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

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person Dr. Roberta Eddy	Email Address 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 121 Chemical Recognition and Identification Techniques
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)	Kenneth Van Fossen Ramsey *	4-06-04
College Curriculum Committee Chair	[signature]	08/10/04
College Dean	John S. Eck	8/19/04
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate: (include title)		
UWUCC Co-Chairs	Gail Sechrist	10-26-04

* where applicable

* see letter

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SYLLABUS OF RECORD

I. Catalog Description

SDR 121 Chemical Recognition and Identification Techniques — 3 class hours

4 lab hours

5 credit hours

(3c-4l-5cr)

Prerequisites: CHEM 113 and 114 or equivalent and permission of instructor and local, state or federal agency/organization authorization.

Level 1 chemistry focuses on atomic structure; periodic properties; chemical bonding, chemical structure, molecular forces, types of chemical reactions, stoichiometry, chemical kinetics, chemical equilibria, and acids and bases in relation to CBRN identification and analysis. Laboratory exercises focus on techniques to aid CBRN identification and analysis.

II. Course Objectives

Students successfully completing this course will be able to:

1. Relate the atomic structure of matter to how an unknown substance interacts with the interrogating medium for the identification of the unknown substance.
2. Predict the hazards of an element based on the element's location in the Periodic Table.
3. Relate chemical bonding to the solubility, volatility and reactivity of hazardous chemical substances.
4. Predict the properties of organic molecules, especially those of toxic industrial compounds (TICs) and Toxic Industrial Materials (TIMs), based on molecular structure.
5. Assess an unknown at an incident site based on its intermolecular interactions.
6. Predict how hazardous chemical substances at an incident site will react.

7. Calculate the amount of decontamination material that is required to ensure the safety of an incident site.
8. Relate basic organic reaction rates and mechanisms to the rates and mechanisms of interaction with the body of the various G agents, VX, mustards, and TICs and TIMs.
9. Predict the hazards associated with acidic and basic TICs and TIMs.

III. Detailed Course Outline

Lecture (42 hours total)

A. Foundations of Chemical Structure, the Smallest Piece of the Puzzle! (3 hours)
   1. The atomic nature of matter
   2. Characterization of subatomic particles
   3. Characterization of isotopes by mass spectrometry and how signature isotopic peaks in the mass spectrum can aid in the identification of an unknown substance
   4. Characterization of electromagnetic radiation for the identification of unknown chemical substances through FT-IR spectroscopy.
   5. Line spectra of elements in relation to the quantized energy of electrons
   6. Electron configurations in relation to chemical reactivity and chemical hazards
   7. Wave nature of the electron

B. Predicting Chemical Behavior – Periodic Properties With a View Toward Weaponizing Selected Elements (4 hours)
   1. The Periodic Law to predict the individual properties of atoms.
   2. Characterization and hazards of the Group IA Alkali Metals
   3. Characterization and hazards of the Group IIA Alkaline Earth Metals
   4. Classification of a metal, non-metal, metalloid, or noble gas based on the element's location in the Periodic Table
   5. Characterization and hazards of metals, non-metals, metalloids, noble gases, and halogens and the use of common industrial chemicals as weapons
   6. Predicting the hazards of the elements based on the electron configurations of the elements

C. Chemical Bonds: A Key Feature in Determining Chemical Behavior and the Explosive Nature of Chemical Reactions (6 hours)

1. Valence electrons and the formation of chemical bonds
2. Formation of the chemical bonds between:
    i. Group IA elements and the Group VIIA elements
    ii. Group IIA elements and the Group VIIA elements
    iii. Group IA elements and the Group VIA elements
    iv. aluminum and oxygen and explosive magnification
3. Redox reactions used in industrial applications and as potential weapons
4. Predicting rates of chemical reactions likely to occur at an incident site
5. Predicting a given ionic compound's melting point temperature and solubility in water at an incident site
6. Metals that react to give the pseudo-noble gas electron configuration
7. Covalent bond formation and the relation to the principles of IR spectroscopy
8. Lewis Dot Structures of molecules
9. Names and structures of common, highly reactive polyatomic ions likely to be encountered at an incident site
10. Ions associated with inorganic explosives and corrosive substances
11. Nomenclature of metallic ions likely to be encountered at an incident site
12. Calculating the formal charge on an atom
13. Resonance structures and the role of resonance in the action of many riot control agents
14. Stable compounds that violate the Octet Rule and that are likely to be encountered at an incident site

D. Shape, Charge and Reactivity (3 hours)

1. Applying the valence-bond method to determine the structures of molecular compounds relating to compounds such as arsine, phosphene, thionyl chloride etc.
2. Determining the hybridization of a molecule when given the chemical formula of the molecule
3. Applying VSEPR Theory to determine the structure of a molecule when given the chemical formula of the molecule

4. Deducing the polarity of a molecule based on the structure of the molecule
5. Predicting the properties of organic molecules, especially those of toxic industrial compounds (TICs) and Toxic Industrial Materials (TIMs), based on molecular structure

