

CHATTANOOGA STATE COMMUNITY COLLEGE  
CHATTANOOGA, TENNESSEE  
ENGINEERING TECHNOLOGY DIVISION

**COURSE SYLLABUS**

**RP 235 Radiation Chemistry and Biology**

**Instructor:** Henry Lynn  
**Phone:**  
**E-mail:**

**Credit Hours:** 4  
**Semester:** Fall 2011  
**Room:**

**Catalog Course Description**

Overview of radiation chemistry and biology including applications of radioactivity and the effects of radiation on the environment and human body. Includes a review of key concepts and terms in chemistry and biology such as matter, the periodic table, chemical reactions, cell structure and body systems. (Class 3 hours, Lab 3 hours)

**Prerequisites:**

RP 104 or instructor consent

**Corequisites:**

None

**Entry Level Standards**

**Textbook/Materials**

1. Goggles (Required)
2. An Introduction to Chemistry--Atoms First (online edition), Mark Bishop (Optional)
3. Calculator

**Institutional Student Learning Outcomes**

- ISLO2. Competence in Specialty Area
- ISLO3. Critical Thinking & Analytical Skills

**Program Student Learning Outcomes**

- PSLO1. An ability to apply knowledge of mathematics, basic sciences, and technology to solve problems appropriate to each program. [ISLO2]
- PSLO2. An ability to conduct experiments, collect, analyze and interpret data. [ISLO3]
- PSLO11. An ability to use the techniques, skills, and modern engineering tools necessary to function as a Radiation Protection Technician. [ISLO2,3]

**I. Course Student Learning Outcomes**

CSLO1	Provide students with the knowledge and skills necessary to apply the
	basic 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]

## II. Topics:

Week	Topic
1	<b>8/29-9/2</b> Foundations of Chemistry, Standards for Measurement, Safety
2	<b>9/6-9/9</b> Properties of Matter; Elements and Compounds
3	<b>9/12-9/16</b> Atomic Theory and Structure
4	<b>9/19-9/23</b> Periodic Arrangement of the Elements, Review of Basic Atomic Physics and Nuclear Physics, Chart of the Nuclides
5	<b>9/26-9/30</b> -Chemical Bonding
6	<b>10/3-10/7</b> -Chemical Reactions Bases
7	<b>10/10-10/14</b> -Acids and Bases, pH
8	<b>10/19-10/21</b> -Gases
9	<b>10/24-10/28</b> - Basic Water Chemistry
10	<b>10/31-11/4</b> -Reactor Water Chemistry Fundamentals
11	<b>11/7-11/11</b> -Macromolecules and Cells
12	<b>11/14-11/18</b> -Major Systems & Functions
13	<b>11/21-11/23</b> Biological Effects and Risks Associated with Exposure to Ionizing Radiation
14	<b>11/28-12/2</b> -Biological Effects and Risks Associated with Exposure to Ionizing Radiation
15	<b>12/5-12/9</b> - Effects of Radiation Exposure to the Eye
16	<b>12/14-Final Exam 3:00-4:50</b>

Lab 1	Safety and Measurements
Lab 2	Metals, Nonmetals, and Metalloids
Lab 3	Emission Spectra and Flame Tests
Lab 4	Periodic Trends and Properties of the Elements
Lab 5	Lewis Structures
Lab 6	Chemical Reactions
Lab 7	Properties of Acids and Bases
Lab 8	Chemistry of Life
Lab 9	Cell Structure
Lab 10	Anatomy of the Eye

