

Advanced Medical Imaging (RADR 2333)



Credit: 3 semester credit hours (2 lecture and 2 lab)

Pre-requisite: RADR 2401 Intermediate Radiographic Procedures

Course Description-An exploration of specialized imaging modalities.

The course defines and explains the concept of digital radiography. The course describes differences between analog and digital imaging with emphasis on technique considerations with regard to patient dose reduction. The course emphasizes the performance of radiologic exams that reflect those in imaging departments.

The course also describes specialized imaging modalities and includes concepts and theories of equipment operations, positioning and examination considerations, and their integration for medical diagnosis. The course also describes the various specialized imaging modalities and differentiates between images produced by different modalities and identifies the anatomy demonstrated.

Required Textbooks and Materials

- **Digital Radiography and PACS**, 3rd Ed., Carter and Veale
 - ISBN# 978-0-323-008644-8
- **Radiographic Positioning and Related Anatomy**, Bontrager, 9th Ed.
 - ISBN# 978-0-323-05410-2
- 882 Scantrons
- 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.
- **Blackboard will be utilized in this course for communication and access to material. Students should access Blackboard on a computer and not a cell phone. Not all information displays correctly in the Blackboard app or on the cell phone browser. Issues caused by using a cell phone for access will be the responsibility of the student. For example, if you take a quiz, and it does not work properly, the quiz will not be reset. You will receive the grade assigned.**

Reference

- **Radiography in the Digital Age**, Quinn B. Carroll
 - ISBN# 978-0-398-08119-5
- **Radiologic Science for Technologists**, 12th Ed., Bushong
 - ISBN# 978-0-323-08135-1
- **Principles of Radiographic Imaging**, 3rd Ed., Carlton and Adler
 - ISBN# 0-7668-1300-2

Course Objectives

Describe the various specialized imaging modalities; and differentiate between images produced by different modalities and identify the anatomy demonstrated.

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

1. Differentiate between analog and digital imaging.

2. Identify and discuss the components of computed radiography.
3. Identify and discuss the components of a direct radiography imaging system.
4. Differentiate among the various specialized imaging modalities and associated equipment.
5. Identify and compare anatomy as imaged by different specialty modalities.

Course Outline

Digital Imaging

1. Define image brightness.
2. Discuss analog vs. digital imaging.

Computed Radiography

1. Identify the components of image plates.
 - A. Phosphor layer
 - B. Base
 - C. Protective layer
2. Describe the read process.
 - A. Photostimulable luminescence (PSL)
 - B. Laser scanning
 - C. Erasure
3. Explain the relative speed of digital systems.

Direct Radiography

1. Define digital radiography.
 - A. Collection elements
 1. Photodiodes
 2. Charged-coupled devices (CCD's)
 3. Thin-film transistors
2. Discuss Direct Capture
 - A. Advantages
 - B. Disadvantages
 - C. Flat panel detectors
 - D. Pixel Pitch
 - E. Fill Factor
 - F. Detector Element
3. Discuss Indirect Capture
 - A. Advantages
 - B. Disadvantages

Digital Image Characteristics

1. Explain image matrix
2. Identify and discuss pixels
3. Explain the pixel size formula
4. Identify and discuss image sampling
5. Explain histograms
6. Discuss the concept of equalization

Spatial Resolution

1. Identify the controlling factors.
 - A. Matrix size

B. Pixel size

Contrast Resolution

1. Discuss dynamic range
 - A. Bit depth
 - B. Pixels

Windowing

1. Explain window level
2. Explain window width

Technique Selection

1. Define ALARA and relate to digital imaging
2. Discuss Kvp selection specific to digital imaging
3. Discuss Mas selection specific to digital imaging
4. Define dose creep
5. Define exposure creep

Exposure Index

1. Describe exposure index for computed radiography and direct radiography
2. Define underexposure and discuss corrections
3. Define overexposure and discuss corrections
4. Define normalization
5. Explain the concept of signal to noise ratio
6. Define dose area product

Viewing Monitors

1. Describe cathode ray tubes (CRT)
2. Describe active matrix liquid crystal display (AMLCD)
3. Describe plasma monitors
4. Discuss the photometric properties
5. Define lumen
6. Define luminance

Pre-processing Modes for the Digital Image

1. Explain flat fielding
2. Describe offset images
3. Describe gain images
4. Explain signal interpolation
5. Explain image lag
6. Describe look up tables (LUT)
7. Explain line noise
8. Describe dark noise.

