# R T 55C: PRINCIPLES OF RADIOLOGIC TECHNOLOGY III

## 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 55B. |
| **Advisory:** | Not open to students with credit in R T 52B. |
| **Degree & Credit Status:** | Degree-Applicable Credit Course |
| **Foothill GE:** | Non-GE |
| **Transferable:** | CSU |
| **Grade Type:** | Letter Grade Only |
| **Repeatability:** | Not Repeatable |

## Student Learning Outcomes

- Comprehend the interaction of x-ray and matter and the effect of radiographic quality factors on image production.
- Describe the fundamentals of radiobiology, radiation protection and radiation protection devices.

## Description

Continuation of R T 55B, including physics and technique with the main focus on radiation protection of the patient and the occupational worker. 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. describe the different interactions or radiation and matter.
2. explain the significance of radiation energy transfer on tissues.
3. discuss the effects of radiation at the cellular and subcellular level.
4. describe the radiosensitivity and effect of radiation on living tissue.
5. explain the objectives of a good radiation protection program.
6. describe the utilization of radiation units of measure.
7. discuss current state and national regulations on radiation protection.
8. describe the various devices used for monitoring the radiation protection devices of occupationally exposed personnel.
9. describe the design radiation protective structures in a radiology department.
10. explain the radiation protection devices utilized for protecting the patient.

## Course Content

1. Interactions of photons and matter
    a. Transmission of photons
        i. Attenuated radiation
        ii. Exit/remnant radiation
    b. Unmodified scattering (coherent)
    c. Photoelectric effect
        i. Description of interaction
        ii. Relation to atomic number
        iii. Energy of incident photon and resulting product
        iv. Probability of occurrence
            1. Atomic number
            2. Photon energy
            3. Part density
        v. Application
    d. Modified scattering (Compton)
        i. Description of interaction
        ii. Relation to atomic number
        iii. Energy
        iv. Probability of occurrence
    e. Pair production
    f. Photodisintegration
2. Radiation energy transfer
    a. Molecular effects of radiation
        i. Direct effect—target theory
        ii. Indirect effect—radiolysis of water
3. Radiation effects
    a. Subcellular radiation effects
        i. Types of DNA damage and the implications for humans
        ii. Types of damage to chromosomes and the implications for humans
    b. Cellular radiation effects
        i. Types of cell death
        ii. Other effects
    c. Individual radiation effects
        i. Somatic effects
            1. Short and long term
            2. Stochastic and nonstochastic effects
        ii. Genetic effects
            1. Mutagenesis
            2. Genetically significant dose (GSD)
        iii. Embryo and fetal effects
    d. Factors influencing radiation response
4. Radiosensitivity and response
    a. Law of Bergonie and Tribondeau
        i. Differentiation
        ii. Mitotic rate
        iii. Metabolic rate
    b. Cell survival and recovery
        i. Factors influencing survival
            1. LET
            2. OER
            3. Fractionation and protraction
        ii. Lethal dose (LD)
    c. Systemic response to radiation
        i. Hemopoietic
        ii. Integumentary
        iii. Digestive
        iv. Urinary
        v. Respiratory

