CHATTANOOGA STATE COMMUNITY COLLEGE
CHATTANOOGA, TENNESSEE
ENGINEERING TECHNOLOGY DIVISION

COURSE SYLLABUS

RP 104 RADIATION PROTECTION AND RADIOLOGICAL HEALTH ADMINISTRATION

Instructor:	**Mark Palmer**	**Class Hours/Credit Hours:**	**4**
Phone:	**697-3279**	**Semester:**	**Fall 2011**
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Catalog Course Description:
An introductory course in Health physics and a study of radiation dosimetry, biological effects of ionizing radiation terminology, definitions, radiation doses, atomic and nuclear structure and interactions of radiation with matter.

Prerequisites:
None

Corequisites:
None

Entry Level Standards
None

Textbook/Materials
Basic Radiation Protection Technology, Fifth Edition, Daniel A. Golnick (Required)
Chart of the Nuclides (Recommended)
Calculator (Required**)**

Institutional Student Learning Outcomes

ISLO (2)	Competence in Specialty Area
ISLO (3)	Critical Thinking & Analytical Skills
ISLO (5)	Information & Technology
ISLO (6)	Work Ethic

Program Student Learning Outcomes

PSLO (1)	An ability to apply knowledge of mathematics, basic sciences, and technology to solve problems appropriate to the each program. (ISLO 2,3,5,6)
PSLO (2)	An ability conduct experiments, collect, analyze and interpret data. (ISLO 2,3,5,6)
PSLO (3)	An ability to design a system, components, or process to meet desired needs. (ISLO 2,3,5,6)
PSLO (4)	An ability to function on multi-disciplinary teams. (ISLO 1,6)
PSLO (5)	An ability to identify, formulate, and solve technical problems. (ISLO 2,3,5,6)
PSLO (6)	An understanding of professional and ethical responsibility. (ISLO 3, 6)
PSLO (7)	An ability to communicate effectively. (ISLO 1,5)

PSLO (8) Acquired a broad education necessary to understand the impact of engineering solutions in a global and societal context. (ISLO 3, 5)

PSLO (9) Acquired recognition of the need for, and an ability to engage in life-long learning. (ISLO 3)

PSLO (10) Acquired knowledge of contemporary issues. (ISLO 5,6)

PSLO (11) An ability to use the techniques, skills, and modern engineering tools necessary to function as a radiological protection technician. (ISLO 2,3,5,6)

I. Course Student Learning Outcomes

Students will demonstrate the ability to:

CSLO1 Provide students with the knowledge and skills necessary to apply the basics concepts of chemistry to radiation protection. [PSLO11]

CSLO2 Provide students with knowledge of the biological effects and risks of ionizing radiation exposure. [PSLO11]

CSLO3 Satisfy the requirements for the Nuclear Uniform Curriculum Certificate. [PSLO1,2,11]

Alignment of Assessments with CSLOs (actual assessments are defined below)		
CSLO1	**CSLO2**	**CSLO3**
a.) Lab Assignments **b.) Section Tests** **c.) Final Exam**	**a) Lab Assignments** **b) Section Tests** **c) Final Exam**	**a) Lab Assignments** **b) Section Tests** **c) Final Exam**

II Course Objectives

O1. Explain the principles and operation of radiation detection and monitors including the following; area radiation monitors, electronic dosimeter (self-reading pocket dosimeters), gas-filled detectors, personnel dosimetry (for example, Thermoluminescent detectors), personnel monitors, whole body monitors, process radiation monitors (liquid and gaseous), scintillation detectors. [CSLO1-CSLO3].

O2. Explain radiation effects including the effects of radiation on matter and body tissues (such as somatic, genetic, acute and chronic). [CSLO1-CSLO3].

O3. Perform calculations that involve radioactive dose and matter as follows; conversion of units (grays, sieverts, Becquerel, curies, roentgen, rems, rads), simple calculations to estimate dose (rate X time = dose), nits of measurement. [CSLO1-CSLO3].

