COURSE OUTLINE

Course Number: RAD114
Course Title: Radiation Protection
Credits: 2

Prerequisites: RAD107, RAD119, RAD127

Lecture Hours: 2
Co-Prerequisites: RAD120, RAD128, BIO104

Catalog Description (2016-2017):

Explores principles of radiation biology and radiation protection, including the production of X-rays, the interaction of radiation and matter, radiation units, and methods to protect the radiographer and patient. (Spring 2017)

Required Texts/Other Materials:

REQUIRED:
Title: Radiation Protection in Medical Radiography
Author: Mary Alice Statkiewicz Sherer, et al.
Publisher: Mosby Elsevier
Edition: 7th

Title: Radiation Protection in Medical Radiography Workbook
Author: Mary Alice Statkiewicz Sherer, et al.
Publisher: Mosby Elsevier
Edition: 7th

Title: Radiologic Science for Technologists
Author: S. Bushong
Publisher: Mosby
Edition: 9th

Revision Date
Fall 2016
No Course Changes

Course Coordinator:
William Petrosky
Voice: 609.570.3341; E-mail: petroskw@mccc.edu
Course Competencies/Goals (Student Learning Outcomes): 

Upon completion of this course the student will be able to:

1. Provide ethical, regulatory and scientific justification for the safe and judicious use of ionizing radiation in medicine.

2. Interpret research articles requiring an understanding of conventional and international standard units of ionizing radiation.

3. Understand the basic interactions between ionizing radiation and biologic matter.

4. Identify clinical and global situations that can contribute to somatic and genetic radiation effects.

5. Express knowledge of legislative and regulatory mandates related to radiation protection.

6. Identify basic occupational and patient radiation protection best practices in radiography, radiation therapy and nuclear medicine.

Course-specific General Education Goals and Core Skills (Student Learning Outcomes, Continued):

General Education Knowledge Goals:

Goal 1. Communication. Students will communicate effectively in both speech and writing.

Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Goal 5. Social Science. Students will use social science theories and concepts to analyze human behavior and social and political
institutions and to act as responsible citizens.

**Goal 9. Ethical Reasoning and Action.** Students will understand ethical issues and situations.

**MCCC Core Skills:**

**Goal A. Written and Oral Communication in English.** Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.

**Goal B. Critical Thinking and Problem-solving.** Students will use critical thinking and problem solving skills in analyzing information.

**Goal C. Ethical Decision-Making.** Students will recognize, analyze and assess ethical issues and situations.

**Goal D. Information Literacy.** Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

**Unit Objectives:**

Weeks 1-4: General Concepts of Radiation Protection

Following the completion of week 4, the student will:

1. Explain the need for radiation protection.
2. Define ionizing radiation.
3. Define the various units of radiation.
4. Identify the various sources of ionizing radiation.
5. Define the terms “primary radiation,” “remnant radiation,” and “attenuation.”
6. Describe the various interactions of x-ray and matter.
7. Describe the relationship between kVp and patient/occupational dose.
8. Explain current protection philosophy on the basis of the dose-response curve.
9. Explain the ALARA concept.
10. Detail specific dose limit recommendations for occupational and non-occupational exposure to ionizing radiation.*

*objectives 1-10: (CG 1-3; GE 1, 9, A, C, D)
Weeks 5-7: Overview of Cell Biology and Radiation Biology

Following the completion of week 7, the student will:

1. Describe the various components of the human cell.
2. Describe the process of protein synthesis.
3. Explain the concept of DNA replication.
4. Differentiate between mitosis and meiosis.
5. State the number of chromosomes in the human somatic and genetic cell.
6. Detail the stages of cell division.
7. Explain the potential danger to the cell from ionizing radiation.
8. Differentiate between direct and indirect radiation effects.
9. Explain target theory.
10. Describe the process of ionization of organic molecules.
11. Give examples of free radicals.
12. Explain linear energy transfer and relative biological effectiveness.*

*Objectives 1-12: (CG 4; GE 2, 3, A)

Weeks 8-9: Patient and Occupational Protection Practices

Following the completion of week 9, the student will:

1. Explain the need for effective communication between technologist and patient.
2. Explain the role of effective immobilization of the patient during radiographic procedures.
3. Explain the role of “optimum” exposure factors in limiting patient dose.
4. Explain the role of collimation and other forms of beam restriction in reducing patient dose.
5. Define the 10-day rule. Accurately phrase a pre-examination screening question to female patients regarding their potential pregnancy status.
6. Describe the usefulness of the half-value layer concept.
7. Describe the factors available to occupationally exposed individuals to reduce radiation exposure.
8. Differentiate between primary and secondary barriers.
9. Identify sources of radiation dose to the radiographer.
10. Explain the inverse square law.
11. Define the terms “controlled” and “uncontrolled” areas in radiologic facilities.*

*Objectives 1-11: (CG 6; GE 1, 2, A, B, C)
Weeks 10-12: Radiation Protection Practices in Nuclear Medicine, Radiation Oncology and Non-Medical Nuclear Facilities

Following completion of week 12, the student will:

1. Identify the different kinds of ionizing radiation present at different facilities.
2. Describe protection practices specific to the facility under consideration.
3. Describe the linear accelerator used in radiation oncology.
4. Describe the “hot lab” in nuclear medicine.
5. Distinguish between teletherapy and brachytherapy.
6. Distinguish between nuclear fission and nuclear fusion.
7. Describe the process of nuclear fission and nuclear fusion.

