Virginia Western Community College
RAD 112
Radiographic Science II

Prerequisites
Successful completion of RAD 111.

Course Description
Teaches concepts of radiation, radiography physics, and fundamentals of electromagnetic radiation, electricity and magnetism, and application of these principles to radiography. Focuses on x-ray production, emission, and x-ray interaction with matter. Develops skills in analysis, quantification and synthesis, and applies problem-solving skills.

Semester Credits: 4 **Lecture Hours: 3** **Lab/Clinical/Internship Hours: 3**

Required Materials
Textbook:
Essentials of Radiologic Science. Robert Fosbinder & Diane Orth. 2nd Edition. ISBN: 9781496317278
Radiologic Science for Technologists. Bushong. 11th Edition. ISBN: 9780323353779

Supplementary Materials:
Several resource textbooks are located in the Radiography Lab

Course Outcomes
At the completion of this course, the student should be able to:
- Understand the major concepts of radiation and radiography physics.
- Understand the fundamentals of electromagnetic radiation, electricity and magnetism.
- Apply fundamental principles of electromagnetic radiation, electricity and magnetism production to clinical situations.
- Understand x-ray production, emission and interactions with matter.

Topical Description

1. Chapter 16- Radiographic film and Processing
- Discuss the components of radiographic film
- Identify the stages of image formation
- Identify the stage in film processing
- List the components and describe the operation of automatic film processors
- Describe the purpose and construction of intensifying earth screens
- Identify the factors that affect screen speed and spatial resolution
- Explain the construction of cassettes and how to care for cassettes

2. Chapter 19 – Basic Principles of Digital Imaging
- Describe how a matrix of pixels is used to form a digital image
- Identify the relation between matrix size, pixel size, and field of view
- Identify the differences between spatial resolution and contrast resolution
- Describe how post processing manipulation allows for improved visualization of the image on the monitor
- Compare the dynamic range between digital imaging and film screen
- Discuss how digital image characteristics of brightness, contrast, and resolution compare to film screen imaging
- Recognize the effect of quantum noise, scatter, and artifacts on the quality of a digital image

3. Chapter 20 – Capturing the Digital Image
- Explain the function of an analog-to-digital converter
- Describe the design of the cassette-based detectors
- Identify the components of a digital imaging system
- Describe the operation of ta computed radiography system
- Explain elements used in the digital radiography system
- Explain the process of image extraction for CR and DR
- Discuss the features of a storage phosphor plate
- Describe the process used by the CR reader to scan the imaging plate and produce an image
- Define the difference between indirect capture and direct capture radiography
- Describe the use of silicon, selenium, and cesium iodide in digital radiography

4. Chapter 21 Digital Imaging Exposure Techniques
- Identify the effects of off-centering anatomy on an image using AEC
- List methods for minimizing patient exposure to radiation
- Understand the concept behind using higher kVp levels for CR and DR
- Explain the foundational principles and how each applies to CR and DR
- Describe what “dose creep” is and how it has become common in digital imaging
- Differentiate between sufficient penetration, over penetration, and under penetration of the beam
- List dose reduction techniques
- Describe the process for aligning multiple fields on one CR image receptor
- Recognize and explain technique myths of CR and DR

5. Chapter 22 – Digital Image Processing Operations
- Describe the formation of an image histogram
- Analyze the use of an image histogram in digital imaging
- Discuss rescaling the image for improved brightness and contrast
- Explain how preprocessing is used to improve an image
- Identify the three types of look-up tables

6. Chapter 23 – Digital Exposure Indicators
- Explain the use of exposure indicators for digital imaging
- Differentiate between dose-area product and detective quantum efficiency
- Identify the role of kVp, mAs, and geometric factor for digital imaging
- Describe the various exposure indices based on manufacturer design
- List the myths and facts of digital exposure indicators

7. Chapter 24 – Digital Image Evaluation
- List the seven criteria for producing quality images
- Discuss noise in an image an how it is created
- Identify methods for improving the signal-to-noise ratio in an image
- Evaluate an image for noise
- Discuss the importance of using grids to improve signal-to-noise ratio
- Identify common error in positioning and tub/Bucky alignment

8. Chapter 25 – Digital Image Display
- Distinguish differences between the CRT and AMLCD
- Identify the component of the cathode ray tube
- Explain how the raster pattern functions to produce an image
- Describe how the electron stream is shaped
- Differentiate between reflective and veiling glare
- Explain the construction of the liquid crystal diodes
- Discuss the features of an active matrix liquid crystal display

9. Chapter 26 – Digital Image Management
- Describe the use of image storage in relation to short and long term storage
- Explain the function of the image manager
- Define Digital Imaging and Communication in Medicine (DICOM)
- Describe what a picture archiving and communication system (PACS) is an how it is used
- Compare a radiology information system to a hospital information system
- Explain the purpose of the Health Level 7 communication system