E. The Ties that Bind – Molecular Forces (4 hours)

1. Differentiating between the four classes of solids: ionic, molecular, metal, and network
2. Correlating ion-ion forces of attraction with high melting points for ionic compounds
3. Assessing the solubility of an ionic compound in water with respect to ion-dipole forces
4. Assessing hydrates with respect to ion-dipole forces
5. Applying the solubility rules for common ionic compounds in water
6. Assessing the hydrogen bridge bond
7. Predicting the properties of the liquid state of a compound based on hydrogen bridge bonding
8. Assessing dipole-dipole forces
9. Assessing dispersion (London) forces and assessing the volatility of common organic species
10. Assessing dipole-induced dipole forces
11. Assessing molecular solids
12. Assessing network covalent solids
13. Differentiating between organic and inorganic compound based on intermolecular forces of attraction
14. Polycyclic aromatic hydrocarbons (PAHs), a common TIM
15. Chemistry of phosphorus and its use to produce pesticides and nerve agents

F. Chemical Equations – Predicting How Substances Will React, the Responder's Greatest Asset, Particularly Those Industrial Materials that may have been Weaponized. (4 hours)

1. Writing a balanced chemical equation for a chemical reaction

2. Predicting the products and the theoretical amounts of the products formed during:
    i. decomposition reactions
    ii. combination reactions
    iii. double displacement reactions
    iv. oxidation-reduction (redox) reactions
    v. single replacement reactions
3. Writing balanced chemical equations for complex redox reactions
4. Reactions of important TIMs (potassium dichromate, hydrogen chloride, sulfuric acid, nitric acid, phosphoric acid, sulfur dioxide, barioum oide and oxalic acid)
5. Production of prussic acid, a blood agent
6. The thermite reaction and its hazards
7. The oxidizing ability of the hypochlorite ion

G. Quantifying the Amount of Reagents Used in Chemical Reactions: Can You Trust the Decontamination Procedure? (4 hours)

1. What stoichiometry entails, Why and how does Sandia foam® work?
2. Using stoichiometry to predict:
    i. the moles of a substance in a chemical reaction when given the moles of another substance in the chemical reaction
    ii. the grams of a substance in a chemical reaction when given the grams of another substance in the chemical reaction
    iii. the volume of a substance in a chemical reaction when given the moles of another substance in the chemical reaction
    iv. the volume of a substance in a chemical reaction when given the volume of another substance in the chemical reaction
    v. the grams of a substance in a chemical reaction when given the volume of another substance in the chemical reaction
    vi. the volume of a substance in a chemical reaction when given the grams of another substance in the chemical reaction
3. Using stoichiometry to solve problems at an incident site that involve solutions

4. Using stoichiometry to solve problems at an incident site that involve acid-base reactions
5. Using stoichiometry and the Ideal Gas Equation to solve problems at an incident site
6. Using stoichiometry and the limiting reagent of a chemical reaction to predict the amounts of reactants and products of a chemical reaction likely to be encountered at an incident site
7. Using the relationship between the molar mass and the molar volume of a gas to calculate the density of the gas
8. The decomposition of cyclonite (RDX)

Exam 1 (1 hour)

H. Factors that Control the Rate of Chemical Reactions and Reaction Mechanisms (4 hours)

1. Importance of chemical kinetics
2. Predicting the rate of a chemical reaction
3. Calculating the rate constant of a chemical reaction
4. Formulating the rate law for a chemical reaction
    i. a zero order chemical reaction
    ii. a first order chemical reaction
    iii. a second order chemical reaction
5. Determining the half-life of a chemical reaction (how does this relate to CBRN work)
6. Determining the order of a chemical reaction
7. Deducing the mechanism of a chemical reaction from the kinetics of the chemical reaction
8. Rates and mechanisms of interaction with the body of the G agents, VX, mustards, and TICs and TIMs
9. Rates and mechanisms of various decontamination reactions

I. Caustics, Corrosives or Highly Acidic Compounds (9 hours)

1. Applying working definitions for an acid and a base -- which acids are associated with "immediate" threat vs precursor acids
2. Applying the classic definitions of an acid and a base
3. Applying the Brønsted-Lowry definitions of an acid and a base
4. Correlating conjugate acid-base pairs
5. Judging the strength of an acid
6. Characterizing the autoionization of water
7. Calculating the pH of a solution
8. Assessing polyprotic acids
9. Predicting the acidity of a binary acid based on factors that influence the acidity
10. Special dangers associated with commonly used binary acids.
11. Predicting the acidity of an oxyacid based on factors that influence the acidity
12. Correlating the name of an oxyacid with the chemical formula of the oxyacid and special dangers associated with oxy acids.
13. Predicting the strength of an oxyacid based on the number of oxygen bonded to the central atom
14. Powerful oxidizing acids – nitric acid and perchloric acid
15. Prussic acid, a blood agent
16. Predicting the acidity of organic compounds based on the factors that affect the acidity
17. Predicting the strength of a base according to the factors that affect basicity
18. Quantifying the strength of a base using the base ionization constant, K_b, of the base
19. Highly basic TICs and TIMs
20. Determining the amount of base required to neutralize an acid of known volume and concentration or the amount of acid required to neutralize a base of known volume and concentration
21. Predicting the pH of an aqueous solution containing a salt
22. Assessing the hydrolysis reaction between a salt and water