*Objectives 1-7: (CG 1, 6; GE 1, 3. A, C, D)

Weeks 13-14: Radiation Monitoring and Detection, and Regulatory Considerations

Following the completion of week 14 the student will:

1. Explain the role of radiation monitoring.
2. Differentiate between radiation monitoring and radiation protection.
3. Distinguish between the different kinds of personnel monitors in current use.
4. List the advantages and disadvantages of the different kind of monitors used by occupationally exposed individuals.
5. Explain what radiation survey instruments are used for.
6. Name the different types of survey instruments in use in radiology departments.
7. Identify specific federal and state regulations governing radiation protection of patients and personnel.
8. Identify the different agencies involved in specifying dose limits and protection practices.

*Objectives 1-8: (CG 5, 6; GE 1, 3, 4, A)

Week 15: Special Topics in Radiation Protection.

1. Explain radiation hormesis.
2. Explain the basis of radiation hormesis from experiments.
3. Explain the significance of hormesis on human longevity.
4. Explain why hermetic theory is controversial.*
5. Radiation dose in computed tomography (CT).
6. Factors influencing radiation dose in CT.
7. Dose reduction methods during CT procedures.
8. Dose comparisons: CT versus diagnostic radiography/fluoroscopy.**

*Objectives 1-4: (CG 1; GE 1, 3)  **Objectives 5-8: (CG 6; GE 1, 3, 4, A-C)

**LECTURE SCHEDULE (Mondays & Wednesdays 9:00-9:50 AM)**

<table>
<thead>
<tr>
<th>Wed-Mon Sequence</th>
<th>Week #</th>
<th>Topic</th>
<th>Reading Assignment (Statkiewicz)</th>
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</thead>
<tbody>
<tr>
<td>1/18/17 (W) 1/23/17 (M)</td>
<td>1</td>
<td>Introduction X-ray Interactions with Matter</td>
<td>Chapter 1, Chapter 2, 3</td>
</tr>
<tr>
<td>1/25/17 (W) 1/30/17 (M)</td>
<td>2</td>
<td>Radiation Quantities and Units Practice Problems</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>2/1/17(W) 2/6/17(M)</td>
<td>3</td>
<td><strong>TEST #1: CHAPTERS 1-4</strong> Exposure Limits</td>
<td>Chapter 10, pp 215-223</td>
</tr>
<tr>
<td>2/8/17(W) 2/13/17(M)</td>
<td>4</td>
<td>Overview of Cell Biology Radiation Biology, Part I</td>
<td>Chapter 6-7</td>
</tr>
<tr>
<td>2/15/17(W) 2/20/17(M)</td>
<td>5</td>
<td>Radiation Biology, Part II</td>
<td>Chapter 8-9</td>
</tr>
<tr>
<td>2/22/17(W) 2/27/17(M)</td>
<td>6</td>
<td>Review for Test II</td>
<td></td>
</tr>
<tr>
<td>3/1/17(W) 3/6/17(M)</td>
<td>7</td>
<td><strong>TEST #2: CHAPTERS 6-10</strong> Patient Protection</td>
<td>Chapter 12 (and parts of Chapter 11)</td>
</tr>
<tr>
<td>3/8/17(W)</td>
<td>8</td>
<td>Patient Protection, Continued</td>
<td>Chapter 12</td>
</tr>
<tr>
<td>3/13/17(M) 3/15/17(W)</td>
<td></td>
<td><strong>SPRING BREAK</strong></td>
<td>ENJOY!</td>
</tr>
<tr>
<td>3/20/17 (M) 3/22/17(W)</td>
<td>9</td>
<td>Personnel Protection</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>3/27/17(M) 3/29/17(W)</td>
<td>10</td>
<td><strong>Test #3: CHAPTERS 10-13</strong> Primer on Nuclear Chemistry</td>
<td>On-Line Handouts</td>
</tr>
<tr>
<td>4/3/17(M) 4/5/17(W)</td>
<td>11</td>
<td>Protection in Nuclear Medicine Protection in Radiation T_x</td>
<td>On-Line Handouts</td>
</tr>
<tr>
<td>4/10/17(M) 4/12/17(W)</td>
<td>12</td>
<td><strong>TEST #4: NUCLEAR MED. &amp; RADIATION THERAPY</strong> Nuclear Power Generation</td>
<td>On-Line Handouts</td>
</tr>
<tr>
<td>4/17/17(M) 4/19/17(W)</td>
<td>13</td>
<td>Radiation Monitoring and Detection Regulatory Considerations</td>
<td>Chapter 5, Chapter 10, pp 204-215</td>
</tr>
<tr>
<td>4/24/17(M) 4/26/17(W)</td>
<td>14</td>
<td><strong>TEST #5: NUCLEAR POWER &amp; CH. 4</strong> Dose Considerations in Computed Tomography</td>
<td>On-Line Handout</td>
</tr>
<tr>
<td>5/1/17(M) 5/3/17(W)</td>
<td>15</td>
<td>Making Sense of Radiation Dose Final Examination Review (Final on 5/10/17)</td>
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Method of Instruction:
This is a fifteen-week course that provides instruction in the fundamental principles of radiation protection and biology. Discussion of clinical application of these principles is encouraged.

