Radiation Fundamentals Syllabus

ACADs (08-006) Covered

Keywords

Description

Supporting Material

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SYLLABUS
Columbia Basin College
Career and Technical Education Division

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COURSE TITLE RPT 111 Radiation Fundamentals

CATALOG DESCRIPTION
This course provides future radiological protection technicians with an overview of radioactivity, sources of radiation, and radioactive decay. Emphasis will be placed on plant safety, radiological hazards and radioactivity containment.

PREREQUISITE OR ASSET/COMPASS SCORE
Completion of NT 111, NT 114, NT 131 and NT 141 or 142 with 2.5 grade or better

CREDITS AND HOURS 5 CREDITS (4 credits lecture – 44 hours/ 1 credit lab – 22 hours)

TEXT (S) AND MATERIALS
10CFR20, *Standards for Protection Against Radiation*
10CFR835, *Occupational Radiation Protection*
Cember, *Introduction to Health Physics 4th Edition*
Gollnick, *Basic Radiation Protection Technology 5th Edition*
Shleien, et. al., *Handbook of Health Physics and Radiological Health 3rd Edition*

GENERAL TEACHING METHODS
Lecture, Discussion, Group Projects, Assigned Homework

STUDENT LEARNING OUTCOMES

CBC Student Learning Outcomes
Students who graduate from Columbia Basin College will have been exposed to the skills, concepts, and methods of inquiry in many different disciplines. The totality of their learning experience is expressed in a set of general student learning outcomes (SLO's), which all students, regardless of program, are expected to demonstrate:

1. Think critically
2. Communicate effectively
3. Reason quantitatively and symbolically
4. Apply information tools and resources
5. Develop cultural awareness
6. Master Program Learning Outcomes

Program Outcomes (SLO 6)
Graduates of the Associates Degree of Applied Science in Nuclear Technology Program will be able to effectively address the needs of the nuclear industry by:

* Applying relevant theory and techniques from Mathematics, Physics, and Chemistry to effectively understand, communicate, and/or operate, nuclear systems, structures and components promoting excellence and safety
* Effectively and accurately applying, understanding and communicating nuclear technology related concepts
* Effectively and accurately applying, understanding, and communicating basic knowledge of nuclear facilities operations
* Understanding nuclear fundamentals, systems, tools and equipment

* Applying skills pertinent to each discipline minimizing personnel exposure to radiation and/or hazardous materials.
* Applying, understanding, and communicating radiological protection theory and techniques promoting excellence and safety
* Understanding and communicating nuclear facilities, design, theory and/or operations

Course Outcomes
RPT 111 Radiation Fundamentals is intended to develop abilities to think critically, communicate effectively, reason quantitatively and symbolically, apply information tools and resources and master program learning outcomes through the following:

1. Explain the importance of following systems to plant safety and radioactivity containment, and identify any radiological hazards and precautions associated with maintenance tasks for each. (SLO 1, 3, 4 & 6)

2. Properly select, inspect, use, and care for tools and equipment used in radiological protection technician task performance. (SLO 1, 4 & 6)

3. Explain and apply the theory of radioactivity and radioactivity decay. (SLO 2 & 6)

4. Identify and quantify sources of radiation. (SLO 1, 3 & 6)

COURSE OUTLINE

1. Radioactivity and Radioactive Decay
    a. Identify the types of radioactive decay (alpha, beta, gamma, electron capture, and internal conversion).
    b. Characterize alpha particles, beta particles, gamma rays, and neutrons (for example, describe the physical properties of these types of radiation)
    c. Use basic equations to describe each type of decay.
    d. Describe the process of neutron activation using basic equations.
    e. Identify and use radiological quantities and their units, including activity (curies and becquerels, disintegrations per second, disintegrations per minute), exposure (roentgens), dose (rads and grays), and dose equivalent (rems and sieverts).
    f. Discuss complex decay schemes, such as natural decay chains, reactor-produced decay chain, and equilibrium isotopes (secular, transient, or no equilibrium).
    g. Use exponential equations and appropriate graphs (linear and semi-log) to perform radioactive decay calculations.
2. Internal and External Exposure Control
    a. Equate radioactivity to dose rate through simple rules of thumb and associated calculations for various source geometries (for example, 6CEN, point source, line source, plane source).
    b. Identify, (content added: calculate), and use the following significant dose terms:
        - Deep
        - Eye (lens, shallow, effective (using weighting factors))
        - Committed (for example, using in vivo and in vitro measurements and intake retention fractions)
        - Committed effective (using in vivo and in vitro measurements and intake retention fractions)
        - Total effective
        - Total organ dose equivalents
3. Operational Health Physics
    a. Identify and quantify these major sources of natural background radiation: cosmic radiation, uranium, thorium decay chains, potassium 40, and radon gas, including daughter products.

