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:
- #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. 14 Computers in Medical Imaging
   A. Discuss hardware devices
      1. Input devices
      2. Output devices
   B. Discuss types of software
      1. System software
      2. Application software
   C. Discuss computer usage in the radiology department
      1. DICOM
      2. PACS
3. Teleradiology
   D. Compare and contrast analog and digital radiography systems

X. Ch. 32 Exposure Systems
   A. Fixed kVp systems
   B. Variable kVp systems
   C. Anatomically Programed Units

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. Laptop 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. **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.

**Technical Requirements (for courses using Blackboard)**

The latest technical requirements, including hardware, compatible browsers, operating systems, software, Java, etc. can be found online at: [https://help.blackboard.com/enus/Learn/9.1_2014_04/Student/015_Browser_Support/015_Browser_Support_Policy](https://help.blackboard.com/enus/Learn/9.1_2014_04/Student/015_Browser_Support/015_Browser_Support_Policy) 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 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. You may also visit the online resource at [http://www.lit.edu/depts/stuserv/special/defaults.aspx](http://www.lit.edu/depts/stuserv/special/defaults.aspx)

**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.