O4. Explain exposure control including the following; contamination, decontamination, exposure reduction methods, protective clothing and respirators, provisions of 10CFR20, radiologically controlled areas, site administrative controls and limits (margin from regulatory limits). [CSLO1-CSLO3].

O5. Explain the function of an ion chamber, proportional counter, alpha scintillation detectors, plastic scintillation detectors and Geiger-Mueller counter. [CSLO1-CSLO3].

O6. Draw and explain gas-filled detector six region curve, including gas amplification. [CSLO1-CSLO3].

O7. Explain the operating characteristics and basic electrical circuitry of each survey instrument. [CSLO1-CSLO3].

O8. Perform and describe operational checks on survey instruments, such as battery, zero, source, response, background and calibration. [CSLO1-CSLO3].

O9. Identify conditions that might affect survey instrument response, including the following; atmospheric pressure, extreme temperatures, geotropism, high humidity, mixed radiation fields, noble gas atmospheres, off-scale reading, radiofrequency interference. [CSLO1-CSLO3].

O10. Identify the instruments available for performing contamination surveys such as the following; alpha scintillation detectors, Geiger-Mueller tubes, plastic scintillation detectors, proportional counters. [CSLO1-CSLO3].

O11. Convert meter indications of contamination detection equipment to contamination levels in standard units (cpm to dpm/100cm^2). [CSLO1-CSLO3].

O12. Demonstrate proper techniques for surveying an item for contamination (loose and fixed) using a hand-held frisker. [CSLO1-CSLO3].

O13. Explain the operating characteristics and basic electrical circuitry of counting and spectroscopy equipment (such as proportional counters, liquid scintillation detectors, high-purity germanium, zinc sulfide detectors). [CSLO1-CSLO3].

O14. Perform and describe operational checks on counting and spectroscopy equipment resolution, source, response and background. [CSLO1-CSLO3].

O15. Identify unusual conditions that might affect counting and spectroscopy equipment response such as high humidity, abnormal background, electronic noise and extreme temperature. [CSLO1-CSLO3].

O16. Describe the statistical nature of radioactive decay as it relates to uncertainties encountered when measuring radioactivity (such as normal distribution curves, standard deviations, confidence levels, lower limits of detection and minimum detectable activity). [CSLO1-CSLO3].

O17. Identify factors that affect the statistical accuracy of radioactivity measurements, including count rate, background, count time, equipment efficiency, and sample volume and sample geometry. Explain how the statistical accuracy of measurements can be improved. [CSLO1-CSLO3].

O18. Define the lower limit of detection (LLD). [CSLO1-CSLO3].

O19. Perform LLD and minimum count rate calculations for various radioactivity measurements. [CSLO1-CSLO3].

O20. Explain the operating characteristics and use of the following radiological survey and analysis instruments; alpha survey instrument, beta/gamma survey instrument, frisker, gamma survey instrument, gross alpha counter, gross alpha/beta counter, gross gamma counter, liquid scintillation counter, multichannel analyzer (gamma spectrometer), neutron survey instrument, proportional counters, smear counter. [CSLO1-CSLO3].

O21. Explain the principles of operation of area radiation monitoring systems. [CSLO1-CSLO3].

O22. Explain the principles of operation of process radiation monitoring systems. [CSLO1-CSLO3].

O23. Identify the locations of the area and process radiation monitoring systems and their associated components *(plant specific)*. [CSLO1-CSLO3].

O24. Identify unusual conditions that might affect radiation monitoring systems response such as high humidity, abnormal background, mixed radiation fields and temperature effects. [CSLO1-CSLO3].

O25. Explain the operating characteristics and use of monitoring devices including the following monitors: area radiation, automatic tool, continuous air, hand and foot, iodine air, noble gas air, particulate air, personnel whole-body contamination, portable area radiation, portal monitors. [CSLO1-CSLO3].

