**COURSE OUTLINE**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAD 120</td>
<td>Principles of Imaging Science II</td>
<td>3</td>
</tr>
</tbody>
</table>

**Hours:**
2 Lecture
2 Lab

**Pre-requisites:** RAD119, RAD107, RAD127

**Co-requisites:** RAD 114, RAD 128

**Catalog description (2018-2019 Catalog):**
Radiographic principles, both analog and digital, which control and contribute to the radiographic image are examined. The principles of electricity, magnetism and x-ray circuitry are presented. The laboratory component is designed to demonstrate the application of image production and evaluation.

**Required texts/Supplements:**

**REQUIRED:**
- **Title:** Radiologic Science for Technologists
  - Author: S. Bushong
  - Publisher: Mosby
  - Edition: 11th

- **Title:** Mosby’s Radiography Online: Radiologic Physics
  - Author: Mosby
  - Publisher: Mosby Elsevier
  - Edition: 2nd

- **Title:** Mosby’s Radiography Online: Radiologic Imaging
  - Author: Mosby
  - Publisher: Mosby Elsevier
  - Edition: 2nd

- **Title:** Digital Radiography and Pacs
  - Author: C.Carter and B.Veale
  - Publisher: Mosby Elsevier
  - Edition: 3rd

**Mathematical Instrument:** Basic Non-Programmable Calculator

**Revision date/No Changes:**
Spring 2019

**Course coordinator:**
Deborah Greer, 215-630-6371, email: greerd@mcc.edu
Sandra L. Kerr, 609-570-3337, e-mail: kerrs@mccc.edu
Course Competencies/Goals:
This course combines lecture and laboratory components. Questions and discussion of the clinical application of theory are encouraged in lecture. The laboratory component is designed to provide students with the necessary skills to produce a diagnostic quality image, and evaluate for level of quality. Laboratory projects will be performed to ensure the correlation of the theoretical and clinical applications.

Upon completion of this course the student will be able to:
1. Develop an understanding of the purpose, function, types of grids used in conventional and digital imaging.
2. Analyze the factors that affect image quality relative to density or image receptor exposure, contrast or dynamic range, and geometric recorded detail or spatial resolution.
3. Apply digital and conventional imaging principles to produce diagnostic quality images in the laboratory; determine and implement corrective action when images are suboptimal.
4. Discuss the variety of digital image receptors, image receptor exposure, and dynamic range, EI and DI indices along with post processing of the digital image.
5. Differentiate among the variety of automated exposure systems utilized in diagnostic radiology departments.
6. Correlate the principles of electricity, magnetism, and electromagnetism to diagnostic imaging.
7. Describe the function of the x-ray circuit components and recognize conventional and mobile equipment malfunctions.
8. Perform laboratory experiments to correlate the theoretical applications associated with the darkroom, density or image receptor exposure, contrast or dynamic range, recorded detail or spatial resolution, and grids.

Course-specific General Education Knowledge Goals and Core Skills.

**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 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. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Lecture Unit Objectives:
Week #1 - 2: Grids
Following the completion of week 2, the student will be able to:
- State the purpose of a grid and compare grid types. (CG 1, 2, 3; GE 3)
- Select the most appropriate grid for a given clinical situation. (CG 1, 2, 3; GE 3,B)
- Interpret grid efficiency in terms of grid ratio and frequency. (CG 1; GE 2, 3, B)
- Define grid cutoff and summarize the factors that influence grid cutoff. (CG 1; GE 3)
- Evaluate grid artifacts in conventional and digital imaging. (CG 3; GE 3, B)

Week #2 - 5: Density and Contrast
Following the completion of week 4, the student will be able to:
- Describe the purpose of radiographic density/image receptor exposure/brightness. (CG 2; GE 3)
- Identify the acceptable range of radiographic density/image receptor exposure/brightness. (CG 2, 4; GE 3)
- Calculate mathematical problems using the factors that affect radiographic density/image receptor exposure/brightness. (CG 2, 3; GE 2)
- Analyze radiographs for density adequacy using all technique factors. (CG 2, 3; GE2, B)
- Describe the function of radiographic contrast or dynamic range. (CG 2, 4; GE 3)
- Differentiate between subject contrast and film contrast. (CG 2; GE 3, B)
- Analyze radiographs for contrast adequacy using all technique factors. (CG 2, 3; GE 2, 3, B)
- Analyze relationships of factors affecting radiographic density or image receptor exposure and contrast or dynamic range. (CG 2, 3, 4; GE 2, 3, B)
- Compare digital image characteristics to film screen image quality. (CG 2, 3, 4;GE 2, 3, B)

