## COURSE OUTLINE

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAD 119</td>
<td>Principles of Imaging Science I</td>
<td>2</td>
</tr>
</tbody>
</table>

### Hours: 2 Lecture

### Co-requisites

<table>
<thead>
<tr>
<th>Co-requisites</th>
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<tbody>
<tr>
<td>RAD 102, RAD 127</td>
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### Catalog description (2018-2019 Catalog):

The fundamental principles of Principles of Imaging Science I are discussed including the atom, electromagnetic radiation, x-ray tube components and x-ray production. Imaging Science principles including the primary factors of technique formation and the art of film critique are presented. Clinical application of these principles is discussed. Fall offering

### Required texts/other materials:

#### REQUIRED:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiologic Science for Technologists</td>
<td>S. Bushong</td>
<td>Elsevier Mosby</td>
<td>11th</td>
</tr>
<tr>
<td>Digital Radiography and PACS</td>
<td>C. Carter</td>
<td>Elsevier</td>
<td>3rd</td>
</tr>
<tr>
<td>Mosby's Radiography Online: Radiologic Physics</td>
<td>Mosby</td>
<td>Elsevier Mosby</td>
<td>2nd</td>
</tr>
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</table>

### Revision date / No Changes:

<table>
<thead>
<tr>
<th>Revision date / No Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2019</td>
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</tbody>
</table>

### Course coordinator:

Sandra L. Kerr, 609-570-3337, e-mail: kerrs@mccc.edu
**Course Competencies/Goals:**

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

1. Explain the fundamental physical principles of radiation and identify clinical applications of these principles.

2. Compare the electromagnetic radiations that exist in the electromagnetic spectrum; summarize their properties and relevance to radiography.

3. Differentiate among the variety of x-ray equipment used in modern radiology departments.

4. Develop an understanding of the control panel settings that activate the component parts of the x-ray imaging system; describe safe operation to ensure equipment longevity.

5. Differentiate between the types of x-ray production; apply the concepts to imaging patients.

6. Analyze the relationships of factors that control and affect image density, contrast, and patient radiation dose; correlate to image processing.

7. Develop an understanding of the basic manifestations of pathological conditions, correlate x-ray quantity and quality to imaging patients with active disease.

**Course-specific General Education Knowledge Goals and Core Skills.**

**General Education Knowledge Goals**

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

**MCCC Core Skills**

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

**Unit Objectives:**

**Week #1: Radiation Physics Fundamentals**

Following the completion of week 1, the student will be able to:

- Define the terms applicable to matter.
  - Differentiate between the Thomson, Rutherford and Bohr atoms. (CG 1; GE 3)
  - Identify the fundamental particles of an atom. (CG 1; GE 3)
  - Describe electron arrangement. (CG 1; GE 3)
  - Differentiate between isobars, isotones and isotopes. (CG 1, GE 3)
  - Interpret the periodic table of elements. (CG 1; 6, GE 3)
Week #2 - 3: Electromagnetic Radiation
Following the completion of week 4, the student will be able to:

- Describe the photon. (CG 2; GE 3)
- Differentiate between velocity, amplitude, frequency and wavelength. (CG 2, GE 3)
- Describe the electromagnetic spectrum and its application to radiography. (CG 2; GE 3)
- Define the terms radiolucent and radiopaque and discuss its application to radiography. (CG 2; GE 3)
- Describe and calculate the inverse square law. (CG 2; GE 2, 3)

Week #4 - 6: X-ray Tube and Equipment
Following the completion of week 7, the student will be able to:

- Identify the x-ray equipment used in a diagnostic radiology department. (CG 3)
- Describe table, tube support ancillary equipment configurations. (CG 3)
- Identify the components of the x-ray tube and describe the function of each. (CG 3)
- Discuss thermionic emission. (CG 3, GE 2, 3)
- Describe the characteristics of the cathode and anode. (CG 3, 4, GE 3)
- Describe the construction of the protective housing. (CG 3, 4; GE 3)
- Explain the line focus principle and anode heel effect. (CG 3, 4; GE 3)
- Apply the anode heel effect to diagnostic radiographic procedures. (CG 3, 4, GE 2, B)
- Interpret tube rating charts, anode cooling and housing cooling curves. (CG 3, 4; GE 2, B)
- Calculate heat units. (CG 3; 4, GE 2, 3)

Week #7 - 8: X-ray Production, Emission and Filtration
Following the completion of week 9, the student will be able to:

- Describe bremsstrahlung and characteristic x-ray production. (CG 5; GE 3)
- Describe the discrete and continuous x-ray spectrum. (CG 5; GE 3)
- Plot characteristic and bremsstrahlung radiation using a continuous and bar graph. (CG 5; GE 2, 3)
- Differentiate between x-ray quantity and quality. (CG 5; 6, GE 3)
- Identify the factors which affect the emission spectra. (CG 5, 6, 7; GE 3, B)
- State the purpose of filtration. (CG 3; GE 3)
- Define half-value layer (HVL). (CG 3; GE 3)
- Calculate HVL given problems. (CG 3, 4; GE 2, 3)