vi. Reproductive
vii. Muscle
viii. Nervous
d. Radiation dose-response curves
i. Linear, nonthreshold
ii. Noninear, nonthreshold
iii. Linear, threshold
iv. Nonlinear, threshold
e. Total body irradiation
i. ARS
1. Hemopoietic
2. Gastrointestinal
3. Central nervous system
ii. Stages of response and dose levels
iii. Factors that influence response
iv. Medical interventions of response
f. Late effects of radiation
i. Somatic responses
1. Mutagenesis
2. Carcinogenesis
ii. Stochastic effects
iii. Nonstochastic effects
iv. Genetic effects
v. Occupational risks for radiation workers
g. Risk estimates
5. Objectives of a radiation protection program
a. Documentation
b. Occupational and non-occupational dose limits
c. ALARA concept
d. Comparable risk
e. Negligible individual dose (NID)
6. Units, detection and measurement
a. Radiation units
i. Exposure
1. Coulomb/kilogram (C/kg) Roentgen (R)
ii. Absorbed dose
1. Gray (Gy) (Rad)
iii. Kerma
1. Kinetic energy release in matter
2. Measurement unit in gray
iv. Dose equivalent
1. Sievert (Sv) (Rem)
b. Dose reporting
i. NRC (10 Code of Federal Regulations) Part 20 Standards for Radiation Protection
ii. NCRP guidelines
1. Dose quantities
a. Effective dose (E)
b. Collective effective dose (S)
c. Average effective dose to a individual in a group exposed to a specific source (EExp)
d. Effective dose per individual in the U.S. population whether exposed to the specific source or not (EUS)
7. Surveys, regulatory/advisory agencies and regulations
a. General survey procedures
i. Qualified expert
ii. Records
b. Equipment survey
i. Conditions
ii. Radiographic and fluoroscopic equipment
c. Area survey
i. Controlled/uncontrolled areas
ii. Conditions
iii. Recommendations
iv. Radiation area sign posting
v. Monitors
d. Regulatory agencies
i. Nuclear Regulatory Commission (NRC)
ii. Food and Drug Administration (FDA)
iii. EPA
iv. OSHA
v. State agencies
e. Advisory agencies
i. International Council on Radiation Protection and Measurements (ICRP)
ii. National Council on Radiation Protection and Measurements (NCRP)
iii. Biological Effects of Ionizing Radiation (BEIR)
f. Radiation safety officer
i. Requirements
ii. Responsibilities
8. Personnel monitoring
a. Historical perspective
i. Evolution of standards
ii. NRC Regulations (10 CFR) Part 20 Standards for Radiation Protection
iii. NCRP recommendations
iv. ICRP recommendations
b. Requirements for personnel monitoring
i. Deep dose equivalent (DDE)
ii. Shallow dose equivalent (SDE)
iii. Eye dose equivalent (EDE)
iv. Total effective dose equivalent (TEDE)
c. Methods and types of personnel monitors
i. Thermoluminescent dosimeter (TLD)
1. Body badge
2. Ring badge
ii. Optimally stimulated luminescent dosimeter (OSLD)
d. Records of accumulated dose
i. Purpose
ii. Content
iii. Length of record keeping
iv. Retrieval from previous employers
e. Effective dose limits
i. Occupational
ii. Nonoccupational limits
iii. Critical organ sites
iv. Embryo and fetus
f. Responsibilities for radiation protection

i. Radiographer
ii. Radiation safety officer
iii. Facility

9. Application
   a. Design
      i. Materials
      ii. Primary barrier
      iii. Secondary (scatter and leakage) barrier
      iv. HVL and tenth-value layer (TVL)
      v. Factors
         1. Use (U) controlled and uncontrolled
         2. Workload (W)
         3. Occupancy (T)
         4. Distance (D)
      vi. X-ray and ancillary equipment
         1. Beam-limiting devices
         2. Exposure control devices
         3. On and off switches
         4. Interlocks
         5. Visual/audio monitors
         6. Emergency controls
         7. Quality control
            a. Calibration
            b. Standards
   b. Regulations and recommendations
      i. Current NRC recommendations and/or regulations
      ii. Current NCRP recommendations and/or regulations
      iii. Applicable state regulations
      iv. Public Law 97-35 (The Patient Consumer Radiation Health and Safety Act of 1981)
      v. CARE
      vi. Public awareness
         1. Background equivalent radiation time (BERT)
         2. Social marketing (Image Gently, Image Wisely)
   c. Cardinal principles in protection
      i. Time
      ii. Distance
      iii. Shielding
         1. NCRP recommendations regarding shielding
   d. Emergency procedures
10. Patient protection
   a. Beam-limiting devices
   b. Filtration
   c. Shielding
   d. Exposure factors
   e. Positioning
   f. Image receptor system
   g. Immobilization
   h. Fluoroscopic procedures
   i. Mobile radiography
   j. Special considerations
      i. Pediatric patient
      ii. Pregnant patients

## Lab Content

Not applicable.

## Special Facilities and/or Equipment

1. Multimedia classroom
2. Internet access
3. Classroom with viewboxes
4. Radiation protection devices

## Method(s) of Evaluation

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

Quizzes
Midterms
Final examination
Group radiation protection project.

## Method(s) of Instruction

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

Lecture
Discussion
Demonstration

## Representative Text(s) and Other Materials

Sherer, Mary Alice. Radiation Protection in Medical Radiography. 2022.

Bushong, Stewart. Radiologic Science for Technologists. 2021.

Clover Learning online platform

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

1. Weekly reading assignments from text, approx. 1 chapter per week
2. Radiation protection project that includes a reflective paper demonstrating critical thinking

## Discipline(s)

Radiological Technology