10. Chapter 27 – Fluoroscopy
- Identify the components of a fluoroscopic system
- Identify the components of an image intensifier
- Describe the purpose of an automatic brightness control circuit
- Identify the factors that influence patient dose during fluoroscopy
- Explain the effects of flux and minification gain on total brightness gain
- Discuss the factors that affect fluoroscopic image contrast, resolution, distortion, and quantum mottle

11. Chapter 28 – Imaging Equipment
- Describe the principles of linear tomography
- Recognize the variation between mobile and dedicated units and linear tomography
- State the purpose of dedicated units and identify their unique features

12. Chapter 29 – Quality Assurance and Control
- Describe factors included in radiographic quality control (QC)
- State the factors included in processor QC
- Explain the types and sources of film artifacts
- Explain the various test patterns suggested by the AAPM T19 and SMPTE
- State the factors included in fluoroscopic QC
- Describe various factors associated with the performance of digital display systems
- Identify concepts that are tested for AEC quality control
- Describe tomographic QC test for section depth indicators and section thickness
- Explain quality control measure for electronic display systems

13. Chapter 31 – Radiation Biology: Cellular Effects
- Describe the reproductive cycle of the human cell
- Identify the relative radiation sensitivity of human cells, tissues, and organs
- Discuss target theory of radiobiology
- Relate the Law of Bergonie and Tribondeau

14. Chapter 32 – Organism Response to Radiation
- Describe dose-response models
- Identify stages of acute radiation syndrome
- Discuss the biologic factors that affect the degree of tissue damage in relation to radiation exposure
- Describe the three acute radiation syndromes
- Define lethal dose, LD 50/30
- Discuss local tissue damage after high-dose irradiation
- Review the three features of a deterministic radiation effect

15. Chapter 33 – Radiation Protection: Principle Concepts and Equipment
- Identify the units of exposure, dose, and effective dose
- State the requirements for personnel monitoring
- Identify devices used to detect and measure radiation
- Describe ALARA
- Name the dose limits for occupational and nonoccupational workers
- List the three types of natural radiation
- Discuss man=made radiation and its impact on radiation doses

16. Chapter 34 – Minimizing Exposure to Ionizing Radiation

- Explain the construction of protective barriers
- Identify factors that determine the thickness of lead in primary and secondary barriers
- Describe the methods of reducing radiation exposure
- Describe ALARA
- State the three methods of radiation reduction to staff
- Name the dose limits for occupational and nonoccupational workers
- Discuss the radiosensitivity of pregnancy

Specific Course Outcomes

- Describe the purpose and construction of intensifying screens.
- Describe the characteristics of intensifying earth screens
- Identify the factors that affect screen speed and spatial resolution
- Explain the construction of cassettes and how to care for cassettes
- Describe luminescence, fluorescence, and phosphorescence
- Discuss the components of radiographic film
- Identify the stages of image formation
- List and describe the important portions of the characteristic curve
- Identify the optical density, speed, contrast, and latitude of radiographic film
- Identify the stages of film processing
- List the components of automatic film processing
- Identify the components of a fluoroscopy system.
- Identify the components of an image intensifier.
- Describe the purpose of an automatic brightness control circuit.
- Identify the factors that influence patient dose during fluoroscopy.
- Explain the effects of flux and minification gain on total brightness gain.
- Discuss the factors that affect fluoroscopic image contrast, resolution, distortion, and quantum mottle.
- Describe how a matrix of pixels is used to form a digital image.
- Identify the relation between matrix size, pixel size, and field of view.
- Identify the components of a digital imaging system.
- Describe the operation of a computed radiography system.
- Explain the elements used in a digital radiography system.
- Describe the reproductive cycle of the human cell.
- Identify the relative radiation sensitivity of human cells, tissues, and organs.
- Describe the dose-response models.
- Identify the stages of acute radiation effects.
- Discuss target theory of radiobiology.
- Relate the Law of Bergonie and Tribondeau.
- List and discuss the biologic factors that affect the degree of tissue damage in relation to radiation exposure.
- State the requirements for personnel monitoring.

- Describe the construction of protective barriers and identify factors that determine the thickness of lead in the barriers.
- Identify devices used to detect and measure radiation.
- State the requirements for construction of radiographic equipment.
- Describe safety requirements of mobile and fluoroscopic equipment.

- Describe the methods of reducing radiation exposure.
- Describe ALARA.
- State the three methods of radiation reduction to staff.
- Name the dose limits for occupational and nonoccupational workers.
- Discuss the radiosensitivity of pregnancy.
- State the factors included in radiographic quality control (QC).
- State the factors included in processor QC.
- State the types and sources of film artifacts.
- State the factors included in fluoroscopic QC.

Note to Instructors

1. Students will continue to identify and set proper radiographic technique in the clinical setting.
2. Students will discuss technical factors and image quality into their procedure competency reviews.
3. Students will apply radiation protection practices while in the clinical setting.