UWUCC Appr 10/26/04 Senate Appr 12/7/04

04-13c

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person	Email Address
Dr. N. Bharathan/Dr. Seema Bharathan/A. Andrew	BHARATHN@IUP.EDU/BHARATHS
Proposing Department/Unit	Phone
SDR/Science for Disaster Response	724-357-2584/2277

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 211 Interaction of CBRN Materials with Biological Systems and PCR Technology
***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)	Arthur Ortola - Biology	3-22-04
Department Chair(s)		
		3/22/04
College Curriculum Committee Chair		08/10/04
College Dean	John D. Enck	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

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SYLLABUS OF RECORD

I. Catalog Description

SDR 211 Interaction of CBRN Materials with Biological Systems and PCR Technology

3 class hours
3 lab hours
5 credit hours
(3c-3l-5cr)

Prerequisites: SDR 111 and permission of instructor and local, state or federal agency/organization authorization.

Level 2 biology designed to provide the intermediate level first responders with the knowledge, skills, and practical capabilities to effectively identify bacteria, viruses, toxins, ands potential genetically modified pathogens which might be used as biological weapons against military forces or civilian communities. Lecture presentations bring together variety of subjects intimately linked to the advancement of molecular genetics. The course integrates advanced safety techniques in handling microbes to basic principles and facts of microbiology, microscopy and microbe identification using both molecular biological and immunological techniques. A large section of the course features an in-depth discussion of principles and application of polymerase chain reaction. Hands-on training is a primary goal and is complemented by formal lectures.

II. Course Objectives:

Students successfully completing this course will be able to

1. Explain the impact that the DNA revolution has had on the development of the discipline of biotechnology.
2. Analyze the diversity of the microbial world and classify important zoonotic diseases caused by infectious agents.
3. Analyze the interaction between the host and parasite and describe the different immune mechanisms of the host.

4. Evaluate selected microorganisms based on specific diagnostic procedures and describe the general properties of eukaryotic pathogens.
5. Differentiate potential bioterrorism agents on the basis of genome characteristics, morphologies of Gram reaction and immunological properties.
6. Review the fundamentals of the structure and replication of DNA, the process of transcription, and translation, and the principles of recombinant DNA technology.
7. Explain how DNA technology is applied for the production of a wide variety of genetically modified organisms, pharmaceutical products, vaccines.
8. Explain how DNA analysis can be utilized for the diagnosis of infectious agents in plants, animals, and humans.
9. Explain how repetitive DNA sequences can be exploited for forensics and DNA profiling in DNA matching techniques.
10. State the principles of polymerase chain reaction (PCR) and have an understanding of different strategies in PCR technology.
11. Apply the principle of PCR methods as it relates to characterization of mutations that cause human diseases.
12. Review the standard laboratory procedures used in recombinant DNA experiments, including Southern, Northern, and Western blotting.
13. Explain the biological basis of biological weapons and the importance of biotechnology practices in protecting the society.

III. Course Outline

Lecture (42 hours total)

A. **Cell Biology** (3 hours)

1. Chemical context of life
2. Cell as the fundamental unit of life
3. The pivotal role of carbon atom in the formation of biological molecules
4. Classification of biological molecules by function
5. Protein classification based on function
6. Protein engineering
7. The chemical structure of ribonucleotides

8. Eukaryotic chromosome structure (chromatin/nucleosome)
9. Structure and function of organelles

B. Study Of Infectious Agents, Toxins And Engineered Biological Weapons

(6 hours)

1. Importance of microorganisms and different biological agents Infectious agents
2. Bacteria genetic variation, mechanisms of genetic variation
3. Bacterial nutrition and metabolism, bioactive antioxidants supplements
4. Bacterial classification based on ecological relationships
5. Bacterial parasitism, receptor-associated responses, bacterial toxins, genetically engineered toxins as biological warfare agents.
6. Virus, viral agents characteristics, infection process, emerging viral Infection and genetically engineered virus.
7. Classification of bioterrorism agents and the level of laboratory risk associated with those agents.
8. Retroviral vectors and gene transfer/gene therapy applications.

C. Etiology Of Diverse Agents Like Bacteria, Viruses And Fungi As Hazardous Materials Not Only To WMD Personnel But To Agriculture And Farm Animals

(8 hours)

1. Describe the etiology of bacterial systemic zoonotic diseases.
2. Describe how humans can be infected with anthrax disease.
3. Identify different clinical forms of Anthrax in humans.
4. Describe the etiology of the causal agent of Salmonellosis.
5. Describe the important characteristics and modes of transmission of *Yesrsinia pestis* the causal agent of bubonic plague.
6. Identify viral genome arrangements.
7. Describe the genome characteristics, spread, and epidemiologic features of the variola virus.
8. Describe the important features of the family of viruses that cause hemorrhagic fever and its potential as a bioterroristic agent.
9. Describe the etiology and spread of equine encephalitis virus.

