RADT-1300: FUNDAMENTALS OF RADIOGRAPHY

Cuyahoga Community College

Viewing: RADT-1300 : Fundamentals of Radiography

Board of Trustees:
March 2021

Academic Term:
Fall 2021

Subject Code
RADT - Radiography

Course Number:
1300

Title:
Fundamentals of Radiography

Catalog Description:
Basic study of ionizing radiation relative to its nature, production, interaction with matter and effect on radiographic quality. Includes the fundamentals of radiation protection and image acquisition methods.

Credit Hour(s):
4

Lecture Hour(s):
3

Lab Hour(s):
2

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
Departmental approval: admission to program.

Outcomes

Course Outcome(s):
Apply knowledge of radiation concepts as they relate to the field of x-ray.

Essential Learning Outcome Mapping:
Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):
1. Describe the properties of matter, energy, atomic theory and standard units of measurement.
2. Differentiate between types of radiation along the electromagnetic spectrum.
3. Diagram the x-ray tube and explain its components.
4. Illustrate the process of x-ray production as it relates to the x-ray tube.
5. Describe the general principles of x-ray interactions with matter.
6. Differentiate between characteristic and bremsstraulung interaction in the x-ray tube.
7. Explain the interactions between x-rays and matter at the patient level including: photoelectric absorption, compton scatter, and coherent scatter.
8. Calculate heat units and understand tube rating charts.
9. Explain how beam filtration affects x-ray beam intensity and patient exposure.

Course Outcome(s):

Correctly set prime factors and identify their effects on an image.

Objective(s):

1. Perform calculations for milliamperage per second and kilovoltage.
2. Solve for the law of reciprocity and understand its application.
3. Apply the inverse square law and the exposure maintenance formula.
4. Modify images related to digital imaging including post production manipulation.
5. Understand and apply the fifteen percent rule.
6. Demonstrate a basic understanding of Automatic Exposure Control's (AEC) and its effect on the image.
7. Consider exposures relative to patient size.
8. Determine various methods for reducing quantum mottle.

Course Outcome(s):

Perform basic skills for radiographic image acquisition.

Objective(s):

1. Recognize differences and similarities between conventional (film screen) radiography and photostimulable phosphor (PSP) image capture or computed radiography.
2. Recognize differences between PSP and flat panel detector (FPD) options, including both indirect and direct capture.
3. Appropriately handle images from any of the acquisition methods.
4. Evaluate conventional, PSP and FPD images for quality.

Course Outcome(s):

Manipulate and apply basic radiation principles as they relate to the protection of the patient, the radiographer and image production.

Objective(s):

1. Practice safe radiation protection principles.
2. Apply appropriate collimation during exposures.
3. Demonstrate appropriate scatter reduction techniques.
4. Describe the purpose, construction and appropriate uses for various grid types.
5. Evaluate grid cut-off.
6. Evaluate patient dose with the use of grids.
7. Summarize the relationship of factors affecting scatter and secondary radiation.
8. Identify advantages and methods used for beam restriction.

Course Outcome(s):

Evaluate image processing and display characteristics.

Objective(s):

1. Distinguish factors controlling and influencing brightness, gray scale, spatial resolution and distortion.
2. Evaluate images for adequate brightness, gray scale, spatial resolution and distortion.
3. Recommend appropriate adjustments to correct brightness, gray scale, spatial resolution and distortion.
4. Describe how density and contrast in film-screen imaging relate to brightness and gray scale n digital imaging.
5. Identify windowing and leveling and describe what they control.
6. Understand factors affecting spatial resolution in digital imaging.
7. Define pixel and matrix as they relate to digital images.

Course Outcome(s):

Appreciate various methods of image evaluation.

Objective(s):

1. Describe various exposure response indicators and their range of acceptance.
2. Evaluate dark noise, quantum mottle, and exposure creep in digital images.
3. Describe Picture Archiving and Communication System (PACS), Digital Imaging and Communications in Medicine (DICOM) and Health Level Seven (HL7) and their functions.

Course Outcome(s):

Apply previously learned knowledge from the classroom to the laboratory and evaluate laboratory experiments as they relate to both film-screen and digital technology.

Objective(s):

1. Prove by experiment the inverse square law and the exposure maintenance formula.
2. Demonstrate the law of reciprocity.
3. Produce long and short scale contrast.
4. Manipulate computed radiography equipment to produce an image.
5. Manipulate digital radiography equipment in order to create an image.
6. Calculate and create images demonstrating the fifteen percent rule.
7. Demonstrate proper grid usage and grid errors.
8. Demonstrate collimation and its effect on radiographic quality.
9. Manipulate a digital image on a monitor to demonstrate windowing and leveling.
10. Acquire and accurately annotate digital images.

