



## **Radiographic Imaging Equipment (RADR 2309)**

**Credit:** 3 semester credit hours (3 hours lecture)

**Prerequisite:** RADR 1313 Principles of Radiographic Imaging I

**Course Description:** Equipment and physics of x-ray production. Includes basic x-ray circuits. Also examines the relationship of conventional and digital equipment components to the imaging process.

### **Textbook And Materials:**

- Bushong, Stewart C. *Radiologic Science for Technologists*, 10<sup>th</sup> edition, ISBN: 978-0-323-08135-1, Elsevier, Mosby Publishing 2013.
- Carlton, Richard. *Principles of Radiographic Imaging, An Art and Science*, 5<sup>th</sup> edition, Delmar Publishing, ISBN: 978-1-4390-5872-5
- #882 Scan-Trons and pencils

### **Course Objectives:**

By the end of the semester of instruction the student will be able to:

1. Compare and contrast conventional and digital equipment.
2. Explain the physics of x-ray production.
3. Describe basic x-ray circuits.
4. Relate conventional and digital equipment components to the imaging process.

### **Course Outline:**

**At the completion of each chapter the student should be able to...**

#### **I. Ch. 1 Essential Concepts of Radiologic Science**

- A. Describe the characteristics of matter and energy
  1. Mass/weight
  2. Building blocks
- B. Identify various forms of energy
  1. Potential
  2. Kinetic
  3. Thermal
  4. Nuclear
- C. Define electromagnetic radiation and ionizing radiation
- D. Discuss the two main categories of radiation
  1. Natural environmental
  2. Man-made

- E. Discuss the origin of scientific systems of measurement
- F. List the three systems of measurement
  - 1. Mass
  - 2. Length
  - 3. Time
- G. Identify the nine categories of mechanics
  - 1. Velocity and acceleration
  - 2. Force
  - 3. Weight and momentum
  - 4. Work and power
  - 5. Kinetic energy and potential energy
- H. Calculate problems using fractions, decimals, exponents and algebraic equations
- I. Identify scientific notation and associated prefixes
- J. List and define units of radiation and radioactivity
  - 1. Roentgen(R)
  - 2. rad
  - 3. rem
  - 4. Curie(Ci)

## **II. Ch. 2 Structure of Matter**

- A. Identify the structure of the atom
  - 1. Proton
  - 2. Neutron
  - 3. Electron
- B. Describe electron shells and instability within atomic structure
  - 1. Electron arrangement
  - 2. Ionization
- C. Discuss radioactivity and the characteristics of alpha and beta particles
- D. Explain the difference between particulate and electromagnetic radiation
  - 1. Alpha and beta particles
  - 2. X-ray and gamma rays (photons)

## **III. Ch. 3 Electromagnetic Energy**

- A. Identify the properties of photons
  - 1. Frequency and wavelength
  - 2. Velocity and amplitude
- B. Explain the inverse square law
- C. Define frequency, wavelength and velocity
- D. Discuss the relationship between wavelength, frequency and velocity
  - 1. Wave equation
  - 2. Electromagnetic wave equation
- E. Describe the electromagnetic spectrum
  - 1. Light
  - 2. Radiofrequency
  - 3. Ionizing radiation

## **IV. Ch. 4 Electricity, Magnetism and Electromagnetism**

- A. Define electrification and give examples
  - 1.Contact
  - 2.Friction
  - 3.Induction
- B. List the laws of electrostatics
  - 1.Electrostatic force
  - 2.Like Charges
  - 3.Conductors
  - 4.Surface shape
  - 5.Negative charges
- C. Identify units of electric current, electric potential and electric power
- D. Describe electric circuits
  - 1.Series
  - 2.Parallel
  - 3.Symbols
- E. Identify the interactions between matter and magnetic fields
- F. Discuss the laws of magnetism
  - 1.Like poles repel opposites attract
  - 2.Two poles
  - 3.Force of Attraction/Repulsion
- G. Identify the laws of electromagnetic induction
  - 1.Solenoid
  - 2.Electromagnet
  - 3.Faraday's Law

**V. Ch. 5 The X-ray Imaging System**

- A. Identify the components of the operating console
  - 1.Timers
  - 2.mAs selectors
  - 3.kVp selectors
  - 4.AEC
- B. Explain the operation of the high voltage generator including filament transformers and rectifiers
  - 1.Autotransformers
  - 2.Rectification
- C. Differentiate between single-phase, three-phase and high frequency power
- D. Identify the voltage ripple in various high voltage generators
- E. Discuss the importance of voltage ripple to x-ray quantity and quality
- F. Define the power rating of an imaging system
  - 1.Single phase
  - 2.Three phase/High frequency

**VI. Ch. 6 The X-ray Tube**

- A. Describe the general design of an x-ray tube
- B. List the external components that house and protect the x-ray tube
  - 1.Ceiling support
  - 2.Floor to ceiling support