10. Describe the role of C*ryptosporidium parvum* in cryptosporidiosis and its transmission to humans from animals.
11. Identify how contaminated water supplies and food cause the spread of the protozoan agent *Cryptosporidium parvum*, and its significance as a potential biological weapon.

EXAM I (1 hour)

D. Introduction To Nonspecific Defense And Specific Defense Mechanisms Of The Host (6 Hours)

1. Describe the mechanical and chemical defenses that are associated with non-specific resistance.
2. Identify the role of phagocytes, inflammation, and antimicrobial substances against pathogens.
3. Assess the differences between immunity and nonspecific resistance.
4. Describe the important control mechanisms and organs of the immune system.
5. Describe the role of lymphocytes in specific immune function.
6. Differentiate humoral and cellular immunity.
7. Describe the mechanisms involved in immune gene regulation and the role of recombinant DNA technology in vaccine production.

E. DNA Replication, Mutation, And Polymerase Chain Reaction (6 Hours)

1. Describe the principles of DNA replication.
2. State function of different enzymes associated with DNA replication.
3. Identify the important steps and mechanisms associated with DNA replication.
4. Describe different mutagens and their specific effect on DNA structure.
5. Identify the biological and genetic effects of radiation.
6. Identify the requirements for polymerase chain reaction (PCR).
7. State the important applications of PCR technology.
8. Primer selection; temperature parameters; false positives.
9. Identify the important limitations/difficulty associated with PCR technology.

F. **Central Dogma of Molecular Biology: Principles of Transcription, mRNA Processing, and Translation** (4 hours)

1. Describe the flow of genetic information from DNA to protein.
2. Describe the process of transcription, identify the important steps, role of different RNA involved and RNA polymerase in the transcription process.
3. Structure of immature and mature mRNA and the important steps involved in mRNA processing.
4. Role of each macromolecule in the translation process, protein synthesis and the genetic code.

G. **Recombinant DNA Technology Methods, Principles And Application As It Relates To Potential Bio-Warfare Agents** (8 hours)

1. State the important steps in recombinant DNA technology and its application in agriculture, medicine, and biological warfare.
2. Assess the fundamental theory of recombinant DNA technology and the role of different enzymes in the development of a recombinant DNA molecule.
3. State the important properties of the cloning vehicle and target DNA in recombinant DNA technology.
4. State the principles of essential techniques in genetic engineering and their important applications in cloning.
5. Describe various ways to create genomic and cDNA libraries.
6. List the ways by which a foreign gene could be delivered into a desired host.
7. Discuss the important applications of DNA technology and the use of cloned DNA in gene expression.

COMPREHENSIVE FINAL EXAM –During the finals week (2 hours)

H. **<u>Laboratory Exercises (42 hours total)</u>**

1. Bacterial Growth, Maintenance (6 hours)
2. Bactericidal Effects of Normal serum (6 hours)
3. Recombinant DNA technology laboratories genetically engineering *E. coli* (6 hours)

4. Nucleic acid purification from engineered organisms (above 3) (2 hours)
5. RNA purification from infected and healthy tissue (2 hours)
6. PCR experiments from purified nucleic acids from 4 and 5 above (4 hours)
7. Identification of serum proteins and establishment of evolutionary relationship (4 hours)
8. Western blot techniques, ELISA, and hand held assays experiments (4 hours)
9. PCR experiments as it relates to forensic (Conventional PCR) (4 hours)
10. REAL-TIME PCR experiments (4 hours)

V. Evaluation Methods

A. Examinations (50%)

There will be two exams in the course. A mid-term during the middle of the semester and a comprehensive final during the finals week. The exams will be a variety of different question types including short answer and essay questions.

B. Laboratory Component (25%).

The students will be required to submit laboratory portfolios with all the data carefully analyzed and discussed. The portfolios will be evaluated through out the semester after completion of a specific module. Each portfolio must include experimental observations, analysis, calculations, and conclusions. The portfolio will be evaluated for data collection, analysis, content, data presentation, and writing. The individual laboratory portfolio is expected to demonstrate the author's ability to collect the data, synthesize and interpret results and to think critically about scientific data. In its final form, the portfolio is to resemble a scientific review article with correct grammar usage, punctuation and spelling as well as scientific terminology.

C. 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 biological hazards and conduct a proper response call. The student will apply prior training and education in response to biological 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.

Grading Scale: Grades will be determined from the total points obtained divided by the total possible points, and expressed on a percentage scale.

