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

**Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee**

| Contact Person | Email Address |
|---|---|
| Dr. V. Wijekumar | vjwije@iup.edu |
| Proposing Department/Unit | Phone |
| SDR/Science for Disaster Response | 724-357-4588 |

**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 131 Principles of Radiation |
| ***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) | Kenneth E Hershman | 4/3/04 |
| Department Chair(s) | Kenneth E Hershman | 4/3/04 |
| College Curriculum Committee Chair | | 08/10/04 |
| College Dean | | 8/19/04 |
| Director of Liberal Studies * | | |
| Director of Honors College * | | |
| Provost * | | |
| **Additional signatures as appropriate:** (include title) | | |
| UWUCC Co-Chairs | Gail Eschrist | 10-26-04 |

* where applicable

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RECEIVED OCT 29 2004 LIBERAL STUDIES

## SYLLABUS OF RECORD

### I. Catalog Description

SDR 131 Principles of Radiation — 2 class hours, 2 lab hours, 3 credit hours (2c-2l-3cr)

Prerequisites: PHYS 111, 121, 112, and 122 or equivalent and permission of instructor and local, state or federal agency/organization authorization.

Level 1 nuclear physics focuses on nuclear radiation basics; radioactivity; radiation measurements, and sources of nuclear radiation in relation to CBRN materials identification and analysis. Laboratory exercises focus on techniques to aid CBRN materials identification and analysis.

## II. Course Objectives

Students successfully completing this course will be able to

1. Assess general radiological and nuclear risks, as they apply to the first responder.
2. Identify potential sources of radioactive materials for the possible application as a WMD.
3. Describe the threat of radiological dispersion devices, or "dirty bombs."
4. Explain the terrorist threats posed by the use of conventional nuclear weapons.
5. Recognize examples of radioactive accidents via the presented case studies.
6. Define basic radiation terms, radiation, alpha particle, beta particle, gamma ray, neutron radiation, reactors, and x-rays.
7. Describe terms that affect radiation dose.
8. Explain the concepts of activity, exposure, radiation energy, dose, and dose-equivalent.
9. Explain the Nuclear Regulatory Commission (NRC) Rules and Regulations relevant to "dose limits" for occupational use.
10. Explain the Nuclear Regulatory Commission (NRC) Rules and Regulations relevant to "dose limits" for public use.
11. Distinguish between various sources of radiation emitted from the ground, building materials, water and food, and other targets.
12. Differentiate between various sources of radiation emitted from technically-enhanced norms.
13. Apply the charts of radioactive materials found at various incident sites.
14. Determine the range of alpha particles in air from an alpha source, range of beta particles in plastic from a beta source and half-value layer thickness of lead for gamma rays from a gamma source.

## III. Detailed Course Outline

Lecture (28 total hours)

A. Introduction to Radiation (7 hours)

1. Introduction

i. Spent nuclear fuel

ii. Nuclear powered light houses

2. Nuclear terrorism and dirty bombs
    i. Radiological Dispersion Devices (RDD)
    ii. Dirty Bombs
    iii. Nuclear Weapons Threat
    iv. Small Nuclear Weapons-Special Atomic Demolition Munition (SADM)
    v. Davy Crockett
    vi. Global Nuclear Weapons
3. Case Studies:
    i. Accidental Leakage of Cesium-137 in Goiania, Brazil, in 1987
    ii. 1994 Cs-137 Estonian Accident
    iii. San Salvador Co-60 accident (5 February 1989)

B. Radiation Basics (7 hours)
1. Radiation
2. Alpha decay
3. Beta decay
4. Gamma decay
5. Neutron decay
6. Nuclear Reactors
7. X-rays

Exam 1 (1 hour)

C. Radiation Measurements (7 hours)
1. Activity
2. Measurement of Radiation Interaction with Matter
    i. Radiation Exposure
    ii. Absorbed Dose
    iii. Dose-Equivalent
    iv. Internal Radiation Exposure Dose Calculations
    v. External Radiation Exposure
    vi. Radioactive Contamination
    vii. Ionizing Radiation Exposure to the Public and Occupational Use

D. Radiation Sources (7 hours)

1. Natural and Man-made Radiation sources
    i. Natural Background Radiation
        1. Cosmic Radiation
        2. Terrestrial Radiation
        3. Internal Radiation
    ii. Man-made Sources of radiation
        1. Brachytherapy Sources in Nuclear Medicine
        2. Teletherapy Sources in Nuclear Medicine
        3. Radioisotope Thermal-Electric Generators (RTG)
        4. Irradiators
    iii. Sources of Technologically Enhanced, Naturally Occurring Radioactive Material (TENORM)

