Course Acronym:	RTEC
Course Number:	244
Descriptive Title:	Radiation Physics, Equipment, and Safety
Division:	Health Sciences and Athletics
Department:	Radiologic Technology
Course Disciplines:	Radiologic Technology
Catalog Description:	This course continues with the study of radiation and radiological physics. Additional subjects covered are: the operation of medical x-ray and fluoroscopy units, the effects of radiation in humans, and the principles of radiation protection as applied in medical radiography. An introduction to health physics instrumentation, and radiation control regulations, with an emphasis on radiation health and safety will be discussed along with the principles of digital imaging.
Prerequisite:	Radiologic Technology 124 with a minimum grade of C
Co-requisite:	Radiologic Technology 217 AND Radiologic Technology 233
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	4
Hours Laboratory (per week):	0
Outside Study Hours:	8
Total Course Hours:	72
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	3/15/1999
Transfer UC:	
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	

Student Learning Outcomes:	**SLO #1 Comparing Techniques for Imaging Systems** The student will formulate radiographic techniques and compare exposure differences for 3 radiographic examination (Ex: chest, lumbar spine and knee), using digital and film screen imaging systems. **SLO #2 Patient Dose and Techniques** The student will calculate the radiation exposure levels to the patient for 3 types of imaging systems (film screen, DR and CR) and compare and contrast the relationship of the imaging systems to patient dose. **SLO #3 Biologic Effect of Radiation Exposure** Students will describe the acceptable radiation dose limits for patients and radiation workers, and then analyze the biologic effects to humans that receive an overexposure.
Course Objectives:	1. Analyze the biological effects of on humans. 2. Differentiate between somatic and genetic, direct and indirect radiation effects. Explore the relationship between radiation dose levels and the degree of biologic response to the specific radiation induced disease. 3. Compare how the practice of safe radiation protection measures to both patients and personnel can reduce the levels of radiation exposure during the use of radiographic and fluoroscopic equipment. 4. Calculate the allowable dose limits (DL) for radiation workers, and compare the results to the actual readings listed on the dosimetry reports. Analyze how the principles of radiation protection can affect the occupational exposures received. 5. Analyze laboratory experiments measuring x-ray output compared to the dose received by the patient and operator. Describe how using the fundamentals of radiation protection including time, distance, shielding (primary and secondary) and the inverse square law, can reduce the exposures received. 6. Perform experiments at the clinical sites to demonstrate methods to reduce radiation exposure and dose to patients and personnel using radiographic phantoms for fluoroscopy exams. 7. Identify the radiation protection and shielding requirements for radiographic, mobile and fluoroscopic procedures. 8. Label parts of x-ray, fluoroscopy, and digital imaging equipment, describe and demonstrate the functions of each part, including image recording equipment. 9. Describe fluoroscopic principles of operation relative to components, image quality, radiation safety procedures, and regulatory provisions for stationary and mobile c-arm units. Diagram the basic components of an image intensifier tube and fluoroscopic imaging chain. 10. Perform and assess quality control testing and evaluations for regulatory compliance with radiologic and fluoroscopic equipment. 11. Identify anatomy; explain the physiology and function of the eye. Relate the typical radiation exposures received by the early radiologists to the onset of cataracts. 12. Formulate the correct technical factor changes needed when using different grids, changes in tube distance and patient pathology. Compare the differences in technique with digital image receptor response and computed radiography. 13. Compare and contrast computed radiography, digital radiography and film/screen radiography for image capture, dynamic range versus latitude, image artifacts and patient dose.

	14. Explore digital imaging post-processing for raw data image acquisition and errors affecting image quality. Review fundamentals that affect exposure index, detector quantum efficiency (DQE) and monitor viewing conditions. 15. Differentiate between the basic principles of electricity, magnetism, and electromagnetism. Recognize the principles in the operation of x-ray generators and motors. 16. Identify the general components and functions for x-ray circuitry including an analysis of x-ray generators to radiation production, efficiency and patient dose. 17. Calculate heat units for various types of generators, utilize anode cooling charts and tube rating charts and formulate safe exposures to protect and extend tube life. 18. Evaluate and critique radiographic images and formulate methods for improving image quality, while reducing patient dose. 19. Interpret the specific sections of California regulation control (Title 17) which govern basic radiologic and fluoroscopic standards and safety.
Major Topics:	**I. Fluoroscopy (28 hours, lecture)** A. State regulations for operation, maintenance, and quality control B. Radiation safety for the patient and the operator C. Image modalities and equipment D. Fluoroscopy equipment E. Image intensifiers F. Mobile c-arms G. Principles of automatic exposure operations and image recording devices H. Exposure control and regulations I. Anatomy and Physiology of the eye J. Television cameras and closed circuit systems and image viewing devices **II. Protection and Radiation Biology (8 hours, lecture)** A. Classification and measurement B. Properties and Biologic effects C. Monitors and records D. Radiobiology E. Interaction of radiation and matter F. Ionization of matter G. Side effects of radiation exposure H. Cell life cycle I. Cell sensitivities to ionization J. Other biological effects of radiation K. Anatomy and physiology of the eye **III. Title 17 and State Radiation Syllabus (8 hours, lecture)** A. State of California radiation control regulations B. Shielding and radiation safety C. Dose limits (DL) and exposure reports D. Surveys and radiation monitoring E. Radiation dose calculations **IV. Principles of digital imaging (16 hours, lecture)** A. Capturing devices/receptors B. Direct versus indirect capture C. Photostimulable phosphor (PSP) plates D. Thin film transition (TFT) arrays E. Advantages and disadvantages of digital imaging and film/screen systems F. Resolution and patient doses G. Exposure index "s" numbers

