



## Radiographic Imaging Equipment (RADR 2309 3A1)

**LAMAR INSTITUTE  
OF TECHNOLOGY**

### CREDIT

3 Semester Credit Hours (3 hours lecture, 0 hours lab)

### MODE OF INSTRUCTION

This course will be taught face-to-face using a multimedia format. Lectures, demonstrations, lab experiments and discussion will be utilized to enhance the cognitive learning process. Students will have outside reading and out of class homework assignments periodically in the semester. The student will be required to utilize both reading and listening skills.

### PREREQUISITE/CO-REQUISITE:

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.

### COURSE OBJECTIVES

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

1. Differentiate between 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.

### INSTRUCTOR CONTACT INFORMATION

Instructor: Brenda A. Barrow, M.Ed., R.T.

Email: [babarrow@lit.edu](mailto:babarrow@lit.edu)

Office Phone: 409-241-9829

Office Location: 232 Multipurpose Center

Office Hours: office hours posted outside door and in Starfish

### REQUIRED 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*, 13<sup>th</sup> edition, ISBN: 978-0-323-

76536-7, Elsevier, Mosby Publishing 2026.

- 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
- Clover Learning Student Plan - purchased previously in RADR 1313

## ATTENDANCE

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. The student is responsible for getting 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. **Ten points** deduction for make-up exams unless previously approved by the instructor for extenuating circumstance.

To encourage class attendance, students that miss two (2) or more class sessions in a unit will have a five (5) point reduction on that test. Students who are tardy four (4) times will equal one (1) absence.

## DROP POLICY

If you wish to drop a course, you are responsible for initiating and completing the drop process by the specified drop date as listed on the [Academic Calendar](#). If you stop coming to class and fail to drop the course, you will earn an "F" in the course.

## RADR 2309 Equipment - COURSE CALENDAR: Tues/Thurs 10:15 – 11:30 All dates are tentative

DATE	TOPIC/BUSHONG CH	REFERENCE CARLTON	ASSIGNMENTS (Due on this Date)
Jan 20	Course Intro. & CH 1 Concepts of Rad. Science		
Jan 22	CH. 2 Basic Physics primer	Ch 2	
Jan 27	CH 3 The Structure of Matter		
Jan 29	CH 4 Electromagnetic Energy		<a href="#">Unit I homework due</a>
Feb 3	Review		
<b>Feb 5</b>	<b>TEST I CH 1 – 4</b>		<b>TEST I CH 1 – 4/Ticket to test</b>
Feb 10	Go over test & CH 5 Electrostatics	Ch 3	
Feb 12	CH 5 Electrodynamics		
Feb 17	CH 5 Circuits, Magnetism & Electromagnetism	Ch 4	
Feb 19	CH 5 Generators, Motors & Transformers		<b>Remediation test 1 due</b>
Feb 24	CH 6 The X-Ray Imaging System	Ch 5	<a href="#">Unit II homework due</a>
Feb 26	CH 6 cont. & Review		
<b>Mar 3</b>	<b>TEST II CH 5 &amp; 6</b>		<b>TEST II CH 5 &amp; 6/Ticket to test</b>

Mar 5	Go over test		
<b>Mar 10&amp;12</b>	<b>SPRING BREAK</b>		
Mar 17	CH 7 The X-Ray Tube	Ch 6	
Mar 19	CH 7 cont.	Ch 36	
Mar 24	CH 8 X-Ray Production		Remediation test 2 due
Mar 26	CH 9 X-Ray Emission	Ch 8	
Mar 31	CH 27 Imaging Science (Computers)		
Apr 2	Exposure Systems & Review	CH 32	
Apr 7	RADR 2401 lecture – Trauma video		
<b>Apr 9</b>	<b>TEST III CH 7 – 9 &amp; 27</b>		<b>TEST III CH 7 – 9 &amp; 27 / Ticket to test</b>
<b>Apr 14</b>	Go over test & prep bowl review all classes		
Apr 16	No class -- RADR 2401 Comp Exam		Remediation test 3 due
<b>Apr 21</b>	<b>FINAL EXAM</b>		<b>FINAL EXAM</b>
<b>Apr 23</b>	<b>Surgery – G. Johnson</b>		
Apr 28	Go over test & Refresher RADR 1313 & 1411		
Apr 30	RADR 2401 lecture – Radiation Therapy		
<b>May 5</b>	<b>Pathology presentations</b>		

### COURSE EVALUATION

- There will be three (3) major tests
- The final exam will be comprehensive
- Blackboard will be utilized for some 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 Blackboard gradebook.
- There will be a **ten (10) point** reduction for make-up exams unless previously approved by the instructor for extenuating circumstance.

Final grades will be calculated according to the following criteria:

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

### GRADING SCALE

**A=93-100**

**B=84-92**

**C=77-83**

**D=60-76**

**F=0-59**

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

## **TECHNICAL REQUIREMENTS**

The latest technical requirements, including hardware, compatible browsers, operating systems, etc. can be online at <https://lit.edu/online-learning/online-learning-minimum-computer-requirements>. A functional broadband internet connection, such as DSL, cable, or WiFi is necessary to maximize the use of online technology and resources.

## **DISABILITIES STATEMENT**

The Americans with Disabilities Act of 1990 and Section 504 of the 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 Americans with Disabilities 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)-951-5708 or email [specialpopulations@lit.edu](mailto:specialpopulations@lit.edu). You may also visit the online resource at [Special Populations - Lamar Institute of Technology \(lit.edu\)](#).

## **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). Please note that the online version of the *LIT Catalog and Student Handbook* supersedes all other versions of the same document.

## **ARTIFICIAL INTELLIGENCE STATEMENT**

Lamar Institute of Technology (LIT) recognizes the recent advances in Artificial Intelligence (AI), such as ChatGPT, have changed the landscape of many career disciplines and will impact many students in and out of the classroom. To prepare students for their selected careers, LIT desires to guide students in the ethical use of these technologies and incorporate AI into classroom instruction and assignments appropriately. Appropriate use of these technologies is at the discretion of the instructor. Students are reminded that all submitted work must be their own original work unless otherwise specified. Students should contact their instructor with any questions as to the acceptable use of AI/ChatGPT in their courses

## **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.

#### **ADDITIONAL COURSE POLICIES/INFORMATION**

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. Late work for daily assignments is not accepted. The lowest assignment will be dropped.
8. 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. There will be remediation assignments in Clover Learning Student Plan. ***These must be successfully completed or the student will not be allowed to take the next unit exam.***

#### **STUDENT EXPECTED TIME REQUIREMENT**

For every hour in class (or unit of credit), students should expect to spend at least two to three hours per week studying and completing assignments. For a 3-credit-hour class, students should prepare to allocate approximately six to nine hours per week outside of class in a 16-week session OR approximately twelve to eighteen hours in an 8-week session. Online/Hybrid students should expect to spend at least as much time in this course as in the traditional, face-to-face class.

#### **ACADEMIC DISHONESTY**

Students found to be committing academic dishonesty (cheating, plagiarism, or collusion) may receive disciplinary action. Students need to familiarize themselves with the institution's

Academic Dishonesty Policy available in the Student Catalog & Handbook at  
<http://catalog.lit.edu/content.php?catoid=3&navoid=80#academic-dishonesty>.

## **COURSE OUTLINE:**

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

### **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. Human-made
- E. List and define units of radiation and radioactivity
  - 1. Air Kerma
  - 2. Gray
  - 3. 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 (15% Rule)

C. Explain x-ray quality and penetrability

1. penetrability
2. HVL
3. filtration

**X. Ch. 27 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

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