Exam 2 (During Final Exam Week or end of course depending on mode of delivery) (1 hour)

Laboratory (Practical Exercise) (28 total hours)

1. Introduction; Radiation Safety (2 hours)
2. Range of alpha particles in air and other materials (4 hours)
3. Range of beta particles in plastic and other materials (4 hours)
4. Half-value layer thickness of lead for gamma rays from various sources (4 hours)
5. Gamma Spectrometers:
    a. FieldSpec system with sodium iodide detector (6 hours).
    b. ISOCART mobile assay system with germanium detector (6 hours).
6. Capstone Event (2 hours)

## IV. Evaluation Methods

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

**Written Exams (50%)**

Two, one-hour, comprehensive, problem-solving exams are given during the course. Typical questions are scenario based and require students to analyze and identify radioactive materials, perform calculations, and estimate the activities of radioactive isotopes.

**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 radioactive substances, and quantify their activities as well as on shielding.

**Capstone Event (25%)**

The capstone 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 radiological hazards, predict the hazards associated with the unknown radioisotope(s), and conduct the proper response call.

## 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:**

Wijekumar, V. *Weapons of Mass Destruction-Response Element Advanced Laboratory Integrated Training and Indoctrination (WMD-REALITI) Novice Level (Level 1) Radiological Lesson Plans.* (Revised November 2003.)

## VIII. Special Resource Requirements

None

## VIII. Bibliography


1. Cember, H.. *Introduction to Health Physics*, 3rd ed.; McGraw-Hill (HP division): New York, 1996.

2. Gloyna, E. F.; Ledbetter, J. O. *Principles of Radiological Health*; Marcel Dekker Inc.: New York, 1969.

3. Pierce, D.A.; Shimizu, Y.; Preston, D.L.; Vaeth, M.; Mabuchi, K. *Studies of the mortality of A-bomb survivors.* Report 12, Part I. Cancer: 1950-1990; Radiation Research 146:1-27, 1996.

4. Richardson, H. D. *Industrial Radiography Manual*; U.S. Government Printing Office: Washington, 1968.

5. Shultis, K. J.; Faw, R. E. *Fundamentals of Nuclear Science and Engineering;* Marcel Dekker Inc., 2002.

6. Thompson, D.E.; Mabuchi, K.; Ron, E.; Soda, M.; Tokunaga, M.; Ochikubo, S.; Sugimoto, S.; Ikeda, T.; Terasaki, M.; Izumi, S.; Preston, D.L. *Cancer incidence in atomic bomb survivors. Part II: Solid tumors, 1958-1987*; Radiation Research 137:S17-S67, 1994.

7. Turner, J. E. *Atoms, Radiation, and Radiation Protection*; John Wiley and Sons: NewYork, 1995.

## 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/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 of this course is too specific to the science of terroristic instruments and too specific to the protocols of the first responders to be incorporated into existing courses.

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 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 (Level 1), Intermediate (Level 2), Apprentice (Level 3), and Advanced (Level 4)] over the three year period of the WMD-REALITI program. This course is part of the Level 1 module. The first year was funded for $170,317, the second year for $441,445, and the third year for $599,777.

## 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 Physics 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 131 (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 four (4) workload hours (2 hours for lecture; 2 hours for lab) 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 2c + 2l = 4 workload hours.

The faculty credentials include possession of a Ph.D. in nuclear physics 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 experimental nuclear physics; nuclear background radiation techniques; analytical techniques; spectroscopic methods of isotope determination using nuclear detectors such as sodium iodide and germanium; recognition, evaluation, and management of nuclear, radiological, biological, and chemical weapons.

- A thorough understanding of laboratory safety procedures to meet the State and Nuclear Regulatory Commission (NRC) standard operating procedures (SOPs) for handling radioactive materials.

- A Radiation Safety Officer certificate issued by an entity (acceptable to NRC and State) in Radiation Safety to ensure competent, safe handling of radioactive materials, appropriate decontamination protocols, and compliance with the State and NRC Rules and Regulations.

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 FieldSPEC system and the ISOCART mobile assay system, 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 preparing to support this course when it is independent of external funding. 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.

No additional information is necessary.