COURSE SYLLABUS
Standards & Theory of Radiological Control
RW 133-01

1. General Course Information
   a. Course Title: Standards & Theory of Radiological Control
   b. Course Number: RW 133-01
   c. Semester/year: Fall/2003
   d. Credit Hours: 3 Hours
   e. Instructor: Olav Amundsen
   f. Office Phone: 505 392 5335 ext 265
   g. Office Hours: Posted on Office Door, HH 228
   h. Prerequisite: None

2. Course Description
   In this course students will be introduced to standards and theory of radiological control. Coverage will include radiological protection standards, the ALARA Principle, external & internal exposure control and radiation detector theory. The understanding of the history of standards and principals of protection and the proper detecting and handling of radioactive matter is taught. Calculations of internal and external exposure, is covered extensively. Basic theory, identifying how we measure radioactivity, together with practical tasks including instrumentation is also a part of this curriculum. Three lecture hours per week.

3. Course Rationale/Transferability
   This course is an undergraduate level course designed to introduce the student Theory and Standards. The course stresses the importance of a regulated business and important principles for handling radioactivity. This course has no guarantee of transferability to other New Mexico Schools or out-of-state institutions. Students are advised to check with the receiving institutions if they intend to transfer to another institution.

4. Required/Suggested Course Materials

   Other material listed with each module under section 7- Specific Course
Objectives/Competencies within this document.

5. **Grading Policy**

Each student is evaluated by homework assignment/pop quizzes, written examinations, reports and projects. Final grades will be determined by averaging three graded areas based on the following scale. A grade of 80 % or better is necessary for certification.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage of Overall Grade</th>
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</thead>
<tbody>
<tr>
<td>Written Examinations</td>
<td>40 %</td>
</tr>
<tr>
<td>Homework / Pop Quizzes</td>
<td>50 %</td>
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<tr>
<td>Final Exam</td>
<td>10 %</td>
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Upon completion of the afore mentioned averaging grades will be administered as follows:

- **A** = 90-100
- **B** = 80-89
- **C** = 70-79
- **D** = 60-69
- **F** = 59-00

6. **General Course Objectives/Competencies**

This course is an undergraduate level course designed to introduce the student to the fundamentals of Radiological Control and Waste Handling. The course is divided into three modules. These modules focus on (1) Radioactivity and Radioactivity decay, (2) Interaction of Radiation with Matter and (3) Biological Effects of Radiation. The course is focused on preparing the students for further development through additional training to become Radiological Control Technicians.

7. **Specific Course Objectives/Competencies**

**Course Title:** Standards & Theory of Radiological Control

**Module Title:** Radiological Protection Standards

**Module Number:** 1.09

**Objectives:**

1.09.01 Identify the role of advisory agencies in the development of recommendations for radiological control.

1.09.02 Identify the role of regulatory agencies in the development of standards and regulations for radiological control.

1.09.03 Identify the scope of the 10 CFR Part 835.
References:

1. ANL-88-26 (1988) "Operational Health Physics Training"; Moe, Harold; Argonne National Laboratory, Chicago
3. 10 CFR Part 835 (1998) "Occupational Radiation Protection"

Course Title: Standards & Theory of Radiological Control
Module Title: ALARA
Module Number: 1.10

Objectives:

1.10.01 Describe the assumptions on which the current ALARA philosophy is based.
1.10.02 Identify the ALARA philosophy for collective personnel exposure and individual exposure.
1.10.03 Identify the scope of an effective radiological ALARA program.
1.10.04 Identify the purposes for conducting pre-job and/or post-job ALARA reviews.
1.10.05 Identify RCT responsibilities for ALARA implementation.

References:

1. NCRP Report No. 91 (1987) "Recommendations on Limits for Exposure to Ionizing Radiation"
4. ICRP Publication 37 "Cost-Benefit Analysis in the Optimization of Radiation Protection"

Course Title: Standards & Theory of Radiological Control
Module Title: External Exposure Control
Module Number: 1.11

Objectives:

1.11.01 Identify the four basic methods for minimizing personnel external exposure.

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1.11.02 Using the Exposure Rate = 6CEN equation, calculate the gamma exposure rate for specific radionuclides.

