Virginia Western Community College
RAD 111
Radiographic Science I

Prerequisites
Admission into the Radiography Program.

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 strategies.

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

I: Chapter 10

- Optical Density
- Technical Factors Affecting Density
- Automatic Exposure Control
- Contrast
- Image or Radiographic Contrast
- Technical Factors influence Contrast

II: Chapter 11

- Image Formation
- Recorded Detail
- Tomography
- Bone Densitometry

III: Chapter 12

- Purpose of the Grid
- Grid Construction
- Types of Grids
- Grid Movement
- Grid Selection
- Grid Errors
- Alternative Method to Reduce Scatter

IV: Chapter 7

- Types of Interactions
- Variations of PE Affect with Atomic #

V: Chapter 5

- X-ray Tube
- Cathode
- Anode
- Line Focus Principle
- Anode Heel Effect
- Off-focus radiation
- Focal Spot Blooming
- Tube Rating Charts
- Anode Heat Monitors
- Tube Life & Warm-Up Procedures

VI: Chapter 6

- X-ray Production
- Bremsstrahlung Interactions
- Characteristic Interactions
- X-ray Beam Quality & Quantity

VII: Chapter 3

- Types of Electrical Materials
- Electrodynamics
- Ohm's Law
- Direct and Alternating Currents
- Electric Power
- Electromagnetism
- Electric Generators
- Electric Motors
- Induction Motors
- Capacitors

VIII: Chapter 4

- Direct & Alternating Currents
- High Voltage Components
- Circuits
- High-Voltage Circuits
- Control Panel Components

IX: Chapter 1

- Units of Radiation
- Atomic Models
- Atomic Structure
- Atoms

X: Chapter 2

- Electromagnetic Radiation
- Magnetism
- Electrostatics

Specific Course Outcomes per Chapter

At the completion of Chapter 1, the student should be able to:

- Define atomic mass and atomic number
- Describe the Bohr model of the atom and its component
- Define electron binding energy
- Describe the process of ionization
- Identify the types of ionizing radiation

At the completion of Chapter 2, the student should be able to:

- Name the types of electromagnetic radiation and describe each
- Describe the characteristics of electromagnetic radiation
- Describe the relationship between frequency, wavelength, velocity, and energy of electromagnetic radiation
- Define radiation intensity and how it varies with distance from the source
- State the laws and units of magnetism
- Identify the different types of magnetic materials
- Describe the methods of electrification
- State the laws of electrostatics
- State Coulomb's Law

At the completion of Chapter 3, the student should be able to:

- Identify the four types of electrical materials
- Describe the direction and movement of current flow
- Define current, voltage, and electric power and identify their units
- Identify Ohm's Law and state the relationship between current, voltage, and resistance
- Distinguish between alternating and direct current
- Describe current induction
- Distinguish between electric generators and motors

At the completion of Chapter 4, the student should be able to:

- Identify single-phase, three-phase, and high-frequency waveforms
- Describe the relationship between current and voltage in the primary and secondary sides of the step-up and step-down transformers
- Identify the components of a typical x-ray circuit and their purpose
- Describe the purpose and operation of a rectifier
- Describe the operation of a transformer
- Define voltage ripple

At the completion of Chapter 5, the student should be able to:

- Define thermionic emission
- Describe the line focus principle and the anode heel effect

At the completion of Chapter 6, the student should be able to:

- Describe the bremsstrahlung x-ray production process
- Describe the characteristic x-ray production process
- Identify the information contained in an x-ray spectrum
- Identify the changes in x-ray beam quality and quantity resulting in changes in kVp, mAs, filtration, x-ray circuit waveform, and anode material

At the completion of Chapter 7, the student should be able to:

- Distinguish between absorption, scattering, and transmission of x-ray photons
- Identify the factors that affect the amount of attenuation
- Define half-value layer
- State five ways in which x-rays interact with matter
- Describe the two x-ray interactions important in image formation

At the completion of Chapter 10, the student should be able to:

- Identify the factors that affect image density
- Describe the operation of an automatic exposure control system
- Identify the factors that make up radiographic contrast
- Identify the factors that make up subject contrast
- Describe the difference between long-scale and short-scale images

At the completion of Chapter 11, the student should be able to:

- Define the factors that affect image detail
- Describe the factors that affect image detail
- Describe the principles of linear tomography
- Describe the various geometric factors
- Discuss appropriate techniques to prevent motion

At the completion of Chapter 12, the student should be able to:

- Describe the effect of scatter on radiographic contrast
- Identify the factors that affect the amount of scatter
- Identify methods of scatter reduction
- Describe the construction of an anti-scatter grid
- Identify the types of grids
- Explain the types of grid errors

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.