Evaluation and Grading System:
There will be a minimum of three tests and a comprehensive final examination. The student must receive a grade of “C” (75%) or higher in the course.

The final grade will be based on the following distribution:

Tests: 60%
Final Exam 40%

Attendance Policy:
1. Students are expected to be in attendance at the scheduled start time of all class and laboratory sessions; late arrival is disruptive to the class and instructor. Attendance will be taken for all lecture and lab sessions. The following grading system will be recorded for late arrival and absences:

A. Lecture:
   1. Three points will be deducted from the final lecture grade for each late arrival to a scheduled lecture.
   2. Five points will be deducted from the final lecture grade for each absence from a scheduled lecture.

B. Laboratory (not applicable to this course):
   1. Three points will be deducted from the final lab grade for each late arrival to a scheduled laboratory.
   2. A total of five (5) points will be deducted from the final laboratory grade for each lab test not taken on schedule. (Refer to item # 3-4 below)

2. Cell phones must be turned off upon entering the classroom. Receiving phone calls in tone or vibration mode are distracting to other students. Calls may not be made on personal cell phones during class time. Students may not charge their personal cell phone in the radiography classroom MS 314.

3. All students are required to attend every lab session. Students must be present for the entire period actively engaged in radiographic positioning, assisting classmates, and image evaluation. In case of emergency or illness, exceptions may be made if the student contacts the course instructor prior to the lab session. If the instructor is not available, a message must be
transmitted by e-mail or voice mail before the lab session begins. A valid, documented excuse (i.e. doctor’s note, vehicular repair) must be presented the next class session. It will be the instructor’s prerogative to decide whether or not the excuse is valid. If deemed valid, a make-up session would be conducted in the college lab according to a schedule arranged by the instructor. Students may not lab test until the lab session has been completed. If a student misses more than one lab session clinical education progression may be jeopardized, leading to course failure.

4. Students who miss a laboratory test will be rescheduled according to a schedule arranged by the instructor. Students may not progress with the clinical competency process on the missed lab procedure; this may jeopardize completion of clinical education requirements. A total of five (5) points will be deducted from the final laboratory grade for each lab test not taken on schedule.

5. Make-up written exams are not permitted. Students must contact the instructor directly, leave a voice or e-mail message prior to the time of the scheduled exam. Students who miss an examination must provide a valid, documented excuse i.e. doctors note, vehicular repair by the next class session. If determined valid by the instructor, the comprehensive mid-term and/or final exam will be calculated with an additional weight equal to the missed examination. This will serve as verification of material comprehension covered on the missed examination.

**Academic Integrity:**
Mercer County Community College is committed to Academic Integrity -- the honest, fair and continuing pursuit of knowledge, free from fraud or deception. This implies that students are expected to be responsible for their own work.

Academic Integrity is violated whenever a student:

A. Uses or obtains unauthorized assistance in any academic work.
B. Gives fraudulent assistance to another student.
C. Knowingly represents the work of others as his/her own, or represents previously completed academic work as current.
D. Fabricates data in support of an academic assignment.
E. Inappropriately or unethically uses technological means to gain academic advantage.

For any academic integrity violation, the faculty member will determine the penalty and shall notify the chairperson of the Academic Integrity Committee of the violation and the penalty imposed. Students should refer to the MCCC Student Calendar/Handbook for the complete policy and OMB210 (http://www.mccc.edu/academic_policies_integrity.shtml).
Accessibility:
Mercer County Community College is committed to ensuring the full participation of all students in its programs. If you have a documented differing ability or think that you may have a differing ability that is protected under the ADA or Section 504 of the Rehabilitation Act, please contact Arlene Stinson in LB216 (stinsona@mccc.edu) for information regarding support services.