1.11.03 Identify "source reduction" techniques for minimizing personnel external exposures.

1.11.04 Identify "time-saving" techniques for minimizing personnel external exposures.

1.11.05 Using the stay time equation, calculate an individual's remaining allowable dose equivalent or stay time.

1.11.06 Identify "distance to radiation sources" techniques for minimizing personnel external exposures.

1.11.07 Using the point source equation (inverse square law), calculate the exposure rate or distance for a point source of radiation.

1.11.08 Using the line source equation, calculate the exposure rate or distance for a line source of radiation.

1.11.09 Understand how exposure rate varies depending on the distance from a surface (plane) source of radiation, and identify examples of plane sources.

1.11.10 Identify the definition and units of "mass attenuation coefficient" and "linear attenuation coefficient".

1.11.11 Identify the definition and units of "density thickness."

1.11.12 Identify the density-thickness values, in mg/cm², for the skin, the lens of the eye and the whole body.

1.11.13 Calculate shielding thickness or exposure rates for gamma/x-ray radiation using the equations.

References:

1. ANL-88-26 (1988) "Operational Health Physics Training"; Moe, Harold; Argonne National Laboratory, Chicago
2. "Basic Radiation Protection Technology"; Gollnick, Daniel; Pacific Radiation Press; 1983
Course Title: Standards & Theory of Radiological Control
Module Title: Internal Exposure Control
Module Number: 1.12

Objectives:

1.12.01 Identify four ways in which radioactive materials can enter the body.

1.12.02 Given a pathway for radioactive materials into the body, identify one method to prevent or minimize entry by that pathway.

1.12.03 Identify the definition and distinguish between the terms "Annual Limit on Intake" (ALI) and "Derived Air Concentration" (DAC).

1.12.04 Identify the basis for determining Annual Limit on Intake (ALI).

1.12.05 Identify the definition of "reference man".

1.12.06 Identify a method of using DACs to minimize internal exposure potential.

1.12.07 Identify three factors that govern the behavior of radioactive materials in the body.

1.12.08 Identify the two natural mechanisms which reduce the quantity of a radionuclide in the body.

1.12.09 Identify the relationship between the physical, biological and effective half lives.

1.12.10 Given the physical and biological half lives, calculate the effective half life.

1.12.11 Given a method used by medical personnel to increase the elimination rate of radioactive materials from the body, identify how and why that method works.

References:

1. "Basic Radiation Protection Technology"; Gollnick, Daniel; Pacific Radiation Press; 1983
2. "Reactor Health Physics Technology Course"; Gilchrist, R. L.; PNL; Richland, Wa.
References:

1. "Basic Radiation Protection Technology"; Gollnick, Daniel; Pacific Radiation Press; 1983
2. ANL-88-26 (1988) "Operational Health Physics Training"; Moe, Harold; Argonne National Laboratory, Chicago
3. "Radiation Detection and Measurement"; Knoll, Glenn F. John; Wiley & Sons; 1979

8. General/Miscellaneous
See attached General Information Sheet / Institutional Page

9. Critical Incident and Evacuation Plan with Evacuation Route Map

See attached; New Mexico Junior College Emergency/Critical Incident Information sheet and campus map.

10. Course Outline

a. Class Dates
Monday, Tuesday, Wednesday 11:00-11:50 AM

b. Instructional Aids:
1. Overheads, Videos, Internet Instruction
2. Overhead projector/screen
3. Chalkboard/whiteboard
4. Computer Lab

c. Examinations
In addition to the final exam, a minimum of one exam for each module will be administered during the semester. The test date and specific course material covered by the exam will be announced during class by the instructor at the start of each module. Examinations must be taken at the scheduled time. If a student is aware that she/he will not be able to take the exam at the scheduled time, then prior to the exam date he/she must reschedule a special examination with the professor. Any other absences from examination will be retaken only if the professor decides it was a valid excuse, otherwise, a grade of “0” will be recorded.

d. Late Papers, Homework or Projects
Five points per day will be deducted from the grade for late work. Possible field trips associated with class projects will be announced and scheduled as early as practical.

e. Tardiness
Students are expected to be seated at the time each lecture is scheduled to begin.
f.  **Withdrawal**  
You may officially withdraw from this class on or before the end of the class with a grade of “W”. Last date of withdrawal will be posted by instructor at the beginning of the class.

g.  **Audits**  
No student may “audit” the class after having signed up for credit. In other words, you may not change from credit status to audit status once the course has commenced.

h.  **Attendance**  
Students are not required to attend lectures, but will have to take all exams and deliver all homework.