23. Assessing Lewis acid-base reactions, dangers associated with Lewis acids and use of these compounds as weapons
24. Determining the empirical and molecular formulas of an unknown hydrocarbon using data obtained from combustion analysis
25. Assessing coordination compounds

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

Laboratory (56 hours total)

1. Introduction; Safety, and Check-In (4 hours)
2. Differentiating Between Organic and Inorganic Substances (4 hours)
3. Using Density to Identify an Unknown Chemical Substance (4 hours)
4. Molecular Mass Determination of a Volatile Organic Compound (4 hours)
5. Qualitative Analysis of Fifteen White Powders (8 hours)
6. Distillation of a Dirty Liquid Sample (4 hours)
7. Chemical Communication for WMD (4 hours)
8. Controlling Chemical Reactions for Maximum Product (4 hours)
9. Synthesis of a Flammable Gel Using Commonly Available Materials (4 hours)
10. Preparation of a Potential Weapon Using Commonly Encountered Materials (4 hours)
11. Decontamination of an Acid (4 hours)
12. Target Language for CWAs, Precursors, and Explosives (4 hours)
13. Check-Out and Final Exam (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 analyze and identify hazardous chemical substances, perform calculations, and predict the products of chemical reactions.

Laboratory Component (25%)

Students write laboratory reports, which include experimental observations, data analysis, calculations, and conclusions. Laboratory experiments focus on methods to analyze and identify unknown chemical substances, nomenclature of inorganic compounds, techniques involved in the preparation of potential chemical weapons, and a decontamination reaction. 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) Novice Level (Level 1) Chemistry Lesson Plans*. (Revised November 2003.)

Supplemental Books:

Hill, J.W.; Petrucci, R.H. *General Chemistry: An Integrated Approach*, 3rd ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 2002.

VIII. Special Resource Requirements

Laboratory goggles.

IX. Bibliography

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

1. Atkins, P.W. *General Chemistry*; Scientific American Books distributed by W.H. Freeman and Company: New York, New York, 1989.
2. Birk, J.P. *Chemistry*; Houghton Mifflin Company: Boston, MA, 1994.
3. Brown, T.L.; LeMay, H.E.; Bursten, B.E.; Burdge, J.R. *Chemistry The Central Science*, 9th ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 2003.

4. Chang, R. *Chemistry*, 5th ed.; McGraw Hill, Inc.: Hightstown, NJ, 1994.

5. Compton, C. *Inside Chemistry*; McGraw-Hill Book Company: New York, 1979.

6. Ebbing, D.D. *General Chemistry*, 3rd ed.; Houghton Mifflin Company: Boston, MA, 1990.

7. Emsley, J. *The Elements*, 3rd ed.; Oxford University Press: Oxford, 1998.

8. Hill, J.W.; Kolb, D.K. *Chemistry for Changing Times*, 8th ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 1998.

9. Hill, J.W.; Petrucci, R.H. *General Chemistry: An Integrated Approach*, 3rd ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 2002.

10. McMurry, J.; Fay, R.C. *Chemistry*, 2nd ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 1998.

11. McQuarrie, D.A.; Rock, R.A. *General Chemistry*; W.H. Freeman and Company: New York, 1984.

12. Norman, N.C. *Periodicity and the p-Block Elements*; Oxford University Press, Inc.: Oxford, 1994.

13. Olmsted III, J.; Williams, G.M. *Chemistry*, 3rd ed.; John Wiley & Sons, Inc.: New York, 2002.

14. Petrucci, R.H. *General Chemistry*, 4th ed.; Macmillan Publishing Company: New York, 1985.

15. Petrucci, R.H.; Harwood, W.S.; Herring, F.G. *General Chemistry: Principles and Modern Applications*, 8th ed.; Prentice Hall, Inc.: Upper Saddle River, NJ, 2002.

16. Spencer, J.N.; Bodner, G.M.; Rickard, L.H. *Chemistry: Structure and Dynamics*, 2nd ed.; John Wiley & Sons: New York, 2003.

17. Timberlake, K.C. *Chemistry: An Introduction to General, Organic, and Biological Chemistry*, 7th ed.; Addison Wesley Longman, Inc.: Menlo Park, CA, 1999.

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 existing courses such as CHEM 113 and CHEM 114.

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).

A pilot of an 11-day WMD-REALITI Chemical, Biological, Radiological and Nuclear Novice Module was conducted for the National Guard and other first responders in the WMD community in October 2003. There were 19 students enrolled in this course. The course received outstanding evaluations from both students and the government personnel present.

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 121 (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 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 Spring semester 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.