Department of Radiological Control and Waste Handling

Fundamentals of Radiation Control

RW 123-01

COURSE SYLLABUS

1. General Course Information
   a. Course Title: Fundamentals of Radiation Control
   b. Course Number: RW 123-01
   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 fundamentals of radiological control and waste handling. Coverage includes the fundamentals of radioactivity and radioactive decay. Characteristics of alpha, beta and gamma radiations are introduced, using simple equations of radioactive decay, identify alpha, beta, positron decay and electron capture. Differences between natural and artificial radioactivity and Unstable fission products will also be taught. The elements of the Chart of Nuclides, half life, specific activity, and units are also introduced. Three lecture hours per week.

3. Course Rationale/Transferability
   This course is an undergraduate level course designed to introduce the student to the fundamentals of Radiological control. 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.

- Written Examinations: 40% of overall grade
- Homework / Pop Quizzes: 50% of overall grade
- Final Exam: 10% of overall grade

Upon completion of the above mentioned averaging grades will be administered as follows:

A = 90-100
B = 80-89
C = 70-79
D = 60-69
F = 59-0

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: Fundamentals of Radiation Control
Module Title: Radioactivity & Radioactive Decay
Module Number: 1.06

Objectives:

1.06.01 Describe how the neutron to proton ratio is related to nuclear stability.

1.06.02 Identify the definition for the following terms:
   a. radioactivity
   b. radioactive decay

1.06.03 What are the characteristics of alpha, beta, and gamma radiations.

1.06.04 Given simple equations identify the following radioactive decay modes:
1.06.05 Identify two aspects associated with the decay of a radioactive nuclide.

1.06.06 Describe differences between natural and artificial radioactivity.

1.06.07 Identify why fission products are unstable.

1.06.08 List the three naturally-occurring radioactive families and end product of each.

1.06.09 Given a nuclide, locate its block on the Chart of the Nuclides and identify the following for that nuclide:
   - atomic number
   - atomic mass
   - natural percent abundance
   - stability
   - half-life
   - types and energies of radioactive emissions

1.06.10 Given the Chart of Nuclides, trace the decay of a radioactive nuclide and identify the stable end-product.

1.06.11 What are the definition of the following units:
   - curie
   - becquerel

1.06.12 Define specific activity.

1.06.13 What is the definition of half-life.

1.06.14 Calculate activity, time of decay, and radiological half life using the formula for radioactive decay.

1.06.15 Define the following:
   - exposure
   - absorbed dose
   - dose equivalent
Identify the definition of the following units:

a. roentgen  
b. rad/gray  
c. rem/sievert

References:

1. "Training Publication 89n, Training Publication 30n"; GPO Division of Radiological Health.

Instructional Aids:

1. Overheads, Internet Study follow up  
2. Overhead projector/screen  
3. Chalkboard/whiteboard  
4. Lessons learned

Course Title: Fundamentals of Radiation Control  
Module Title: Interaction of Radiation with Matter  
Module Number: 1.07

Objectives:

1.07.01 Define the following terms:
   a. ionization  
   b. excitation  
   c. bremsstrahlung

1.07.02 Define the following terms:
   a. specific ionization  
   b. linear energy transfer (LET)  
   c. stopping power  
   d. range  
   e. W-value
1.07.03 Identify the two major mechanisms of energy transfer for alpha particulate radiation.

1.07.04 Identify the three major mechanisms of energy transfer for beta particulate radiation.

1.07.05 Identify the three major mechanisms by which gamma photon radiation interacts with matter.

1.07.06 Identify the four main categories of neutrons as they are classified by kinetic energy for interaction in tissue.

1.07.07 Identify three possible results of neutron capture for slow neutrons.

1.07.08 Describe and Understand elastic and inelastic scattering interactions for fast neutrons.

1.07.09 List the characteristics of materials best suited to shield:
   a. alpha
   b. beta
   c. gamma
   d. neutron radiations

References:


Instructional Aids:

1. Overheads, Internet
2. Overhead projector/screen
3. Chalkboard/whiteboard
4. Lessons learned
Course Title: Fundamentals of Radiation Control
Module Title: Biological Effects of Radiation
Module Number: 1.08

Objectives:

1.08.01 Describe the function of the following cell structures:
   a. Cell membrane
   b. Cytoplasm
   c. Mitochondria
   d. Lysosome
   e. Nucleus
   f. DNA
   g. Chromosomes

1.08.02 Identify effects of radiation on cell structures.

1.08.03 Define the law of Bergonie and Tribondeau.

1.08.04 Identify factors which affect the radiosensitivity of cells.

1.08.05 Given a list of types of cells, identify which are most or least radiosensitive.

1.08.06 What are the primary and secondary reactions on cells produced by ionizing radiation.

1.08.07 Identify the following definitions and give examples of each:
   a. Stochastic effect
   b. Non-stochastic effect

1.08.08 What is the LD 50/30 value for humans.

1.08.09 Identify the possible somatic effects of chronic exposure to radiation.

1.08.10 Distinguish between the three types of the acute radiation syndrome, and identify the exposure levels and the symptoms associated with each.

1.08.11 What are the risks of radiation exposure to the developing embryo and fetus.

1.08.12 Distinguish between the terms "somatic" and "heritable" as they apply to biological effects.
References:


Instructional Aids:

1. Overheads
2. Overhead projector/screen
3. Chalkboard/whiteboard
4. Lessons learned

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 Time & Dates

Monday, Tuesday, Wednesday from 10:00 to 10:50 AM.

b. Instructional Aids:

1. Overheads, Internet, Videos
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 are required to take all exams and deliver all homework.