A = 90-100%; B = 80 – 89%; C= 70 - 79%; D= 60-69%; F = below 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 Text, and Supplemental books and Readings:

1. Bharathan, N., Seema Bharathan, and A. Andrew: Weapons of Mass Destruction-Response Element Advanced Laboratory Integrated Training Indoctrination (WMD-REALITI) Intermediate Level Biological Lesson Plans. (Revised January 2003).
2. Microbiology, An Introduction: Gerard J. Tortora, Berdell R. Funke, and Christine L. Case. Addison Wesley, and Longman VII, Edition 2002.

Supplemental Books and Readings:

Boyd, R. *Basic Medical Microbiology*; 5th ed.; Little, Brown and Company: Boston, MA, 1995.

Burden, D. W.; Whitney, D.B. *Biotechnology: Proteins to PCR*; Birkhauser: Boston, 1995.

Chrispeels, M. J.; Sadava, D. E. *Plants, Genes, and Crop Biotechnology*, 2nd ed.; Jones and Bartlett Publishers: Sudbury, MA, 2003.

Farrell, R. E., Jr. *RNA Methodologies*; Academic Press: New York, 1998.

Fleming, D., Hunt, D., Eds. *Biological Safety: Principles and Practices*, 3rd ed.; ASM Press: Washington, DC, 2000.

Forbes, B. et al. *Baily and Scott's Diagnostic Microbiology* 10th ed.; Mosby: St. Louis, MO, 1998.

Jensen, M. et al. *Microbiology for the Health Sciences* 4th ed.; Prentice Hall: Upper Saddle River, NJ, 1997.

McKane, L.; Kandel, J. *Microbiology*, 2nd ed.; McGraw Hill: New York, 1996.

Primrose, S.B.; Twyman R.M.; Old, R.W. *Principles of Gene Manipulation*, 6th ed.; Blackwell Science: Cambridge, MA, 2001.

VIII. Special resource Requirements

None.

IX. Bibliography

Alberts, B.; Bray, D.; Lewis, J.; Raff, M.; Roberts, K.; Watson, D.J. *Molecular Biology of The Cell*; Garland Publishing: New York, 1994.

August, J.T.; Anders, M.W.; Murad, F.; Coyle, T. J. *Gene Therapy* Vol. 40 of *Advances in Pharmacology;* Academic Press: New York, 1997.

Brown, T.A. *Gene Cloning*; Chapman and Hall: London, 1990.

Browne, M.; Thurlby, P. *Genomes, Molecular Biology, and Drug Discovery*; Academic Press: New York, 1996.

Calladine C.; Drew, H. *Understanding DNA*; Academic Press: New York, 1997.

Chrispeels, M.J.; Sadava, D.E. *Plants, Genes and Agriculture*; Jones and Barlett Publishers: Sudbury, MA, 1994.

Glick, B.R.; Pasternak, J.J. *Molecular Biotechnology: Principles of Recombinant DNA*; ASM Press: Washington, DC, 1994.

Heldt, H.-W. *Plant Biochemistry and Molecular Biology*; Oxford University Press: New York,1997.

Hawley, S.R.; Mori, A.C. *The Human Genome*; Academic Press: New York. 1998.

Hehl, R. Transposon tagging in heterologous host plants. *Trends in Genetics* **1994,** 10: 385-386.

Howell, H.S. *Molecular Genetics of Plant Development*; Cambridge University Press: New York, 1998.

Innis, A. M.; Gelfand, H. D.; Sninsky, J.J.; White, J. T. *PCR Protocols: A Guide to Methods and Applications*; Academic Press: New York, 1990.

Jefferson, R.A. Assaying chimeric genes in plants: The GUS gene fusion system. *Plant Molecular Biology Reporter* **1987,** 5: 387-405

Karp, G. *Cell and Molecular Biology Concepts and Experiments*; John Wiley and Sons, Inc.: New York, 1999.

Kier, B., L.; Hall H. L. *Molecular Structure Description*; Academic Press: New York, 1999.

Kenyon, C. If birds can fly, why can't we? Homeotic genes and evolution. *Cell* **1994,** 78: 175-180.

Kriegler, M. *Gene Transfer and Expression*; W.H. Freeman and Company: New York, 1990.

Laux,T.; Jurgens, G. Embryogenesis: A new start into life. *Plant Cell* **1997,** 9:989-1000.

Lodish, H.; Berk, K.; Zipursky, L.S.; Matsudaria, P.; Baltimore, D.; Darnell, J. *Molecular and Cell Biology*; W.H. Freeman: New York, 2000.

Long, D.; Coupland,G. In *Arabidopsis Protocols*; Zapater, J.M., Salinas, J., Eds.; Transposon tagging with Ac/Ds in Arabidopsis Methods in Molecular Biology, Vol. 82; Humana Press Inc.: Totowa, NJ, 1998.