3.C-arm support

4.Housing

5.Enclosure

C. Discuss the cathode and filament currents

1.Focusing cup

2.Thermionic emission

D. Describe the parts of the anode and the induction motor

1.Target

2.Stator

3.Rotor

4.Electromagnetic induction

E. Define the line focus principle and the heel effect

F. Identify three causes of x-ray tube failure

1.Electron arcing/filament burn out

2.Failure to warm up tube

3.High temp due to over exposure

G. Explain and interpret x-ray tube rating charts

## **VII. Ch. 7 X-ray Production**

A. Discuss the interactions between electrons and the anode

B. Identify characteristic and bremsstrahlung x-rays

C. Describe the x-ray emission spectrum

1.Discrete

2.Continuous

D. Explain how mAs, kVp, added filtration, target material and voltage ripple affect the x-ray emission spectrum

1.mAs

2.kVp

3.Filtration

4.Anode

5.Voltage ripple

## **VIII. Ch. 8 X-ray Emission**

A. Define radiation quantity and its relation to x-ray intensity

B. List and discuss factors that affect the intensity of the x-ray beam

1.mAs formula

2.kVp formula

3.Distance formula

C. Explain x-ray quality and penetrability

1.Penetrability

2.HVL

D. List and discuss the factors that affect the quality of the x-ray beam

1.kVp

2.Inherent

3.Added

## **IX. Ch. 15 Computed Radiography**

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- A. Describe several advantages of computed radiography over film screen radiography
  - 1. Time
  - 2. Image quality
  - 3. Lower patient dose
- B. Discuss the differences between conventional imaging equipment and digital imaging equipment
  - 1. Image plate
  - 2. Plate readers
  - 3. Image characteristics
- C. Compare and contrast processing in conventional and digital imaging
- D. Explain the operating characteristics of a computed radiography reader
  - 1. Mechanics
  - 2. Optics
  - 3. Computer Control

**Grade Scale:**

A=93-100  
B=84-92  
C=77-83  
D=60-76  
F=0-59

**Course Evaluation:**

Grades will be determined in the following manner:

Major Exams (3)	60% (20%)
Comprehensive Final	20%
Homework and Quizzes	20%

\* STUDENTS MUST HAVE A 77 OR ABOVE AVERAGE TO PASS THIS COURSE!

**Course Requirements:**

- 1. There will be three (3) major tests
- 2. The final exam will be comprehensive
- 3. Quizzes will be utilized in this course. If a student misses a quiz it **may not** be made up. Quiz grades will be averaged for one (1) test grade. Students will be allowed to drop their **lowest** quiz grade at the end of the semester. If more than one quiz is missed a zero (0) will be given.

**Course Policies:**

- 1. No food, drinks, or use of tobacco products in class.
- 2. Beepers, telephones, headphones, and any other electronic devices must be turned off while in class.

3. Do not bring children to class.
4. Recording devices may be used except during test reviews and when otherwise stated by the instructor.
5. Lap top computers, I-pad... may be used to take notes during class but may not be used to “surf” the internet, look-up answers, nor anything not directly related to note taking.
6. **ATTENDANCE POLICY:**

Each student is responsible for attending every class session. When it becomes necessary to miss a session, it is the responsibility of the **STUDENT** to contact the instructor and to inquire about assignments.

When the student has missed sufficient hours to cause a drop in grade points by missing class discussions, participation, quizzes, major test and or assignments, he/she will be notified in writing by the instructor concerning the possibility of failure in the course. The student should respond and meet the instructor for counseling.

If a major test is missed, the student must request a make-up examination from the instructor. This test will be administered at the first day the student returns to class or at a time designated by the instructor. There will be an automatic **10 point reduction** on the make-up exam.

### **Disabilities Statement:**

The Americans with Disabilities Act of 1992 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. Among other things, these statutes require that all students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodations for their disabilities. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409) 880-1737 or visit the office in Student Services, Cecil Beeson Building.

### **Course Schedule:**

<b><i>DATE</i></b>	<b><i>REQUIRED CHAPTER</i></b>	<b><i>REFERENCE</i></b>
Week1	Course Introduction & CH 1 Concepts of Radiologic Science	Ch. 2 Carlton
	CH 1 cont.	
Week2	CH 2 The Structure of Matter	
	CH 3 Electromagnetic Energy	
Week3	CH 3 cont.	
	Test Review	
Week4	<b><i>TEST I (CH 1 – 3)</i></b>	

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	Go over test	
Week5	CH 4 Electricity, Magnetism, & Electromagnetism	
	CH 4 Electricity	Ch. 3 Carlton
Week6	CH 4 Circuits	
	CH 4 Magnetism & Electromagnetism	Ch. 4 Carlton
Week7	CH 4 Generators	
	Test Review	
Week8	<b>TEST II (CH 4)</b>	
	Go over test	
	<b>SPRING BREAK</b>	
Week 9	CH 5 The X-Ray Imaging System	
	CH 5 cont.	Ch. 5 Carlton
Week9	CH 6 The X-Ray Tube	
	CH 6 cont.	Ch. 6 Carlton
Week10	CH 7 X-Ray Production	
	CH 7 cont.	Ch. 7 Carlton
Week11	CH 8 X-Ray Emission	
	<b>NO CLASS</b>	
Week12	Test Review	
	<b>TEST III (CH 5 – 8)</b>	
Week 13	Go over test	
	CH 32 (Carlton) Exposure Systems	
Week 14	CH 32 cont.	
	Review for Final	
Week 15	STUDY	
Week 16	<b>FINAL EXAM 10:00-11:30</b>	

**Contact Information:**

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**Office hours** Posted on office door each semester