	H. Image contrast and resolution I. Histograms and algorithms J. Thin film transition (TFT) arrays K. Look up table (LUT's) gray scale L. Window leveling and width M. Image processing, DQE N. PACS and teleradiography **V. Electromagnetism (1 hour, lecture)** A. Generators and Motors B. Electricity and Electrostatics C. Electrodynamics D. Electromotive force E. Resistance and power **VI. Equipment (1 hour, lecture)** A. Transformers 1. Coils and rectification B. X-ray tubes: 1. History 2. Construction 3. Principles **VII. X-ray Circuit (2 hours, lecture)** A. Primary B. Secondary C. Filament D. Control panel E. Meters F. Timers G. Remote controls **VIII. Quality Control Testing (4 hours, lecture)** A. Quality assurance and maintenance 1. Radiography 2. Fluoroscopy 3. Digital imaging equipment **IX. Image Analysis and Critique (4 hours, lecture)** A. Image receptors 1. Film/screen 2. Digital B. Artifacts and Errors 1. Grids 2. Processing 3. Digital
Total Lecture Hours:	72
Total Laboratory Hours:	0
Total Hours:	72
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	In small groups, research the effects of a specific level of radiation dose exposure to human tissue and describe the biological damage that may occur. Compare your results with the other groups. Create a graph, plotting the relationship of radiation dose to biologic damage.

Critical Thinking Assignment 1:	Analyze the technique factors used to create a radiographic image of the AP lumbar spine with both the digital and Computed Radiography equipment. Write a one- to two-paragraph summary, comparing the differences in patient dose, benefits and potential hazards of both types of imaging systems.
Critical Thinking Assignment 2:	Evaluate radiographic images for artifacts that affect the image quality. Compare the difference and similarities of the causes of the artifacts in both imaging systems. Prepare a short oral report identifying your findings to the class.
Other Evaluation Methods:	Completion, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Presentation, Quizzes, True/False, Written Homework
Instructional Methods:	Demonstration, Group Activities, Lecture, Multimedia presentations
If other:	
Work Outside of Class:	Answer questions, Observation of or participation in an activity related to course content (such as theatre event, museum, concert, debate, meeting), Problem solving activity, Skill practice, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	Laboratory Work - Perform 15 hours of outside laboratory experiments under direct supervison at the clinical sites to demonstrate; methods to reduce radiation exposure to the patients and personnel. Create and record images of radiographic phantoms. Conduct and analyze quality control testing of fluoroscopic and digital equipment and discuss results.
Up-To-Date Representative Texts:	**Principles of Radiographic Imaging**, by Carlton 6th ed & Carlton's Workbook 2019 ***Radiation Protection In Medical Radiography*** 8th ed. by Statkiewicz et al 2022 ***Digital Imaging & Pacs*** by Carter & Vealé, 2023 4th Edition
Alternative Texts:	*Radiologic Science for Technologists*, by Bushong, 12th ed. 2021 *Workbook for Radiologic Science for Technologists*, by Bushong, 12th ed. 2021 State of California, Radiation Health Branch – Title 17 (on-line)
Required Supplementary Readings:	
Other Required Materials:	
Requisite:	Prerequisite
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	**Prerequisite:** Radiologic Technology-124 **Corequisite**: Radiologic Technology-217 AND Radiologic Technology-233
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Ability analyze radiographic images, formulate and adjust radiographic exposure techniques that will apply to both film/screen and digital systems for a variety of radiographic examinations**. RTEC 124 - Demonstrate the use of accessories, protective devices, and technical competence to perform diagnostic imaging procedures and meet acceptable patient care standards. RTEC 124 - Evaluate and analyze radiographic images. **Knowledge of radiation safety principles for protection of the patient and personnel.** RTEC 124 - Demonstrate the proper use of radiographic equipment and safely perform radiographic procedures while applying radiation safety principles and shielding while using the energized laboratory and radiographic phantoms.

	Ability analyze radiographic images, formulate and adjust radiographic exposure techniques that will apply to both film/screen and digital systems for a variety of radiographic examinations. RTEC 217 - Critique images for appropriate clinical information, patient positioning and recorded detail. Apply appropriate corrective action when applicable to produce a diagnostic quality image. **Ability analyze radiographic images, formulate and adjust radiographic exposure techniques that will apply to both film/screen and digital systems for a variety of radiographic examinations.** RTEC 233 - Differentiate between the types of contrast media used for specialized radiographic procedures of the cranium and central nervous systems.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Don Visintainer
Date:	04/01/1971
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Dawn Charman
Date:	02/14/2024
Last Board Approval Date:	05/20/2024
Effective Term:	FALL 2025