COURSE OUTLINE

Course Number	Course Title	Credits
RAD117	**Radiation Protection and Biology**	**2**

Hours: Lecture/Lab/Other	Co- or Pre-requisite	Implementation Semester & Year
2	**Pre-requisites: RAD120, RAD128** **Co-requisites: RAD207**	**Summer 2022**

Catalog description:

Explores principles of radiation biology and radiation protection, including the production of X-rays, the interaction of radiation and matter, radiation units, and methods to protect the radiographer and patient.

General Education Category:
Not GenEd

Course coordinator:
Sandra L. Kerr, 609-570-3337, kerrs@mccc.edu

Required texts & Other materials:

Title: Radiation Protection in Medical Radiography
Author: Mary Alice Statkiewicz Sherer, et al.
Publisher: Mosby Elsevier
Edition: 9th

Title: Radiation Protection in Medical Radiography Workbook
Author: Mary Alice Statkiewicz Sherer, et al.
Publisher Mosby Elsevier
Edition: 9th

Title: Radiologic Science for Technologists
Author: S. Bushong
Publisher: Mosby
Edition: 12th

Course Student Learning Outcomes (SLO):

Upon successful completion of this course the student will be able to:

1. Provide ethical, regulatory and scientific justification for the safe and judicious use of ionizing radiation in medicine. (Supports ILG 2-5, 7 and 9-11)

2. Interpret research articles requiring an understanding of conventional and international standard units of ionizing radiation. (Supports ILG 2-4, 5,7 and 9-11)

3. Understand the basic interactions between ionizing radiation and biologic matter.(Supports ILG 2-5,7, and 10)

4. Identify clinical and global situations that can contribute to somatic and genetic radiation effects.(Supports ILG 2-4, 7-8, and 9-11)

5. Express knowledge of legislative and regulatory mandates related to radiation protection. (Supports ILG 1-4 and 10-11)

6. Identify basic occupational and patient radiation protection best practices in radiography, CT, radiation therapy and nuclear medicine. (Supports ILG 1-4 and 9-11)

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 1. Written and Oral Communication in English. Students will communicate effectively in both speech and writing.
Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
Institutional Learning Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Institutional Learning Goal 5. Social Science. Students will use social science theories and concepts to analyze human behavior and social and political institutions and to act as responsible citizens.
Institutional Learning Goal 7. History. Students will understand historical events and movements in World, Western, non-Western or American societies and assess their subsequent significance.
Institutional Learning Goal 8. Diversity and Global Perspective: Students will understand the importance of a global perspective and culturally diverse peoples
Institutional Learning Goal 9. Ethical Reasoning and Action. Students will understand ethical frameworks, issues, and situations.
Institutional Learning Goal 10. Information Literacy: Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.
Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills understand, analyze, or apply information or solve problems.

Units of study in detail – Unit Student Learning Outcomes:

Unit I **General Concepts of Radiation Protection** [Supports Course SLO #1, 2]

Learning Objectives
The student will be able to:

- Explain the need for radiation protection.
- Define ionizing radiation.
- Define the various units of radiation.

- Identify the various sources of ionizing radiation.
- Define the terms “primary radiation,” “remnant radiation,” and “attenuation.”
- Describe the various interactions of x-ray and matter.
- Describe the relationship between kVp and patient/occupational dose
- Explain current protection philosophy on the basis of the dose-response curve.
- Explain the ALARA concept.
- Detail specific dose limit recommendations for occupational and non-occupational exposure to ionizing radiation.* Explain radiation hormesis.
- Explain the basis of radiation hormesis from experiments.
- Explain the significance of hormesis on human longevity.
- Explain why hermetic theory is controversial.*
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Unit II **Overview of Cell Biology and Radiation Biology** [Supports Course SLOs #3, 4]

Learning Objectives
The student will be able to:

- Describe the various components of the human cell.
- Describe the process of protein synthesis.
- Explain the concept of DNA replication.
- Differentiate between mitosis and meiosis.
- State the number of chromosomes in the human somatic and genetic cell.
- Detail the stages of cell division.
- Explain the potential danger to the cell from ionizing radiation.
- Differentiate between direct and indirect radiation effects
- Explain target theory
- Describe the process of ionization of organic molecules.
- Give examples of free radicals
- Explain linear energy transfer and relative biological effectiveness.*

Unit III **Patient and Occupational Protection Practices** [Supports Course SLOs #1,4, 5]

Learning Objectives
The student will be able to:

- Explain the need for effective communication between technologist and patient.
- Explain the role of effective immobilization of the patient during radiographic procedures.
- Explain the role of “optimum” exposure factors in limiting patient dose.
- Explain the role of collimation and other forms of beam restriction in reducing patient dose.
- Define the 10-day rule. Accurately phrase a pre-examination screening question to female patients regarding their potential pregnancy status.
- Describe the usefulness of the half-value layer concept.
- Describe the factors available to occupationally exposed individuals to reduce radiation exposure.
- Differentiate between primary and secondary barriers.

- Identify sources of radiation dose to the radiographer.
- Explain the inverse square law.
- Define the terms “controlled” and “uncontrolled” areas in radiologic facilities.

Unit IV **Radiation Monitoring and Detection, and Regulatory Considerations** [Supports Course SLO #5]

Learning Objectives
The student will be able to:

- Explain the role of radiation monitoring.
- Differentiate between radiation monitoring and radiation protection.
- Distinguish between the different kinds of personnel monitors in current use.
- List the advantages and disadvantages of the different kind of monitors used by occupationally exposed individuals.
- Explain what radiation survey instruments are used for.
- Name the different types of survey instruments in use in radiology departments
- Identify specific federal and state regulations governing radiation protection of patients and personnel.
- Identify the different agencies involved in specifying dose limits and protection practices.

Unit V **Radiation Protection Practices in CT, Nuclear Medicine, Radiation Oncology and Non-Medical Nuclear Facilities** [Supports Course SLO #6]

- Identify the different kinds of ionizing radiation present at different facilities.
- Describe protection practices specific to the facility under consideration.
- Describe the linear accelerator used in radiation oncology.
- Describe the “hot lab” in nuclear medicine.
- Distinguish between teletherapy and brachytherapy.
- Distinguish between nuclear fission and nuclear fusion.
- Describe the process of nuclear fission and nuclear fusion.
- Radiation dose in computed tomography (CT).
- Factors influencing radiation dose in CT.
- Dose reduction methods during CT procedures.
- Dose comparisons: CT versus diagnostic radiography/fluoroscopy.

Evaluation of student learning:
There will be a minimum of three tests and a comprehensive final examination. A grade of "C+" (77%) or higher must be achieved in the course to progress to RAD217 and RAD228. The following grading policy will be utilized:

The final grade will be based on the following distribution:

Exams 50% (Honor Lock Proctoring)
Midterm: 20% (Honor Lock Proctoring)
Final Exam: 30% (Honor Lock Proctoring)