RADT-2401: IMAGING SYSTEMS

Cuyahoga Community College

Viewing: RADT-2401 : Imaging Systems
Board of Trustees:
2016-05-26

Academic Term:
2016-08-29

Subject Code
RADT - Radiography

Course Number:
2401

Title:
Imaging Systems

Catalog Description:
Presentation of imaging systems and imaging modalities. Topics include conventional and digital fluoroscopy, image intensification, conventional tomography, computerized tomography, magnetic resonance imaging, mammography, bone densitometry, ultrasound, nuclear medicine, radiation therapy, digital imaging processing and cross-sectional anatomy.

Credit Hour(s):
2

Lecture Hour(s):
2

Requisites
Prerequisite and Corequisite
RADT-1351 Image Acquisition and Evaluation or concurrent enrollment; or departmental approval.

I. ACADEMIC CREDIT

Academic Credit According to the Ohio Department of Higher Education, one (1) semester hour of college credit will be awarded for each lecture hour. Students will be expected to work on out-of-class assignments on a regular basis which, over the length of the course, would normally average two hours of out-of-class study for each hour of formal class activity. For laboratory hours, one (1) credit shall be awarded for a minimum of three laboratory hours in a standard week for which little or no out-of-class study is required since three hours will be in the lab (i.e. Laboratory 03 hours). Whereas, one (1) credit shall be awarded for a minimum of two laboratory hours in a standard week, if supplemented by out-of-class assignments which would normally average one hour of out-of class study preparing for or following up the laboratory experience (i.e. Laboratory 02 hours). Credit is also awarded for other hours such as directed practice, practicum, cooperative work experience, and field experience. The number of hours required to receive credit is listed under Other Hours on the syllabus. The number of credit hours for lecture, lab and other hours are listed at the beginning of the syllabus. Make sure you can prioritize your time accordingly. Proper planning, prioritization and dedication will enhance your success in this course.

The standard expectation for an online course is that you will spend 3 hours per week for each credit hour.

II. ACCESSIBILITY STATEMENT

If you need any special course adaptations or accommodations because of a documented disability, please notify your instructor within a reasonable length of time, preferably the first week of the term with formal notice of that need (i.e. an official letter from the Student Accessibility Services (SAS) office). Accommodations will not be made retroactively.

For specific information pertaining to ADA accommodation, please contact your campus SAS office or visit online at http://www.tri-c.edu/accessprograms. Blackboard accessibility information is available athttp://access.blackboard.com.

Eastern (216) 987-2052 - Voice
Metropolitan (216) 987-4344 – Voice. (216) 987-4048 – TTY.
Western (216) 987-5079 – Voice. (216) 987-5117 – TTY.
II.  ATTENDANCE TRACKING

Regular class attendance is expected. Tri-C is required by law to verify the enrollment of students who participate in federal Title IV student aid programs and/or who receive educational benefits through other funding sources. Eligibility for federal student financial aid is based in part on enrollment status.

Students who do not attend classes for the entire term are required to withdraw from the course(s). Additionally, students who withdraw from a course or stop attending class without officially withdrawing may be required to return all or a portion of their financial aid based on the date of last attendance. Students who do not attend the full session are responsible for withdrawing from the course(s).

Tri-C is responsible for identifying students who have not attended a course before financial aid funds can be applied to students’ accounts.

Therefore, attendance is recorded in the following ways:

- For in-person and blended-learning courses, students are required to attend the course by the 15th day of the semester (or equivalent for terms shorter than five weeks) to be considered attending. Students who have not met all attendance requirements for in-person and blended courses, as described herein, within the first two weeks or equivalent, will be considered not attending.

- For online courses, students are required to login at least two times per week and submit one assignment per week for the first two weeks of the semester, or equivalent to the 15th day of the term. Students who have not met all attendance requirements for online courses, as described herein, within the first two weeks or equivalent, will be considered not attending.

At the conclusion of the first two weeks of a semester or equivalent, instructors report any registered students who have “Never Attended” a course. Those students will be administratively withdrawn from that course. However, after the time period in the previous paragraphs, if a student stops attending a class or wants or needs to withdraw, for any reason, it is the student’s responsibility to take action to withdraw from the course. Students must complete and submit the appropriate Tri-C form by the established withdrawal deadline.

Tri-C is required to ensure that students receive financial aid only for courses that they attend and complete. Students reported for not attending at least one of their registered courses will have all financial aid funds held until confirmation of attendance in registered courses has been verified. Students who fail to complete at least one course may be required to repay all or a portion of their federal financial aid funds and may be ineligible to receive future federal financial aid awards. Students who withdraw from classes prior to completing more than 60 percent of their enrolled class time may be subject to the required federal refund policy.