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

### III. Course Objectives

#### 1.1.6 Chemistry

- O1 Explain and apply the basic fundamentals of chemistry including the following:  
[CSLO 1, 3] 1.1.6.1
- acids and bases
  - conductivity
  - ion exchangers
  - mixtures, solutions, and compounds
  - molecules
  - Periodic Table
  - pH
  - properties and uses of gases
  - states of matter
  - units of measure
- O2 Explain and apply basic water chemistry control fundamentals including the following: [CSLO 1, 3] 1.1.6.2
- effects of impurities (such as increased corrosion rates, reduction in heat transfer area, tube failure in steam generators)
  - ion exchange theory (such as discussion on anion and cation resin and mixed bed resin; discussions on channeling, break-through and resin bed exhaustion and observation of decontamination factor)
  - parameters monitored (such as pH, conductivity, sodium, chlorides, fluorides, sulfates, hardness, silica)
  - principles of water treatment (such as water purification with filters/reverse osmosis)
  - sources of impurities (such as tube leaks in heat exchangers/condensers)
  - the corrosion process including types characteristics and prevention
  - water chemistry control methods (such as ion exchange, O<sub>2</sub> control with chemistry (hydrazine) or gas (N<sub>2</sub>), pH control (amines))
- O3 Explain and apply reactor water chemistry fundamentals including the following:  
[CSLO 1, 3] 1.1.6.3
- analytical results and core conditions (*plant specific*)
  - control/removal of impurities (such as demineralization, chemical addition, hydrogen addition, hydrazine, degassing)
  - effects of impurities (such as an increase in corrosion rates, total gases, local radiation levels)
  - hydrogen gas in reactor water (such as for use of O<sub>2</sub> control)
  - radioanalysis and recombination (such as water/ammonia and the effects on pH)
  - radiochemistry (such as causes of an indications of crud burst and/or fuel failure, ion exchange exhaustion sampling methods (*plant specific*))

- sources of impurities (such as air intrusion, ion exchanger exhaustion)
- types of impurities (such as chlorides, fluorides, O<sub>2</sub> and H<sub>2</sub>)

### Basic Human Anatomy and Physiology

- O4 Know the levels of organization of the body. [CSLO 2, 3]
- O5 Identify the body systems, their general function, and the organs in each system. [CSLO 2, 3]
- O6 Know the important elements of the body. [CSLO 2, 3]
- O7 Know the types of organic molecules that make up the human body. [CSLO 2, 3]
- O8 Learn the general structure and function of a cell and be able to identify the various organelles. [CSLO 2, 3]
- O9 Understand the process by which proteins are synthesized. [CSLO 2, 3]
- O10 Be able to identify the two types of cell division. [CSLO 2, 3]
- O11 Know the basic structure of DNA, and know how it can be damaged. [CSLO 2, 3]
- ### 3.3.4 Biological Effects and Risks Associated with Exposure to Ionizing Radiation
- O12 Describe the mechanisms of radiation interactions with cells (primary, secondary/free radicals). [CSLO 2, 3] 3.3.4.1
- O13 Identify cell characteristics that affect radiosensitivity (cells with a longer dividing future, division rate and cell type). [CSLO 2, 3] 3.3.4.2
- O14 Define stochastic and non-stochastic (deterministic) effects. [CSLO 2, 3] 3.3.4.3
- O15 Explain the difference between acute and chronic radiation exposure and for each, describe the following: [CSLO 2, 3] 3.3.4.4
- somatic effects
  - genetic effects
  - teratogenic effects
- O16 For acute exposures, describe the following: [CSLO 2, 3] 3.3.4.5
- dose response relationship
  - acute radiation syndrome
  - LD-50/30
- O17 For chronic exposures, describe the following: [CSLO 2, 3] 3.3.4.6
- long-term health effects
  - quantitative risk assessment
  - comparison of radiation exposure risks to other health risks
- O18 Describe the potential health effects and risks due to exposure to internally deposited radioactivity. [CSLO 2, 3] 3.3.4.7
- O19 Describe situations where the risk due to exposure to internally deposited radioactivity would be lower than the increased risks that would result from the use of respiratory protective equipment. [CSLO 2, 3] 3.3.4.8
- O20 Describe the studies used to determine qualitative health risks. [CSLO 2, 3] 3.3.4.9
- O21 Discuss the basis for and implications of the linear zero-threshold dose-response curve. [CSLO 2, 3] 3.3.4.10
- O22 Discuss the concept of "effective dose equivalent" and how it applies to planning work in contaminated areas and radiation fields. [CSLO 2, 3] 3.3.4.11
- O23 Discuss why radiation exposures to both individuals and groups of workers should be kept as low as reasonably achievable (ALARA). [CSLO 2, 3] 3.3.4.12
- O24 Discuss the risk to the general public from operation of a nuclear plant and compare it to other risks accepted in everyday life. [CSLO 2, 3] 3.3.4.13
- O25 Discuss the risk to a declared pregnant worker and fetus. [CSLO 2, 3] 3.3.4.14