O26. Describe the application and explain the principles of operations of each type of sample collection equipment. [CSLO1-CSLO3].

O27. Convert detection equipment indications to airborne radioactivity in standard units (µCi/cm3) and in derived air concentration, to specific activity (µCI/ml) for liquid samples, or to specific activity (µCi/g) for solid samples. [CSLO1-CSLO3].

O28. Operate the following air sampling equipment and describe when each is used: continuous air monitors, high volume samplers, low volume samplers, lapel samplers[CSLO1-CSLO3].

O29. Describe the use of calibration source decay curves. [CSLO1-CSLO3].

O30. Describe source accountability procedures. [CSLO1-CSLO3].

O31. Describe source leak testing for alpha, beta, gamma, and (if applicable) neutron sources. [CSLO1-CSLO3].

O32. Describe disposal of sources, including licensed and non-licensed *(plant specific)*. [CSLO1-CSLO3].

O33. Identify the types of radioactive decay (alpha, beta, gamma, electron capture and internal conversion). [CSLO1-CSLO3].

O34. Use basic equations to describe each type of decay. [CSLO1-CSLO3].

O35. Use exponential equations and appropriate graphs (linear and semi-log) to perform radioactive decay calculations. [CSLO1-CSLO3].

O36. Characterize alpha particles, beta particles, gamma rays, and neutrons (for example, describe the physical properties of these types of radiation). [CSLO1-CSLO3].

O37. Describe the process of neutron activation using basic equations. [CSLO1-CSLO3].

O38. Identify specific isotopes of concern in power reactors during operation and following shutdown. [CSLO1-CSLO3].

O39. Discuss complex decay schemes, such as: natural decay chains, reactor produced decay chain, equilibrium isotopes (secular, transient or no equilibrium) [CSLO1-CSLO3].

O40. Identify and use radiological quantities and their units including; activity (curies and Becquerel's, disintegrations per second, disintegrations per minute), exposure (roentgens), dose (rads and grays), dose equivalent (rems and sieverts). [CSLO1-CSLO3].

O41. Identify, 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 equivalent Equate radioactivity to dose rate through simple rules of thumb and associated calculation for various source geometries (for example, 6CEN, point source, line source, plane source). [CSLO1-CSLO3].

O42. Define the following terms: excitation, ionization, secondary ionization, and specific ionization. [CSLO1-CSLO3].
O43. Describe the processes and characteristics of heavy charged particle (alpha particles, protons) interaction with matter to include energy transfer by ionization and excitation. [CSLO1-CSLO3].
O44. Describe the processes and characteristics of beta particle interactions with matter including; bremsstrahlung production using high atomic number absorber, range of beta particles in air, water, and tissue, density thickness. [CSLO1-CSLO3].
O45. Define linear energy transfer and relative stopping for beta interactions. [CSLO1-CSLO3].
O46. Describe the processes and characteristics of gamma and x-ray interaction with matter to include, exponential attenuation (as opposed to maximum range), interaction by Compton scattering, photoelectric effect, and pair production, effect of atomic number of absorber on attenuation. [CSLO1-CSLO3].
O47. Define linear absorption coefficient and mass absorption coefficient, linear attenuation coefficient and mass attenuation coefficient for gamma interactions. [CSLO1-CSLO3].
O48. Define fast neutron, thermal neutron, cross-section, and barn and describe how neutron energy affects probability of interaction. [CSLO1-CSLO3].
O49. Describe the processes and characteristics of neutron interaction with matter including , elastic scattering, inelastic scattering, absorption, neutron activation, fission, charged particle emission. [CSLO1-CSLO3].
O50. Based on knowledge of interaction mechanics, select types of materials for shielding each type of radiation. [CSLO1-CSLO3].
O51. Define buildup factor. [CSLO1-CSLO3].
O52. Perform gamma and neutron shielding calculations using the following: exponential shielding equation, half and tenth, thickness values, empirically derived graphs. [CSLO1-CSLO3].
O53. Identify common shielding practices for beta particles (low Z number materials), neutrons (hydrogenous material) and gammas (high density, high Z number materials). [CSLO1-CSLO3].
O54. Describe the phenomenon of "sky shine" and the means by which it can be minimized. [CSLO1-CSLO3].
O55. Apply quality factors for converting dose to dose equivalent (use 10CFR20). [CSLO1-CSLO3].