b. Identify and quantify the following man-made sources of background radiation: medical diagnosic X-rays, radio pharmaceuticals, consumer products (television, luminous dials), weapons tests, and air travel.

c. Identify and quantify potential sources of exposure to the public from the plant liquid and gaseous effluent releases, transportation of radioactive materials, and major accidents.

d. Identify specific isotopes of concern in power reactors during operation and following shutdown (such as H-3, N-16, Ar-41, Cr-51, Mn-54, Fe-55, Co-58, Co-60, Zn-65, Kr-85, Kr-88, Zr-95, Ag 110m, I 131-135, Cs-134, Cs-137, and transuranics).

e. Identify and quantify the following major sources of radiation in the plant that contribute to worker exposures:

- Primary system piping and components
- Inside containment during power operation
- Primary system filters and demineralizers
- Radwaste process systems
- Radiography

f. Identify conditions that preclude safe work in the vicinity of system components.

g. Plant safety and containment:

- Chemical and volume control (PWR)
- Circulating water
- Condensate spray
- Control rod drive mechanism
- Emergency core cooling systems
- Feedwater
- Main steam
- Offgas (BWR)
- Post-accident sampling
- Pressurizer (PWR)
- Pressurizer relief (PWR)
- Radiation monitoring
- Reactor coolant
- Reactor water cleanup (BWR)
- Recirculation (BWR)
- Residual heat removal/shutdown cooling
- Suppression pool (BWR)

h. Draw a basic system block diagram.

i. Identify the basic interrelationships with other plant systems.

EVALUATION METHODS

Tests, Homework Assignments, Group Projects and class participation

ACADEMIC DISHONESTY

As members of the Columbia Basin College learning community, students are not to engage in any form of academic dishonesty. Forms of academic dishonesty include, but are not limited to, plagiarism, cheating, fabrication, grade tampering, and misuse of computers and other electronic technology. Students who engage in academic dishonesty may receive an academic penalty or a disciplinary penalty or both. Instances of academic dishonesty may be referred to the Vice President for Student Services in accordance with the Washington Administrative Code (WAC), section 132S-40-165, paragraph 3 (Dishonesty) and the CBC Code of Student Rights and Responsibilities. The disciplinary consequences of engaging in any form of academic dishonesty include reprimand, probation, suspension, and dismissal. A student who knowingly helps or attempts to help another individual to violate the college's policy on academic honesty also may be subject to academic as well as disciplinary penalties.

Students are expected to be familiar with CBC policy on academic dishonesty. This is available on-line at http://www.columbiabasin.edu/academichonesty

PRIVACY
Columbia Basin College abides by the Family Educational Rights and Privacy Act (FERPA), a federal law that maintains students' right to the privacy of their academic records. CBC will not release student information or student records to a parent or guardian without the student's written permission. Students who wish to authorize an instructor to provide information to their parent(s), guardian(s), or others, must complete the necessary authorization, which is available in the Office of Admissions and Registration.

TUTOR CENTER
The Tutor Center offers CBC students help with their studies for most departments and programs. It is also available to facilitate study groups. The center is in TD 434 on the Pasco campus. The phone number is (509) 547-0511, extension 2676.

You can reach the Tutor Center on-line at http://www.columbiabasin.edu/home/index.asp?page=1373

STUDENTS REQUIRING SPECIAL ACCOMMODATION
Columbia Basin College provides reasonable accommodations to students with disabilities. Students who need course accommodations because of a disability, have emergency medical information, or need special arrangements in case the building must be evacuated, should notify their instructors as soon as possible. The responsibility for determining a student's eligibility for accommodations rests with the Resource Center, which can be reached at (509) 547-0511, extension 2325.

CBC SAFETY
Columbia Basin College strives to provide a safe and secure environment for students, staff, and visitors. The CBC Health and Safety Committee's purpose is to pursue potential issues and to establish prevention tactics. For more information, visit www.columbiabasin.edu/**safety**.

Pasco Campus Security: (509) 531-4034
Richland Campus Security (509) 539-8167
After Hours Security: (509) 521-4599

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