## **IV. Assessment**

Grades will be determined in the following manner:

	<u>Assessment Method</u>
A1. Tests	=50% Test
A2. Lab	=30% Performance
A3. Final Exam	= <u>20% Test</u>
	100%

A1. Tests: A minimum of three [3] tests and a final exam will be given. Each test and final exam may consist of multiple choice or discussion type questions, along with problems. The tests will generally not be comprehensive, but will cover the material since the previous test. The final exam may or may not be comprehensive at the discretion of the instructor. The tests and final exam will count 70% of the overall grade. [CSLO1,2,3]

A2. Lab: Lab expectations will include lab attendance, activities, and reports. All students will submit a lab report following the lab studies. The lab report must contain the following: Lab Title, lab purpose, lab procedure, data collected during the lab study, analysis of the data (calculations, graphs, and percent error, and conclusion). Students will be graded on writing skills, adherence to safety, procedure compliance, and oral communication skills with others. Lab will count 25% of the final grade. Lab will count 30% of the final grade. [CSLO 1,2,3]

A3. Final Exam: The final exam will be given during the scheduled final exam period. The final exam may be comprehensive. The final exam will count for 20% of the overall grade.

A4. Work Ethic: This class will support the Chattanooga State W. E. Succeed campaign in which the four areas of teamwork, integrity, productivity, and professionalism will be practices. Students are expected to be present and on time in all classes. In addition, all work must be submitted by the due date. Work not submitted by the due date will have points deducted. After the third day, late work is not accepted. If a student misses a test or quiz, he or she must have a valid reason and make arrangements for a make-up. If the student does not contact the instructor within one day of missing the test or quiz, a "0" will be recorded.

A5. Certification: Students will be required to make a minimum of an 80 to obtain the Nuclear Uniform Curriculum Certification of completion.

## V. Grading Scale

90—100	A
80—89.9	B
70—79.9	C
65—69.9	D
0—64.9	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.

## VIII. 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.

### **SMOKING/TOBACCO USE**

Chattanooga State Technical Community College recognizes the increasing weight of scientific evidence that smoking is harmful not only to the "active" smoker but also to the "passive" smoker who is exposed to others' smoke. Smoking is defined as the lighting or carrying of a lighted cigarette, cigar, pipe, or similar device.

Smoking is prohibited in all college buildings, owned or leased. Additionally, smoking will not be allowed in any college owned vehicles. All building entrances are posted as non-smoking areas. Signs stating "No Smoking within 50 ft of Entrance" are posted at all entrances. Signs are posted at all exits stating "Smoking Prohibited within 50 ft of Building."

The use of mouth tobacco (to include dipping, chewing, etc.) is prohibited in all Chattanooga State buildings, facilities, and vehicles.

The policy applies to all campuses and to the entire college community, including employees, students, and visitors. It is the responsibility of all faculty, staff, and students to adhere to, enforce, and inform visitors of the College's smoking policy. If a student continues to disregard the posting, he/she will be reported to the Dean of Student Affairs. If an employee continues to disregard the posting, he/she will be reported to their respective Vice-President.

### **DESIGNATED SMOKING AREAS**

The College has designated "Smoking" areas on campuses and at the sites. These areas can be located on the campus map.

### **CAMPUS AWARENESS PLAN**

The policy shall be published in the College catalog, student handbook, and the policies and procedures manual. Periodic notices shall be placed in other college publications.

Flyers will be posted on all bulletin board and e-mail notices will be sent each semester, which will inform college visitors as well as students, staff, and faculty of the College's position on this issue.

### **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.

Tigermail is the official means of communication for the College.

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

## **IX. Instructor Policies**

### **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, with the exception of water in a closed container. All food and drinks are prohibited in labs located in the Branch Center for Technology. 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.*