Post Processing Options for the Digital Image

1. Explain image annotation
2. Explain image magnification
3. Explain image flip/image rotate/inversion
4. Explain digital subtraction (DSA)
5. Explain background shuttering
6. Explain pixel shift
7. Describe and explain the region of interest (ROI)
8. Describe image orientation

9. Describe image stitching
10. Describe edge enhancement

PACS

1. Define the components of image storage.
2. Define picture archiving and communication system (PACS)
3. Explain the system components and functions
4. Define the emergency contingency plan regarding archives
5. Define film digitizers
6. List and define network configurations
7. Define teleradiology

Quality Control and Quality Management

1. Describe quality management in digital imaging.
2. Equipment calibration
3. Plate reader QM
4. Image monitor QC
5. Define performance assessment standards in digital imaging.
 - A. SMPTE
 - B. AAPM TG18
6. Define the standards in image monitor evaluation.
7. Define and describe digital image artifacts.
 - A. Image receptor
 - B. Pixel malfunction
 - C. Ghost images
 - D. Moire effect/aliasing
 - E. Backscatter
 - F. Rough handling
 - G. Software
 - H. Dead pixels
 - I. Flatfielding
 - J. Image compression
 1. Lossless
 2. Lossy
 - K. Patient Considerations
 - L. Collimation
 - M. Fading
 - N. Heat
 - O. Banding
 - P. Overexposure

Grade Scale

93-100	.....	A
92-84	.....	B
83-77	.....	C
65 -76	.....	D
64 & below	.....	F

Course Evaluation

Grades will be determined from four (4) tests, lab attendance and assignments, quizzes, and a comprehensive final.

3 tests = 20% each
Lab assignments & quizzes= 15%
Comprehensive Exam= 25%

Course Requirements

1. There will be three major tests and a comprehensive exam.
2. Any student who fails to pass a major test will be required to attend mandatory tutorial. This session may be done before class, after class, or at lunch break. The tutorial may be individual or in a group session.
3. Homework, quizzes, and lab assignments will be averaged together for 15% of the grade.
4. Lab material will be tested during the lecture component. There will be assignments that will have to be completed and signed off on by an instructor for the student to pass the course. These will be graded on a pass/fail basis. Graded assignments will be part of the lab & quizzes grade. **The assignments will need to be completed before the comprehensive exam. Students not completing the assignments for lab will be given an incomplete in the course and will not progress in the radiology program.**

Course Policies

- **Attendance Policy:** Students missing over 3 class days will be dropped from the course and will not be permitted to continue in the program.
- Students who are 10 minutes or more late to lab will be counted absent and will be required to make up the lab assignment at a later time.
- Four tardies in class/lab will be counted as an absence.
- If a student wants to drop a course, the student is responsible for initiating and completing the drop process. If a student stops coming to class and fails to drop the course, the student will receive an 'F' in the course.
- Cell-phones, headphones and any other noisemakers must be turned off while in class. If one of these devices goes off during class you will be asked to leave the classroom. Do not bring children or pets to class. If you enter the classroom late, do not walk in front of the instructor or projector.
- Smart watches may not be worn during quizzes or tests.
- 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 else not directly related to note taking.
- **Missed Examinations:** Any student missing an examination will be allowed to make up the test with a 10 point reduction on their grade for that test.
- **Homework Policy:** Late homework will be accepted but will result in a reduction of 10 points for each class day it is late.

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 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 <https://www.lit.edu/student-success/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 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.