Week #6 - 9: Automatic Exposure Control, Recorded Detail or Spatial Resolution, Distortion, and Digital Image Receptors
Following the completion of week 8, the student will be able to:
- Describe the purpose and clinical application of automatic exposure control systems. (CG 5; GE 3)
- Identify errors associated with exposure control systems. (CG 5; GE 2, B)
- Define recorded detail/spatial resolution and its relationship to diagnostic radiography. (CG 2;GE 3)
- Describe the factors that affect recorded detail or spatial resolution. (CG 2; GE3)
- Describe methods to minimize patient motion. (CG 2; GE 3)
- Analyze radiographs for adequacy of recorded detail/special resolution. (CG 2, 3, 4; GE 2, 3, B)
• Explain methods to minimize distortion when performing mobile radiographic procedures while ensuring maximum recorded detail/spatial resolution. (CG 2, 4; GE 2, 3, B)
• Discuss the process of formulating imaging standards. (CG 2; GE 3, C)
• Identify the imaging standard process and develop an individualized quality standard. (CG 2, 3; GE 3, C)
• Compare digital image receptors to film screen cassettes (CG 2, 3, 4; GE 2, 3, B)

Week #10 – 14: Electricity, Magnetism, Electromagnetism, X-Ray Circuitry
Following the completion of week 14, the student will be able to:
• Differentiate between a series and parallel circuit. (CG 5; GE 3)
• Apply Ohm’s Law to series and parallel circuits. (CG 5; GE 2, 3)
• Define magnetism and discuss its application to radiography (CG 5; GE 3).
• Identify the classifications of magnets. (CG 5; GE 3)
• State the hand rules of electromagnets. (CG 5; GE 3)
• State the laws of magnetism. (CG 5; GE 3)
• Describe electromagnetic induction. (CG 5; GE 3)
• Differentiate between a motor and generator. (CG 5; GE 3)
• Differentiate between alternating and direct current motors and generators. (CG 5; GE 3)
• Describe the function of a transformer and its application to radiography. (CG 5; GE 3)
• Identify the various types of transformers and discuss their efficiency. (CG 5; GE 3)
• Calculate transformer law problems. (CG 5; GE 2)
• Differentiate between single phase and three phase power. (CG 5; GE 3)
• Compare the types of mobile radiographic units available. (CG 6; GE 3, B)
• Identify the components of an x-ray circuit and describe the purpose of each. (CG 6; GE 3)
• Given a diagram of an x-ray circuit, label the components. (CG 6; GE 3)

Laboratory Unit Objectives:
Week #1 - 14:
Following the completion of week 15, the student will be able to:
• Orient to the digital imaging systems. (CG 8; GE 1, 3, A, F)
• Perform a variety of experiments associated with the density, contrast, and recorded detail (CG 8; GE 1, 2, 3, 9, A, B, C, F)
• Compare and contrast conventional radiography to digital radiography (CG 8; GE 1, 2, 3, 9, A, B, C)
**Evaluation of Student Learning:**
The student must earn a grade of "C+" (77%) or higher in the lecture and laboratory sections of the course to advance to Clinical Practicum (RAD 206). The following grading policy will be utilized:

<table>
<thead>
<tr>
<th>Course Grade</th>
<th>Lecture Grade</th>
<th>Laboratory Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture: 100%</td>
<td>Examinations: 50%</td>
<td>Attendance/ Participation 100%</td>
</tr>
<tr>
<td>Lab: Pass/Fail</td>
<td>Final Exam: 25%</td>
<td></td>
</tr>
<tr>
<td>Project/Oral Presentation: 25%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A minimum of four (4) examinations and a final will be administered and a laboratory project with oral presentation is required. Online assignments will be listed on the MCCC Virtual College website. Students will complete laboratory assignments to provide them with the necessary skills to produce diagnostic quality radiographs, to reinforce specific lecture topics and to prepare for the oral presentation. Details of test formats, dates, and the laboratory project will be provided by the instructor. A basic non-programmable calculator is permitted for examinations. The instructor must approve the calculator on the examination day.

