R T 55A: PRINCIPLES OF RADIOLOGIC TECHNOLOGY I

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2022
Units:	3
Hours:	3 lecture per week (36 total per quarter)
Prerequisite:	R T 50; CHEM 25 or 30A.
Advisory:	Not open to students with credit in R T 52A.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU
Grade Type:	Letter Grade Only
Repeatability:	Not Repeatable

Student Learning Outcomes

- Describe the parts of the x-ray tube.
- Differentiate between the quality factors of mAs and kV.

Description

Introduction to elementary principles of x-ray physics, technique, radiation protection and digital radiography. Intended for students in the Radiologic Technology Program; enrollment is limited to students accepted in the program.

Course Objectives

The student will be able to:

1. Define ionization and its effect on the atom.
2. Differentiate SI vs. classical radiation units.
3. Describe the components and function of diagnostic x-ray tubes.
4. Evaluate the probability of attenuation based on patient factors and exam type.
5. Explain the rationale for using beam restriction.
6. Explain how beam filtration affects x-ray beam intensity, beam quality and patient exposure.
7. Summarize the relationship of factors affecting scattered radiation.
8. Interpret grid efficiency in terms of grid ratio and frequency.
9. Apply conversion factors for changes in the following areas: distance, grid, image receptors, reciprocity law and the 15 percent rule.
10. Evaluate exposure to a digital receptor utilizing manufacturer based exposure indexes and deviation index.
11. Describe the methods of image acquisition using CR and DR digital systems.
12. Distinguish and evaluate CR-based and DR-based image artifacts.

Course Content

1. Structure of the atom
    a. Composition
    b. Nucleus
    c. Structure—proton and electron balance
    d. Electron shells
        i. Binding energy
        ii. Valence shell
        iii. Ionization
        iv. Excitation
    e. Nomenclature
        i. Atomic number
        ii. Mass number
2. Nature of radiation
    a. Electromagnetic
        i. Spectrum
        ii. Wave-particle duality
        iii. Properties (e.g., frequency, wavelength, velocity)
    b. Particulate
        i. Types
        ii. Characteristics
    c. Nonionizing (excitation) vs. ionizing
        i. Energy
        ii. Probability
    d. Radiation units
        i. Système International d'Unités (SI Units)
            1. Exposure—Coulomb/kilogram (C/kg)
            2. Absorbed dose—Gray (Gy)
            3. Air kerma
            4. Measurement unit in gray
            5. Kinetic energy release in matter
            6. Dose equivalent—Sievert (Sv)
        ii. Classical
            1. Exposure—Roentgen (R)
            2. Absorbed dose (Rad)
            3. Dose equivalent (Rem)
3. X-ray production
    a. Historical introduction
    b. X-ray tube components
        i. Metal housing
        ii. Glass/metal envelope
        iii. Cathode
        iv. Tungsten filament
        v. Focusing cup
        vi. Anode
        vii. Focal spot
            1. Effective vs. actual
            2. Line focus principle
            3. Anode heel effect
        viii. Rotor
        ix. Stator
    c. Target interactions
        i. Bremsstrahlung
        ii. Characteristic
    d. Common terms related to the x-ray beam
        i. Primary beam
        ii. Exit/remnant beam

iii. Leakage radiation
iv. Off-focus/stem radiation
e. Conditions necessary for x-ray production
i. Source of electrons
ii. Acceleration of electrons
iii. Focusing the electron stream
iv. Deceleration of electrons
f. Beam quality
i. kV
ii. Filtration
iii. HVL
g. Beam quantity
i. mAs
ii. kV
iii. Distance
iv. Filtration

4. Interaction of photons with matter
a. Transmission of photons
b. Differential attenuation
i. Scatter
ii. Absorption
c. Exit/remnant radiation
d. Types and descriptions
i. Unmodified scattering (coherent)
ii. Photoelectric effect
iii. Modified scattering (Compton)
e. Probability of occurrence
f. Effect on image
g. Patient and operator dose effects

5. Beam restriction
a. Function/purpose
i. Reduce irradiated tissue volume
ii. Reduce patient dose
iii. Scatter production reduction
b. Types
i. Collimators
ii. Lead blockers
c. Collimator components
i. Automatic collimators
ii. Cylinders

6. Beam filtration
a. Types
i. Inherent
ii. Added
iii. Compensating
b. Function/mechanism
c. Impact on image characteristics
d. Impact on HVL

7. Scatter radiation
a. Prevention
i. Collimation
ii. kVp
b. Reduction
i. Grid
ii. Air gap (OID)
c. Effects
i. Image quality
ii. Patient dose
iii. Occupational exposure

8. Grids
a. Function/mechanism
b. Construction
c. Types
i. Focused
ii. Parallel
iii. Linear
iv. Crossed
v. Moving
vi. Stationary
vii. Short dimension
viii. Long dimension
ix. Virtual
d. Characteristics
i. Grid radius/focal range
ii. Ratio
iii. Frequency
iv. Grid conversion factor
e. Selection
i. kVp
ii. Patient/exam
iii. Focal range
iv. Alignment latitude
f. Primary cutoff

9. Receptor exposure
a. Factors that affect exposure receptors (e.g., anode-heel, OID, patient pathology)
i. Distance
ii. mA
iii. Time
iv. kV
v. Grids
vi. Beam restriction
vii. Filtration
b. Receptor exposure calculations
i. Inverse square law
ii. Reciprocity law
iii. 15 percent rule
iv. Grid conversion factor
v. Direct square law/exposure maintenance formula

10. Digital introduction
a. Advantages of digital-based imaging systems over film-based systems
i. Increased exposure latitude
ii. Increased dynamic range
iii. Improved structure visualization
iv. Ability to electronically store and transmit images
v. Increased workflow and productivity

b. Exposure evaluation in digital imaging
    i. Exposure index
    ii. Target index
    iii. Deviation index (DI)
    iv. Exposure indicators per manufacturer
11. Digital image acquisition
    a. Direct conversion and thin film transistor (TFT) arrays
    b. Indirect conversion and thin film transistor (TFT) arrays
    c. Charge-coupled device (CCD) system
    d. Photostimulable phosphor (PSP) plate
    e. CMOS
12. Artifacts
    a. Patient-related
    b. Equipment-related
    c. Workflow-related

Lab Content

Not applicable.

Special Facilities and/or Equipment

1. Multimedia classroom
2. Classroom with viewboxes
3. QC evaluation equipment for visual aids and practical use

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Quizzes
Midterms
Final examination
Group project presentation

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
Discussion
Cooperative learning exercises
Demonstration

Representative Text(s) and Other Materials

Bushon, Stewart. Radiologic Science for Technologists. 2021.

Fauber, Terri. Radiographic Imaging and Exposure. 2021.

Clover Learning online system

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

1. Weekly reading assignments from assigned chapters, approx. 1 chapter per week
2. Assigned videos and quizzes from Clover Learning online platform

Discipline(s)

Radiological Technology