Week #9 - 11: Radiographic Technique and Attenuation
Following the completion of week 12, the student will be able to:

Lecture Content Weeks 1 - 3

- Define radiographic density. (CG 6; GE 3)
- Analyze relationships of factors affecting radiographic density. (CG 6; GE 2, 3, B)
• Identify the controlling factors of density. (CG 6; GE 3)
• Analyze radiographs for density adequacy. (CG 6; GE 3, B)
• Define radiographic contrast. (CG 6; GE 3)
• Analyze relationship of factors affecting radiographic contrast. (CG 6; GE 2, 3, B)
• Describe the controlling factor of contrast. (CG 6; GE 3)
• Analyze radiographs for contrast adequacy. (CG 6; GE 3, B)
• Differentiate between long scale and short scale contrast. (CG 6; GE 3, B)
• Identify the factors that affect x-ray beam attenuation. (CG 6; GE 3, B)

**Week #12: Scatter Radiation and Basic Pathology**
Following the completion of week 14, the student will be able to:

• Explain the relationship between kVp and scattered radiation. (CG 4, 6; GE 3, B)
• Identify the factors that affect scatter radiation production. (CG 4, 6; GE 3, B)
• Explain the purpose and construction of beam restricting devices. (CG 3, 6; GE 3)
• Differentiate between the various beam restricting devices and discuss their effect on image quality. (CG 3, 6; GE 3, B)
• Describe the effect of beam restriction on patient dose. (CG 6; GE 3, B)
• Identify the effects of various pathological conditions on photon absorption and image quality. (CG 5, 6, 7, GE B)

**Week #13 - 14: Digital Radiography & Picture Archiving and Communication System (PACS)**
Following the completion of week 13, the student will be able to:

• Define digital imaging terminology (CG 6; GE 3)
• Describe the detectors used in image acquisition (CG 6)
• Compare the exposure indicators for digital imaging systems (CG6)
• Indicate the relationship of digital imaging and PACS (CG 6)

**Evaluation of student learning:**

A grade of "C+" (77%) or higher must be achieved in the course to progress to RAD 120 and co-requisite courses. The following grading policy will be utilized:

- Examinations: 70%
- Mercer Online Mosby Activities: 5%
- Final Examination: 25%

A minimum of four (4) examinations and a final examination will be administered in class. Details of test formats and dates will be provided by the instructor.

**Academic Integrity Statement:**
Mercer County Community College is committed to Academic Integrity -- the honest, fair and continuing pursuit of knowledge, free from fraud or deception. 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.

In all cases, the instructor shall notify the Chair of the Academic Integrity Committee of the violation. Students should refer to the MCCC Student Handbook for the complete policy and the Radiography Clinical Education Student Handbook for additional information regarding reporting of sanctions to the American Registry of Radiologic Technologists.

**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 lectures. 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.

2. Make-up examinations are not permitted. Students who miss an examination must provide a valid, documented excuse the next class session. Valid excuses include emergent situations that arose unexpectedly and could not be mitigated at the time of the exam. Examples include but are not limited to death in family, illness, vehicular repair with supporting documentation from the respective agency. Planned vacations, events, advanced request for time away are not considered valid excuses. If determined valid by the instructor, the final exam weight will be calculated with the additional missed exam weight. This will serve as verification of material comprehension covered on the missed examination. A grade of zero will be recorded for invalid excuses and the final exam will be calculated as listed in the course outline.

3. Students who miss the final examination must contact the instructor by email or phone by the start of the examination administration. A valid, documented excuse must be submitted within two days of the final exam administration date. Valid excuses include emergent situations that arose unexpectedly and could not be mitigated at the time of the final exam. Examples include but are not limited to death in family, illness, vehicular repair with supporting documentation from the respective agency. Planned vacations, events, advanced request for time away are not considered valid excuses.

   If determined valid, the make-up final exam date will be determined by the course instructor in consultation with the student. The final exam must be taken prior to the start of the spring term to be eligible for the spring term radiography courses.

4. Cell phones and other electronic devices must be OFF or in vibration mode upon entering the classroom. Students may not receive a call in vibration mode, send or receive a text message during lecture without permission from the instructor.
Permission will be granted for lecture only on an individual basis for emergency purposes. Cell phones and all electronic devices must be OFF during examinations and placed at the front of the classroom with personal belongings. Items may be retrieved at the conclusion of the examination.