If illness or emergency should necessitate a brief absence from class, students should confer with instructors upon their return. Students having problems with coursework due to a prolonged absence should confer with the instructor or a counselor.

IV. LEARNING OUTCOMES ASSESSMENT

Occasionally, in addition to submitting assignments to their instructors for evaluation and a grade, students will also be asked to submit completed assignments, called ‘artifacts,’ for assessment of course and program outcomes and the College’s Essential Learning Outcomes (ELOs). The artifacts will be submitted in Blackboard or a similar technology. The level of mastery of the outcome demonstrated by the artifact DOES NOT affect the student’s grade or academic record in any way. However, some instructors require that students submit their artifact before receiving their final grade. Some artifacts will be randomly selected for assessment, which will help determine improvements and support needed to further student success. If you have any questions, please feel free to speak with your instructor or contact the Learning Outcomes Assessment office.

V. CONCEALED CARRY STATEMENT

College policy prohibits the possession of weapons on college property by students, faculty and staff, unless specifically approved in advance as a job-related requirement (i.e., Tri-C campus police officers) or, in accordance with Ohio law, secured in a parked vehicle in a designated parking area only by an individual in possession of a valid conceal carry permit.

As a Tri-C student, your behavior on campus must comply with the student code of conduct, which is available on page 29 within the Tri-C student handbook, available athttp://www.tri-c.edu/student-resources/documents/studenthandbook.pdfYou must also comply with the College's Zero Tolerance for Violence on College Property available athttp://www.tri-c.edu/policies-and-procedures/documents/3354-1-20-10-zero-tolerance-for-violence-policy.pdf

Outcomes

Course Outcome(s):

- Explain the principles and application of Conventional and Digital Fluoroscopy/Recording Systems.

Objective(s):

1. Differentiate fluoroscopic examinations from static diagnostic radiographic examinations.
2. Summarize the uses of dynamic and static fluoroscopic recording systems.
3. Explain the general purpose and functioning of image-intensified and digital fluoroscopy.
4. Explain the advantages of a digital fluoroscopy system and flat panel image receptors (FPIR).
5. Compute pixel size in digital fluoroscopy.
6. Calculate flux gain, minification gain and brightness gain as they relate to image intensification.
7. Identify basic anatomy and structures seen on fluoroscopic images.
8. Describe human vision anatomy and physiology and its significance to fluoroscopy.
9. Recognize appropriate approximate kVp and mA techniques for fluoroscopic examinations.
10. Identify reasoning for using contrast media.
11. Apply general radiation safety and protection practices associated with radiographic and fluoroscopic examinations.
12. Describe a typical basic fluoroscopic image chain.
13. Apply various methods of reducing radiation dose to the patient, radiographer and radiologist during fluoroscopic examinations.
14. Explain how the TV monitor can affect the spatial resolution and image display.
15. Identify the minimum source-to-tabletop distances for fixed and mobile fluoroscopic devices.
16. Describe different post-processing fluoroscopic techniques such as digital subtraction, masking and road mapping.
17. Explain the difference between the operation of a fluoroscopic and a diagnostic x-ray tube.
18. Describe the advantages of image intensified fluoroscopy over conventional fluoroscopy.
19. Analyze the functions of the image intensification tube including the input phosphor, photocathode, electrostatic focusing lenses anode and output phosphor.
20. Summarize the operation of a multifield magnification image intensification tube.
21. Explain the basic function of a fluoroscopic automatic brightness control (ABC) or automatic exposure control (AEC).
22. Discuss the factors that affect fluoroscopic image contrast, resolution, distortion, veiling glare and quantum mottle.
23. Indicate the function of Charged Coupling Devices (CCD), lens coupling, fiber optics, video camera, photospot and the TV monitor.

Course Outcome(s):
Explain the principles and application of Digital Imaging Processing.

Objective(s):
1. Describe the basic function of various memory storage, input and output devices.
2. Describe the process of digital image data acquisition.
3. State reasons why Fourier transformation and inverse Fourier transformation are used in digitization of imaging data.
4. Describe the effects of frequency, contrast and noise on digital image quality.
5. Explain the function of digital image window level and width controls.
6. Describe various factors that directly affect digital image resolution.
7. Explain the digital subtraction process and various filtering techniques.
8. Describe the photostimulable imaging process.
9. Describe a digital picture archiving and communication system (PACS).
10. Discuss the frequency of use of digital imaging in modern diagnostic imaging departments.
11. Evaluate the effect of a given exposure change on histogram shape data width and image appearance.
12. Describe conditions that cause quantum mottle in digital imaging.
13. Relate the research and development of digital imaging.
14. Explain the characteristics of digital images, specifically image matrix and dynamic range.
15. Discuss the components and use of a digital radiography system.
16. Explain the picture archiving, teleradiology and hospital information systems used in diagnostic imaging departments to include DICOM, PACS, RIS and HIS.

