# R T 55C: PRINCIPLES OF RADIOLOGIC TECHNOLOGY III

## Foothill College Course Outline of Record

| Heading | Value |
|---|---|
| **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:
A. describe the different interactions or radiation and matter.
B. explain the significance of radiation energy transfer on tissues.
C. discuss the effects of radiation at the cellular and subcellular level.
D. describe the radiosensitivity and effect of radiation on living tissue.
E. explain the objectives of a good radiation protection program.
F. describe the utilization of radiation units of measure.
G. discuss current state and national regulations on radiation protection.
H. describe the various devices used for monitoring the radiation protection devices of occupationally exposed personnel.
I. describe the design radiation protective structures in a radiology department.
J. explain the radiation protection devices utilized for protecting the patient.

## Course Content

A. Interactions of photons and matter
1. Transmission of photons
a. Attenuated radiation
b. Exit/remnant radiation
2. Unmodified scattering (coherent)
3. Photoelectric effect
a. Description of interaction
b. Relation to atomic number
c. Energy of incident photon and resulting product
d. Probability of occurrence
1) Atomic number
2) Photon energy
3) Part density
e. Application
4. Modified scattering (Compton)
a. Description of interaction
b. Relation to atomic number
c. Energy
d. Probability of occurrence
5. Pair production
6. Photodisintegration
B. Radiation energy transfer
1. Molecular effects of radiation
a. Direct effect - target theory
b. Indirect effect - radiolysis of water
C. Radiation effects
1. Subcellular radiation effects
a. Types of DNA damage and the implications for humans
b. Types of damage to chromosomes and the implications for humans
2. Cellular radiation effects
a. Types of cell death
b. Other effects
3. Individual radiation effects
a. Somatic effects
1) Short and long term
2) Stochastic and nonstochastic effects
b. Genetic effects
1) Mutagenesis
2) Genetically significant dose (GSD)
c. Embryo and fetal effects
4. Factors influencing radiation response
D. Radiosensitivity and response
1. Law of Bergonie and Tribondeau
a. Differentiation
b. Mitotic rate
c. Metabolic rate
2. Cell survival and recovery
a. Factors influencing survival
1) LET
2) OER
3) Fractionation and protraction
b. Lethal dose (LD)
3. Systemic response to radiation
a. Hemopoietic
b. Integumentary
c. Digestive
d. Urinary
e. Respiratory
f. Reproductive
g. Muscle
h. Nervous
4. Radiation dose-response curves
a. Linear, nonthreshold
b. Noninear, nonthreshold
c. Linear, threshold
d. Nonlinear, threshold
5. Total body irradiation
a. ARS
1) Hemopoietic
2) Gastrointestinal
3) Central nervous system

b. Stages of response and dose levels
c. Factors that influence response
d. Medical interventions of response
6. Late effects of radiation
a. Somatic responses
1) Mutagenesis
2) Carcinogenesis
b. Stochastic effects
c. Nonstochastic effects
d. Genetic effects
e. Occupational risks for radiation workers
7. Risk estimates
E. Objectives of a radiation protection program
1. Documentation
2. Occupational and non-occupational dose limits
3. ALARA concept
4. Comparable risk
5. Negligible individual dose (NID)
F. Units, detection and measurement
1. Radiation units
a. Exposure
1) Coulomb/kilogram (C/kg) Roentgen (R)
b. Absorbed dose
1) Gray (Gy) (Rad)
c. Kerma
1) Kinetic energy release in matter
2) Measurement unit in gray
d. Dose equivalent
1) Sievert (Sv) (Rem)
2. Dose reporting
a. NRC (10 Code of Federal Regulations) Part 20 Standards for Radiation Protection
b. 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)
G. Surveys, Regulatory/Advisory Agencies and Regulations
1. General survey procedures
a. Qualified expert
b. Records
2. Equipment survey
a. Conditions
b. Radiographic and fluoroscopic equipment
3. Area survey
a. Controlled/uncontrolled areas
b. Conditions
c. Recommendations
d. Radiation area sign posting
e. Monitors
4. Regulatory agencies
a. Nuclear Regulatory Commission (NRC)
b. Food and Drug Administration (FDA)
c. EPA
d. OSHA
e. State agencies
5. Advisory agencies
a. International Council on Radiation Protection and Measurements (ICRP)
b. National Council on Radiation Protection and Measurements (NCRP)
c. Biological Effects of Ionizing Radiation (BEIR)
6. Radiation safety officer
a. Requirements
b. Responsibilities
H. Personnel Monitoring
1. Historical perspective
a. Evolution of standards
b. NRC Regulations (10 CFR) Part 20 Standards for Radiation Protection
c. NCRP recommendations
d. ICRP recommendations
2. Requirements for personnel monitoring
a. Deep dose equivalent (DDE)
b. Shallow dose equivalent (SDE)
c. Eye dose equivalent (EDE)
d. Total effective dose equivalent (TEDE)
3. Methods and types of personnel monitors
a. Film badge
b. Thermoluminescent dosimeter (TLD)
1) Body badge
2) Ring badge
c. Optimally stimulated luminescent dosimeter (OSLD)
4. Records of accumulated dose
a. Purpose
b. Content
c. Length of record keeping
d. Retrieval from previous employers
5. Effective dose limits
a. Occupational
b. Nonoccupational limits
c. Critical organ sites
d. Embryo and fetus
6. Responsibilities for radiation protection
a. Radiographer
b. Radiation safety officer
c. Facility
I. Application
1. Design
a. Materials
b. Primary barrier
c. Secondary (scatter and leakage) barrier
d. HVL and tenth-value layer (TVL)
e. Factors
1) Use (U) controlled and uncontrolled
2) Workload (W)
3) Occupancy (T)
4) Distance (D)
f. 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
2. Regulations and recommendations
a. Current NRC recommendations and/or regulations
b. Current NCRP recommendations and/or regulations
c. Applicable state regulations

d. Public Law 97-35 (The Patient Consumer Radiation Health and Safety Act of 1981)
e. CARE
f. Public Awareness
1) Background equivalent radiation time (BERT)
2) Social marketing (Image Gently, Image Wisely)
3. Cardinal principles in protection
a. Time
b. Distance
c. Shielding
4. Emergency procedures
J. Patient protection
1. Beam-limiting devices
2. Filtration
3. Shielding
4. Exposure factors
5. Positioning
6. Image receptor system
7. Immobilization
8. Fluoroscopic procedures
9. Mobile radiography
10. Special Considerations
a. Pediatric patient
b. Pregnant patients

## Lab Content

Not applicable.

## Special Facilities and/or Equipment

A. Multimedia classroom
B. Internet access
C. Classroom with viewboxes
D. Radiation protection devices

## Method(s) of Evaluation

Quizzes, midterms and final examination.

## Method(s) of Instruction

Lecture, Discussion, Oral presentations.

## Representative Text(s) and Other Materials

Sherer, Mary Alice. Radiation Protection in Medical Radiography. 7th ed. Maryland Heights, MO: C.V. Mosby, 2014. ISBN 978-0-323-17220-2

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

A. Weekly reading assignments from text.
B. Radiation Protection project that includes a reflective paper demonstrating critical thinking.

## Discipline(s)

Radiological Technology