III. Assessment

Grades will be determined in the following manner:

			Assessment Method
A1.	Attendance, etc (W.E. Succeed)	5%	Performance
A2	Laboratory exercises	10%	
A3	Assignments/Quiz	10%	Performance/Product
A3.	Tests	50%	Test
A3	Final	25%	Test
		100%	

A1. Students are expected to attend all classes, come to class on time and be prepared to learn. This class will address Chattanooga State's quality

enhancement plan, W.E. Succeed. This program is intended to improve student success by incorporating four critical attributes of work ethic: teamwork, integrity, productivity, and professionalism.

A2. Laboratory exercises will be performed throughout the semester to apply the concepts discussed in the class lecture. The instructor will observe the students and sign off on each student's lab work. Regular classroom/laboratory attendance and participation is mandatory. Missed lab work must be made up in a timely manner (see note below) in order to receive credit for that portion of the course. Multiple unexcused absences may result in automatic failure of the class. Lab reports may also be required to demonstrate the student's ability to properly document lab tests and interpret the results. [CSLO1- CSLO3]

A3. Quizzes/assignments (either written or performance-based) will be given intermittently throughout the semester to encourage students to attend class prepared for the week's lesson and to review their understanding of the material. . [CSLO1 – CSLO3]

A4. Students will complete a series of tests allowing each student to demonstrate their knowledge of material science. Each test and final exam may consist of multiple choice, short answer and problem solving. The tests will generally not be comprehensive, but will cover the material since the previous test. There will be no make-up tests. Your lowest test grade may be dropped at the end of the semester. The final exam may or may not be comprehensive at the discretion of the instructor. [CSLO 1,2,3]

IV. Topics:

Topics discussed in this course shall include, but not be limited to, the following:

Week		
1	Radioactivity And Radioactive Decay	Chapter 2/provided
2	(continued)	Chapter 2/provided
3	(continued)	Chapter 2/provided
4	Interactions Of Radiation With Matter	Chapter 3, 5/provided
5	(continued)	Chapter 3, 5/provided
6	(continued)	Chapter 3, 5/provided
7	Radiation Protection And Detection Principals	Chapter 7, 8, 9/provided
8	(continued)	Chapter 7, 8, 9/provided
9	Radiation Detection and Measurement Principals	Chapter 7, 8, 9/provided
10	Radiological Survey and Analysis Instruments	Chapter 7, 8, 9/provided
11	(continued)	Chapter 7, 8, 9/provided
12	(continued)	Chapter 7, 8, 9/provided
13	Sample Collection Equipment	Chapter 7, 8, 9/provided
14	(continued)	Chapter 7, 8, 9/provided

V. Grading Scale

Letter grades will be assigned in accordance with the Academic Regulations in the Chattanooga State catalog as follows:

90 - 100	A
80 - 89	B
70 - 79	C
65 - 69	D
Below 65	F

VI. Course Delivery Format

Standard Format – This format is the traditional format and may use an on-line format (eLearn) to provide access to "static" materials which include the syllabus, course material, contact information, and presentations. Faculty must make available, when requested, a copy of the syllabus and any other instructor provided course materials, including instructor contact information. Faculty may require on-line activities and assignments to include on-line tests and submission of all written and on-line communications. The extent of on-line activities/assignments may vary by course but will be specified on the syllabus.

VII. College Policies

This class is governed by the policies and procedures stated in the current Chattanooga State Student Handbook. Additional or more specific guidelines may apply.