Course Outcome(s):
Explain the education and certification required for technologists to practice in Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Mammography, Bone Densitometry, Ultrasonography, Nuclear Medicine and Radiation Therapy.

Objective(s):
1. Explain the educational and certification requirements for all specialized imaging modalities and radiation therapy.

Course Outcome(s):
Identify anatomical planes and basic anatomy on cross-sectional images.

Objective(s):
1. Explain the advantages of a cross sectional image compared to a diagnostic two-dimensional image.
2. Identify the body regions and cavities.
3. Describe anatomy using proper directional terms.
4. Identify the imaging plane used on different CT, MR and ultrasonographic images.
5. Differentiate images produced by various modalities.
6. Identify major sectional anatomical structures found within the head/neck, thorax and abdomen.
7. Name and describe the function of select anatomical structures located in the head/neck, thorax and abdomen.
8. Locate select anatomical structures of the head/neck, thorax and abdomen on CT, MR and ultrasonographic images in the transverse axial, coronal, sagittal and orthogonal (oblique) cross-sectional imaging planes.
9. Name and describe the function of select anatomical structures located in the upper and lower extremities.
10. Locate select anatomical structures in the upper and lower extremities on CT and MR images in the transverse axial, coronal, sagittal and oblique planes.
Course Outcome(s):
Explain the principles and application of Conventional Tomography.

Objective(s):
1. Define tomography and the tomographic principle.
2. Describe the purpose of tomography.
3. Describe tomography-based terminology including tomographic arc, tomographic amplitude, section thickness, section interval, blur, exposure amplitude, fulcrum and blur edges.
4. Identify the relationships between tomographic arc, exposure amplitude, section thickness, contrast, density, fulcrum and blur.
5. Identify different tomographic phantom images and their possible causes.
6. Describe typical conventional tomographic exams.
7. Explain the equipment required to perform a tomogram.
8. Correlate changes in exposure amplitude with its effect on section thickness.
9. Identify a general tomographic technique.
10. Explain specialized tomographic techniques including panoramic tomography.
11. Recognize appropriate conventional tomography kVp and mA techniques.

Course Outcome(s):
Explain the principles and application of Computerized Tomography (CT).

Objective(s):
1. Name the individual who first demonstrated the process of CT.
2. Describe the components and functions of a CT imaging system.
3. List the CT computer data processing steps.
4. Identify the types and appearances of artifacts most commonly affecting CT images.
5. Explain the types and function of collimators in CT.
6. Describe the differences between conventional CT and helical (spiral) CT.
7. Analyze the changes seen between CT generations and state their advantages.
8. Explain CT system components and their functions including the gantry, table, computer and image detectors.
9. Define algorithm and explain its impact on scan factors and reconstruction.
10. Describe characteristics that detectors must have including stability, dynamic range and response time.
11. Define CT-based terminology including pixel, voxel, matrix, CT Hounsfield, window width (ww), window level (wl), spatial resolution, contrast resolution, noise, pitch, slip ring technology, region of interest (ROI), raw data, image data, linear attenuation coefficient, partial volume averaging and annotation.
12. Explain the difference between reconstructing and reformatting an image and define array processing used for image reconstruction.
13. Discuss detector configurations and functions.
14. Describe and explain the common controls on the CT operator console.
15. Discuss radiation protection principles for CT to include technical factor selection and adjustment, immobilization devices and dose measurement units (CTDI, MSAD and DLP).
16. Discuss image quality as it relates to spatial resolution, contrast resolution, system noise, linearity and spatial uniformity.
17. Describe the general purpose of commonly performed CT studies and the importance of patient preparation for the administration of contrast media and understanding of possible risk factors.
18. Explain how artifacts can be reduced or eliminated.
19. Discuss general radiation safety and protection practices associated with CT examinations.
20. Identify basic anatomy and structures seen on a CT image.
21. Explain how a CT scanner generates and displays images in different imaging planes.
22. Summarize CT image characteristics and CT numeric values.
23. Describe how typical CT mA and kVp techniques affect estimated patient dose measured in Computed Tomographic Dose Index (CTDI) and Multiple Scan Average Dose (MSAD).
24. Identify different CT grids and their effect on the image.
25. Explain the diagnostic advantages of CT over diagnostic radiography and summarize advantages and disadvantages of CT imaging.

Course Outcome(s):
Explain the principles and application of Magnetic Resonance Imaging (MRI).