Moffat, A.S. Exploring transgenic plants as a new vaccine source. *Science* **1995,** 268:658-660.

Nicholl, D.S.T. *An Introduction into Genetic Engineering*; Cambridge University Press: New York, 1994.

Plant Cell and Environment. Special issue on transgenic plants. *Plant Cell and Environment* **1994,** 17: 465-680.

Ream, W.; Field, G.K. *Molecular Biology Techniques*. Academic Press: New York, 1999.

Watson, D. J.; Gilman, M.; Witkowski, J.; Zoller, M. *Recombinant DNA*. W.H. Freeman: New York, 1992.

Watson, D.J.; Hopkins, H.N.; Roberts, W.J.; Steitz, A.J.; Weiner, M.A. *Molecular Biology of the Gene*, Vols. I and II; The Benjamin/Cummings Publishing Company, Inc.: USA, 1987.

Willmitzer, L. Transgenic Plants. In *Biotechnology*, a multi-volume comprehensive treatise; Rehm, H.J., Reed, G., Puhler, A., and Stadler, P., Eds.; Verlag Chemie: Weinheim, 1993; Vol. 2, pp 627-659.

Wolfe, L.S. *Introduction to Cell and Molecular Biology*. Wadsworth Publishing Company: USA, 1997.

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 one of the required courses for students in the BS in Natural science with a Science for Disaster Response (SDR) concentration. 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.

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 eleven-day WMD-REALITI Chemical, Biological, Radiological and Nuclear Intermediate Module for the National Guard 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 Department of Defense (DoD) Combating Terrorism Technology Support Office (CTTSO) and the Technical Support Working Group (TSWG) appropriated three years of funding for the Weapons of Mass Destruction-Response Element Advanced Laboratory Training and Indoctrination (WMD-REALITI) program. The purpose of this program is to develop an accredited (professional, academic, or both) education, training, and research program designed to provide the novice, intermediate, apprentice, and advanced laboratory technicians with knowledge, skills, and abilities (KSA) comparable to those needed to work in a chemical Surety, or Biological Safety Level 3 Laboratory. The

intended audience is the National Guard Bureau's Weapons of Mass Destruction-Civil Support Teams (WMD-CST), other U.S. Government WMD and homeland security response elements, state, and local civilian WMD, and homeland security response elements, and related emergency planners. IUP was contracted to develop the four modules of courses (novice, intermediate, apprentice, and advanced) over the three years of the WMD-REALITI program. This course is part of the Intermediate module. The first year was funded for $170,317, the second year for $441,445, and the third year for $599,777. The request for the creation of this course came from the Department of Defense.

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 or three instructors from Biology department as needed (individual faculty workloads will likely dictate whether one or two instructors are assigned to the course. The course has a lecture and laboratory component.. The three instructors who will be teaching this course developed the course to meet government approval and the needs of the first responders to WMD incidents.

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 231 (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 be counted as six (6) workload hours towards the workload for one faculty member, or as credits split appropriately among the workloads of each of three 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 + 3l = 6 workload hours. The faculty credentials include possession of a Ph.D. in experimental biological sciences with emphasis in molecular biological techniques and microbiology 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 Bio safety training, immunological techniques, and demonstrated three to five years of conducting training at a facility using biological materials.

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: For academic year 2002/2003, Weyandt Hall will suffice, but future offerings will require a separate facility. The DoD is covering the cost of this facility. John P. Murtha has arranged to have ten million dollars of DoD money appropriated for the construction of the John P. Murtha Institute of Homeland Security at IUP. The WMD project and the courses will be housed in this building. Until the building is ready, IUP has acquired funds for an interim facility to house the WMD project and courses.

Equipment: Specialized equipment, including glove boxes, class II B and class III B Biological safety cabinets, DNA thermal Cyclers, RAPID, Smart Cyclers, Microscopes with digital capabilities and photo-documentation system is provided by the DoD through the WMD-REALITI grant. In the event that contract money is not available to purchase equipment, ESF funds will be used to purchase the equipment, or the WMD faculty will write grant proposals for specialized equipment.

Laboratory Supplies: Laboratory supplies are provided by the DoD through the WMD-REALITI contract.

Library: Concurrent Technologies Corporation (CTC), on behalf of the National guard Bureau, has packaged 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, such as Pro Packet. Additional materials will be available on-line or purchase optional supplemental text at the Co-op store.

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). Contract with these agencies are expected to continue for several years. However, IUP is preparing to support this course when it is independent of external funding. For example, this course will also be offered to IUP students who want to enter the WMD first responder community. 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 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.

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, 3l, 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.