



## **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:**

- A computer with internet access. The computer must be able to run current programs and platforms such as Windows 10 and the internet must be reliable and robust. The course has an online component and will move to a fully online format if necessary. The computer must have a camera and microphone for online conferencing.
- Bushong, Stewart C. *Radiologic Science for Technologists*, 12<sup>th</sup> edition, ISBN: 978-0-323-66134-8, Elsevier, Mosby Publishing 2021.
- Carlton, Richard. *Principles of Radiographic Imaging, An Art and Science*, 6<sup>th</sup> edition, Delmar Publishing, ISBN# 10: 1-337-71106-3
- #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. List and define units of radiation and radioactivity
  - 1. Roentgen(R)/Air Kerma
  - 2. Rad/Gray
  - 3. Rem/Sievert
  - 4. Curie(Ci)
- II. Ch. 2 Basic Physics Primer**
  - A. Discuss the origin of scientific systems of measurement
  - B. List the three systems of measurement
    - 1. Mass
    - 2. Length
    - 3. Time
  - C. 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
  - D. Calculate problems using fractions, decimals, exponents and algebraic equations
  - E. Identify scientific notation and associated prefixes
- III. Ch. 3 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)
- IV. Ch. 4 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
- V. Ch. 5 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

**VI. Ch. 6 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

**VII. Ch. 7 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.Filament vaporization
  - 2.Failure to warm up tube
  - 3.High temp due to over exposure
- G. Explain and interpret x-ray tube rating charts
- VIII. Ch. 8 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
  - 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 material
    - 5.Machine phase
- IX. Ch. 9 X-ray Emission**
  - A. Define radiation quantity and its relation to x-ray intensity
  - B. List and discuss factors that affect the intensity/quantity of the x-ray beam
    - 1.Inverse Square law
    - 2.Exposure Maintenance formula
    - 3.kVp formula
  - C. Explain x-ray quality and penetrability
    - 1.penetrability
    - 2.HVL
    - 3.filtration
- X. Ch. 11 Imaging Science**
  - A. Discuss history of computers
  - B. Discuss hardware devices
    - 1.Input devices
    - 2.Output devices
  - C. Discuss types of software
    - 1.System software
    - 2.Application software
  - D. Discuss computer usage in the radiology department
    - 1.DICOM

2.PACS

3.Teleradiology

E. Compare and contrast analog and digital radiography systems

F. Artificial Intelligence

1.Machine Learning

2.Deep learning

**XI. NON-MEDICAL USES OF X-RAY**

1. Discuss the use of x-ray in art
2. Discuss the use of x-ray in forensics
3. Describe historical uses of x-ray

**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 POLICIES:**

1. No food, drinks, or use of tobacco products in class.
2. Phones, headphones, and any other electronic devices must be turned off while in class.
3. Recording devices may be used except during test reviews and when otherwise stated by the instructor.
4. 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.
5. It shall be considered a breach of academic integrity (cheating) to use or possess on your body any of the following devices during any examination unless it is required for that examination and approved by the instructor: Cell phone, smart watch/watch phone, laptop, tablet, electronic communication devices (including optical), and earphones connected to or used as electronic communication devices.

- *This is a violation of the Radiologic Technology Student Handbook and will result in dismissal from the program.*

Students with special needs and/or medical emergencies or situations should communicate with their instructor regarding individual exceptions/provisions. It is the student’s responsibility to communicate such needs to the instructor.

6. Do not bring children to class.
7. BlackBoard will be utilized for all quiz/homework assignments. If a student misses an assignment **it may not** be made up. Quiz/homework 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. This is already configured in Black Board gradebook.
8. **Attendance Policy:** Class attendance is important to ensure that a student receives the knowledge and skills necessary to be successful in the Radiologic Technology program. Students are expected to be in class on time. If a student is tardy they may enter only if they do so quietly.

When it becomes necessary to miss a session, it is the responsibility of the *student* to contact the instructor and to inquire about assignments. I will *not* distribute the PowerPoints missed. The student must get the notes from a classmate. If a major test is missed, the test will be administered at the first day the student returns to class or at a time designated by the instructor. There will be a **ten (10) point** reduction for make-up exams.

9. Any student who fails to pass a Unit test will be required to attend mandatory tutorial. This may be done before or after class or at lunch break. The tutorial may be individual or in a group session.

### **Technical Requirements**

The latest technical requirements, including hardware, compatible browsers, operating systems, software, Java, etc. can be found online at:

[https://help.blackboard.com/Learn/Student/Getting\\_Started/Browser\\_Support/Browser\\_Checker](https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support/Browser_Checker)

A functional broadband internet connection, such as DSL, cable, or WiFi is necessary to maximize the use of the online technology and resources.

### **Disabilities Statement**

The Americans with Disability Act of 1990 and Section 504, Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. LIT provides reasonable accommodations as defined in the Rehabilitation Act of 1973, Section 504 and the American with Disability Act of 1990, to students with a diagnosed disability. The Special Populations Office is located in the Eagles' Nest Room 129 and helps foster a supportive and inclusive educational environment by maintaining partnerships with faculty and staff, as well as promoting awareness among all members of the Lamar Institute of Technology community. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409)839-2018. You may also visit the online resource at [Special Populations - Lamar Institute of Technology \(lit.edu\)](http://www.lit.edu/special-populations)

### **Student Code of Conduct Statement**

It is the responsibility of all registered Lamar Institute of Technology students to access, read, understand and abide by all published policies, regulations, and procedures listed in the *LIT Catalog and Student Handbook*. The *LIT Catalog and Student Handbook* may be accessed at [www.lit.edu](http://www.lit.edu) or obtained in print upon request at the Student Services Office. Please note that the

online version of the *LIT Catalog and Student Handbook* supersedes all other versions of the same document

### **Starfish**

LIT utilizes an early alert system called Starfish. Throughout the semester, you may receive emails from Starfish regarding your course grades, attendance, or academic performance. Faculty members record student attendance, raise flags and kudos to express concern or give praise, and you can make an appointment with faculty and staff all through the Starfish home page. You can also login to Blackboard or MyLIT and click on the Starfish link to view academic alerts and detailed information. It is the responsibility of the student to pay attention to these emails and information in Starfish and consider taking the recommended actions. Starfish is used to help you be a successful student at LIT.

<https://lit.edu/student-success/starfish>