ADA Statement

Students who have educational, psychological, and/or physical disabilities may be eligible for accommodations that provide equal access to educational programs and activities at Chattanooga State. These students should notify the instructor immediately, and should contact Disabilities Support Services within the first two weeks of the semester in order to discuss individual needs. The student must provide documentation of the disability so that reasonable accommodations can be requested in a timely manner. All students are expected to fulfill essential course requirements in order to receive a passing grade in a class, with or without reasonable accommodations.

Disruptive Students

The term "classroom disruption" means – student behavior that a reasonable person would view as substantially or repeatedly interfering with the activities of a class. A student who persists in disrupting a class will be directed by the faculty member to leave the classroom for the remainder of the class period. The student will be told the reason(s) for such action and given an opportunity to discuss the matter with the faculty member as soon as practical. The faculty member will promptly consult with the division dean and the college judicial officer. If a disruption is serious, and other reasonable measures have failed, the class may be adjourned, and the campus police summoned. Unauthorized use of any electronic device constitutes a disturbance. Also, if a student is concerned about the conduct of another student, he or she should please see the teacher, department head, or division dean.

Affirmative Action

Students who feel that he or she has not received equal access to educational programming should contact the college affirmative action officer.

Academic Integrity/Academic Honesty

In their academic activities, students are expected to maintain high standards of honesty and integrity. Academic dishonesty is prohibited. Such conduct includes, but is not limited to, an attempt by one or more students to use unauthorized information in the taking of an exam, to submit as one's own work, themes, reports, drawings, laboratory notes, computer programs, or other products prepared by another person, or to knowingly assist another student in obtaining or using unauthorized materials. Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly through participation or assistance, are immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions, which may be imposed through the regular institutional procedures as a result of academic misconduct, the instructor has the authority to assign an "F" or zero for an activity or to assign an "F" for the course.

Children
It is Tennessee Board of Regents policy that children are not permitted in the classrooms or laboratories. If you have children who must stay home for some reason, you must make other arrangements for their care than bringing them with you to class.

Communication
Tigermail is the official communication for students.

The instructor reserves the right to modify this syllabus in writing during the course of the semester.

Instructor Policies
Don’t be late to class and turn in assignments in on time.

Cell Phones
Activation of these devices represents a distraction and their use during lectures and labs (including instant messaging, games, and etc.) will be considered extremely disruptive to the learning environment. Please turn off (or set to vibrate) all such devices before entering the classroom. Please excuse yourself from the room if an emergency requires you to make or receive a phone call during class. If your cell phone goes off during a testing period, five points will be deducted from your test.

Use of Computers/Printers
The use of a computer is mandatory for all students. Students will have access to the computers in C24, C33, C54, C84, & C87. These computers are connected to the ET server and can be used to access Microsoft Office and other software. There may be times when one of the computer rooms will not be available; these times will be posted with as much advance notice as possible. It is the student’s responsibility to see that his or her username and password are working properly and that his or her password is protected. It is also the student’s responsibility to back-up needed files. The school will not be responsible for any computer files that get “lost” or damaged.
Back-up documentation for this class (such as the class syllabus, handouts, description of class assignments, etc.) will be available to the students through eLearn. Printers are to only be used by Engineering Technology students for

assignments related to engineering and engineering technology classes or labs. Paper availability may be subject to print management activities and will be requested through assigned faculty. Please help conserve paper.

Classrooms & Labs

Food and drinks are prohibited in all Engineering Technology classrooms and labs located in the Branch Center for Technology. Only plain water in a sealable container is permitted. Any form of tobacco products are also prohibited in accordance with College and TBR policy.

To Log-in C24, C33, C54, C84, & C87: Username: ET_last name first initial middle initial *(no spaces)*

Password: student

Domain (log-in): CSTCC

Note: Be sure to change your password after your initial log-in.