Methods of Evaluation:

1. Homework assignments
2. Quizzes
3. Midterm examination
4. Final examination
5. Projects
6. Assessment of laboratory experiments

Course Content Outline:

1. Radiation concepts
   a. Matter and energy
   b. Atomic theory
   c. Types of energy
   d. Electromagnetic spectrum
   e. The discovery of x-rays
   f. X-ray properties
2. Technical calculations
   a. Milliamperage per second
   b. Inverse square law
   c. Exposure maintenance formula
   d. Fifteen percent rule
3. The x-ray tube
   a. The cathode assembly
   b. The anode assembly
   c. The glass envelope
   d. Protective housing
   e. Off-focus radiation
   f. Rating charts and cooling curves
   g. Recommendations for extending tube life
4. X-ray production
   a. Conditions
   b. Target interactions
   c. Emission spectrum
   d. Characteristic and bremsstrahlung radiation
5. The prime factors
   a. The prime factors
   b. Milliamperage-second (mAs)
   c. Kilovoltage (kVp)
   d. Distance
   e. Law of reciprocity
6. X-ray interactions
   a. X-ray interactions with matter
   b. Photoelectric absorption
   c. Coherent scattering
   d. Compton scattering

    e. Effect on technical factor selection
    f. Differential absorption
7. Image receptors
    a. Film as compared to photostimulable phosphor plates response to radiation
    b. Basic D log E curve
    c. Computed radiography (PSP) compared to digital radiography
    d. Flat panel detectors
8. Basic radiation protection as it relates to image production
    a. Basic radiation protection principles and practice
    b. Patient considerations
    c. Detection and measurement of radiation exposure
    d. Protection of personnel
9. Exposure
    a. Assessing receptor exposure
    b. Brightness
    c. Effects on image appearance
    d. Factors affecting exposure (mAs, kVp, distance)
    e. Comparing film screen to digital imaging
10. Contrast
    a. Assessing gray scale
    b. Radiographic contrast and subject contrast
    c. Long scale vs. short scale contrast
    d. Evaluating contrast
    e. Factors affecting contrast
    f. Comparing film screen contrast to digital contrast
11. Spatial Resolution
    a. Assessing spatial resolution (recorded detail)
    b. Effects on image appearance
    c. Factors affecting spatial resolution (OID, SID, pixel size, matrix size)
    d. Compare film screen resolution to digital resolution
12. Distortion
    a. Assessing distortion
    b. Factors affecting size distortion
    c. Factors affecting shape distortion
    d. Effect on image appearance
    e. Measuring distortion on images
13. The grid
    a. Purpose of the grid
    b. Grid construction
    c. Grid patterns
    d. Grid types
    e. Grid uses
    f. Grid selection/conversions
    g. Grid performance evaluation
    h. Grid errors
    i. Other scatter reduction methods
    j. Grid use in digital
14. Beam restriction
    a. Define scatter and its causes
    b. Controlling scatter
    c. Beam restrictors
    d. Ancillary devices
    e. Filtration
15. Image acquisition
    a. Analog to digital conversion (ADC)
    b. Pixel and matrix size
    c. Raw data (pre processing)
    d. Displayed data

e. Look up tables (LUT)
f. Post processing

Resources

Carlton, R., and A. Adler. *Principles of Radiographic Imaging, An Art and A Science*. 6th ed. Albany, NY: Thompson Delmar, 2020.

Carroll, Quinn B. *Radiography in the Digital Age.* 2nd ed. Springfield, IL: Charles C. Thompson, 2014.

Carroll, Quinn B. . *Digital Radiography in Practice* . 1st ed. Springfield IL: Charles C. Thomas, 2019.

Martensen, Kathy McQuillen. *Radiogpraphic Image Analysis*. 5th ed. St. Louis, MO: Elsevier Saunders, 2020.

Martensen, Kathy McQuillen. *Radiographic Image Anyalysis Workbook*. 5th. ed. St. Louis, MO: Elsevier Saunders, 2020.

Fauber, Terry. *Radiographic Imaging and Exposure*. 5th ed. St. Louis, MO: Elsevier Mosby, 2017.

Resources Other

1. American Registry of Radiologic Technologists Radiographic Certification Handbook containing examination content specifications. www.arrt.org (http://www.arrt.org)
2. American Society of Radiologic Technologists Radiography Curriculum. www.asrt.org (http://www.asrt.org)

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