this course have been acknowledged and approved by the College of Natural Sciences and Mathematics. Please see Appendix A for letter from Ms. Ola Kaniasty, Assistant Dean of the College of Natural Sciences and Mathematics and Chair of the College Curriculum Committee.