**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.

**Radiation Protection**

1. All students will be provided a monthly laboratory dosimeter that must be worn at the collar. A monthly laboratory radiation monitoring report will be distributed to all participants.
2. A radiography faculty member will be present in the laboratory during the experiment set up and radiographic exposure.
3. All laboratory doors must be closed during the radiographic exposure.
4. All students must be behind the lead-lined barrier or control panel or outside the energized lab during the radiographic exposure.
5. Become accustomed to the normal sounds and operation of the radiographic unit. Students must report any unusual sounds or irregularities in system performance to the radiography faculty member.
6. Immediately report any damage, malfunction, of the radiographic unit or error messages on the control panel to the radiography faculty member.
7. Students must arrive at least 5 minutes prior to the start of the experiment and be prepared to start at the designated time. Students will not be admitted to the laboratory after the designated start time, resulting in a grade of zero for the lab experiment.

**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 (15) week semester identifies the topic to be discussed and reinforced in the laboratory. Reading assignments and laboratory projects will be provided by the individual instructor.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–2</td>
<td>Grids</td>
</tr>
<tr>
<td>2–5</td>
<td>Density/Image Receptor Exposure and Contrast/Dynamic Range</td>
</tr>
<tr>
<td>6–9</td>
<td>Automatic Exposure Control</td>
</tr>
<tr>
<td></td>
<td>Recorded Detail/</td>
</tr>
<tr>
<td></td>
<td>Spatial Resolution</td>
</tr>
<tr>
<td></td>
<td>Distortion</td>
</tr>
<tr>
<td></td>
<td>Digital</td>
</tr>
<tr>
<td></td>
<td>Image Receptors</td>
</tr>
<tr>
<td>10–14</td>
<td>Electricity</td>
</tr>
<tr>
<td></td>
<td>Magnetism</td>
</tr>
<tr>
<td></td>
<td>Electromagnetism</td>
</tr>
<tr>
<td></td>
<td>X-Ray Circuitry</td>
</tr>
<tr>
<td>WEEK #</td>
<td>DATE</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>1/28</td>
</tr>
<tr>
<td>2</td>
<td>2/4</td>
</tr>
<tr>
<td>3-4</td>
<td>2/11- 2/18</td>
</tr>
<tr>
<td>5</td>
<td>2/25</td>
</tr>
<tr>
<td>6 - 8</td>
<td>3/4- 3/25</td>
</tr>
<tr>
<td></td>
<td>3/18</td>
</tr>
<tr>
<td>9</td>
<td>4/1</td>
</tr>
<tr>
<td>10-11</td>
<td>4/8-4/15</td>
</tr>
<tr>
<td>12 -13</td>
<td>4/22- 4/29</td>
</tr>
<tr>
<td>14</td>
<td>5/6</td>
</tr>
<tr>
<td></td>
<td>5/13</td>
</tr>
<tr>
<td>WED</td>
<td>MON</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>1/23</td>
<td>1/28</td>
</tr>
<tr>
<td>1/30</td>
<td>2/4</td>
</tr>
<tr>
<td>2/6</td>
<td>2/11</td>
</tr>
<tr>
<td>2/13</td>
<td>2/18</td>
</tr>
<tr>
<td>2/20</td>
<td>2/25</td>
</tr>
<tr>
<td>2/27</td>
<td>3/4</td>
</tr>
<tr>
<td>3/6</td>
<td>3/11</td>
</tr>
<tr>
<td>3/13</td>
<td>3/25</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3/27</td>
<td>4/1</td>
</tr>
<tr>
<td>4/3</td>
<td>4/8</td>
</tr>
<tr>
<td>4/10</td>
<td>4/15</td>
</tr>
<tr>
<td>4/17</td>
<td>4/22</td>
</tr>
<tr>
<td>4/24</td>
<td>4/29</td>
</tr>
<tr>
<td>5/1</td>
<td>5/6</td>
</tr>
</tbody>
</table>