**Topical Outline**

The general plan for the fifteen-week semester identifies the topic to be discussed. Reading assignments will be provided by the individual instructor.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Physics Fundamentals</td>
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<tr>
<td>2 – 3</td>
<td>Electromagnetic Radiation</td>
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<tr>
<td>4 – 6</td>
<td>X-ray Tube and Equipment</td>
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<tr>
<td>7 – 8</td>
<td>X-ray Production &amp; Emission Filtration</td>
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<tr>
<td>9 – 11</td>
<td>Radiographic Technique</td>
</tr>
<tr>
<td>12</td>
<td>Scatter Radiation &amp; Basic Pathology</td>
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<tr>
<td>13 - 14</td>
<td>Digital Radiography &amp; Picture Archiving &amp; Communication System (PACS)</td>
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TENTATIVE SCHEDULE - FALL 2019

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Reading Assignment Bushong</th>
<th>Reading Assignment Carter</th>
</tr>
</thead>
</table>
| 1    | 9/9  | Course Introduction  
Basic Mathematics  
Physics Fundamentals | Ch 1 (pp. 2-5,12-21)  
Ch 2 (pp.26-37) | | |
| 2    | 9/16 | Electromagnetic Radiation | Ch 3 | | |
| 3    | 9/23 | **Exam 1 (Physics Fundamentals)**  
Electromagnetic Radiation | | | |
| 4    | 9/30 | X-ray Tube & Equipment | Ch 5 (pp.84-87)  
Ch 6 | | |
| 5    | 10/7 | **Exam 2 (EM Radiation)**  
X-ray Tube & Equipment continued | | | |
| 6    | 10/14 | X-ray Tube & Equipment continued | | | |
| 7    | 10/21 | **Exam 3 (X-ray Tube & Equipment)**  
X-ray Production, Emission & Filtration | Ch 7 & Ch 8 | | |
| 8    | 10/28 | X-ray Production, Emission & Filtration | | | |
| 9    | 11/4 | **Exam 4 (X-ray Production, Emission, Filtration)**  
Radiographic Technique & Attenuation | Ch 13  
(pp. 236-258,263-264) | | |
| 10   | 11/11 | Radiographic Technique & Attenuation | | | |
| 11   | 11/18 | Radiographic Technique & Attenuation | | | |
| 12   | 11/25 | **Exam 5 (Technique & Attenuation)**  
Scatter Radiation & Basic Pathology | Ch 11 (pp.192-195) | | |
| 13   | 12/2  | Digital Radiography & PACS | Ch 15 – 17,  
Ch 18 (pp 329-333) | Ch 1, Ch 2 pp 20-25  
Ch 9 pp113 - 125 |
| 14   | 12/9  | Digital Radiography & PACS continued | | | |
| 15   | 12/16 | **Comprehensive Final Exam**  
10:00 – 12:00 | | | |

Students are expected to read the assignment prior to the class session.
# ASSIGNMENTS

<table>
<thead>
<tr>
<th>Week #</th>
<th>Topic</th>
<th>Mercer Online Quiz <a href="https://mccc.blackboard.com/">https://mccc.blackboard.com/</a></th>
<th>Challenge Questions Bushong</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course Introduction Basic Mathematics Physics Fundamentals</td>
<td>Module 1: General Principles Module 2: Structure of the Atom</td>
<td>Ch 3: #1, 3, 8,11-15,17-18</td>
</tr>
<tr>
<td>2 – 3</td>
<td>Electromagnetic Radiation</td>
<td>Module 3: Electromagnetic Radiation</td>
<td>Ch 4: #1, 4 - 7, 9 – 20</td>
</tr>
<tr>
<td>4 – 6</td>
<td>X-ray Tube &amp; Equipment</td>
<td>Module 7: X-ray Tube</td>
<td>Ch 6: #8,10, Ch 7: #1-20</td>
</tr>
<tr>
<td>7 – 8</td>
<td>X-ray Production, Emission &amp; Filtration</td>
<td>Module 8: X-Ray Production</td>
<td>Ch 8: #1-2, 4-5, 7-9, 11-16, 18 Ch 9: #1, 2, 6-7, 11-12, 14-20</td>
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<tr>
<td>9 – 11</td>
<td>Radiographic Technique &amp; Attentuation</td>
<td></td>
<td>Ch 13, #1a-g, 2-7, 9-14, 18, 20</td>
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<tr>
<td>12</td>
<td>Scatter Radiation &amp; Basic Pathology</td>
<td></td>
<td>Ch 11: 1-20</td>
</tr>
<tr>
<td>13 -14</td>
<td>Digital Radiography &amp; PACS</td>
<td></td>
<td>Ch 15, 16, &amp; 17:: #1</td>
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**MERCER ONLINE EXAM DIRECTIONS:**
1. Log on to https://mccc.blackboard.com/
   Read the Course Announcements each time you log on for important updates.
3. Complete the modules, and any associated media and activities. Modules will remain open through the last day of the fall semester.
4. Complete the assignment by Friday before the in class examination at 11:00PM to earn credit
5. Make-up assignments are not permitted. Any assignment not completed will result in a score of zero “0” for the respective assignment.

The textbook questions should be completed at the conclusion of the class session to ensure material comprehension. They are for your reference and will not be collected. Be certain to review the answers by logging on the Evolve website http://evolve.elsevier.com