Objective(s):
1. Describe the source of the magnetic fields within the body that are used during MRI.
2. Describe the properties of proton precession as used in MRI.
3. Describe how magnetic resonance imaging (MRI) is a complement to diagnostic radiography and its advantages over routine radiography.
4. Describe the use of radio frequency (RF) pulses in the various MRI pulse sequence.
5. Describe the components of an MRI unit, including the stationary magnet, gradient and Radio Frequency (RF) coils, table and computer consoles.
6. Explain how MRI image contrast is controlled.
7. Describe the use of paramagnetic contrast agents.
8. Summarize the history of the creation of MRI.
9. Discuss methods of reducing MRI image noise.
10. Discuss safety measures for protection of all persons who approach the MRI unit magnetic field.
11. Discuss patient safety while in the magnet.
12. Discuss the importance of patient screening for MRI.
13. Distinguish how MRI is a unique imaging modality.
14. Explain the process hydrogen takes when introduced to the magnetic field and the subsequent imaging fields.
15. Explain how an MRI unit's magnetic field strength is measured.
16. Define superconductor, solenoid, quenching and surface coils.
17. Explain the different types of MRI units including permanent, resistive and super conductive.
18. Distinguish between extrinsic and intrinsic parameters.
19. Explain how different types of MRI units are used to create different images and gray scales.
20. Explain the importance of patient and room shielding in MRI including the Faraday cage.

Course Outcome(s):
Explain of the principles and application of Mammography.

Objective(s):
1. Discuss the history of mammography.
2. Discuss appropriate patient contact techniques/skills relative to patient assessment and education.
3. List NCRP regulations concerning radiation exposure.
4. Identify anatomical structures of the breast.
5. Describe changes in breast tissue as they relate to hormones, pregnancy, lactation, and menopause.
6. Describe the staging process and treatment options for breast cancer.
7. Explain basic and special mammography positioning protocols.
8. Define medical terms associated with mammography and breast imaging position.
9. Summarize basic Mammography physics principles.
10. Discuss how automatic exposure control (AEC), compression, grids, object-to-image distance (OID), source-to-image distance (SID), and focal spot size relate to image quality for mammograms.
11. Contrast the difference between screening mammograms and diagnostic mammograms.
12. Explain the components and design characteristics of digital mammography units.
13. Justify how important quality assurance control tests are in mammography.
14. Summarize some of the FDA and OSHA regulations in regards to mammography.
15. Identify some of the risk factors for the development breast cancer.
16. Describe specialized mammography procedures such as biopsies, localization procedures utilizing ultrasonography, ductography, scintimammograph, and other stereotactic procedures.

Course Outcome(s):
Explain the principles and application of Bone Densitometry.

Objective(s):
1. Define osteoporosis.
2. Describe the basic components of a bone densitometry unit.
3. Demonstrate basic positioning protocols for bone density studies.
4. Describe how bone density is measured including T and Z scores.
5. Identify reasons for bone loss.
6. Differentiate between different bone densitometry units.

Course Outcome(s):
Explain the principles and application of Ultrasonography.

Objective(s):
1. Describe the basic concepts of ultrasonography.
2. Summarize the different procedures performed using ultrasonography.
3. Explain proper patient preparation techniques for different ultrasonographic exams.
4. Justify the advantages and disadvantages of ultrasonography compared to other imaging modalities.
5. Identify basic anatomy viewed on ultrasonographic images.
6. Describe the equipment used in ultrasonography including the transducer.
7. Define Doppler ultrasound.
8. Explain how attenuation affects ultrasonographic images.
9. Define the conservation of energy law and how it pertains to ultrasonography.
10. Discuss different sound wave parameters including frequency, period, wavelength and amplitude.
11. Describe how different sound wave variables including pressure, tissue density, particle vibrations and temperature affect the ultrasonographic image.
12. Define a longitudinal sine wave.
13. Identify the compression and rarefaction on an ultrasonographic wave.

Course Outcome(s):
Explain the principles and application of Nuclear Medicine.

Objective(s):
1. Explain the basic concepts of Nuclear Medicine.
2. Summarize the history of Nuclear Medicine.
3. Summarize the basic physics behind Positron Emission Tomography (PET).
4. Explain PET's significance to diagnostic radiography.
5. Explain radiation safety used in Nuclear Medicine as it relates to the patient, technologist and lab.
6. Distinguish the different types of imaging studies seen in Nuclear Medicine and their purpose.
7. Describe the relationship between radiopharmaceuticals, radioactive isotopes, half life and hot spots and how they affect imaging in Nuclear Medicine.
8. Compare different imaging techniques used in Nuclear Medicine including gamma cameras, CT, PET, SPECT and hybrid fusion studies.

Course Outcome(s):
Explain the principles and application of Radiation Therapy.

Objective(s):
1. Define radiation therapy.
2. Explain the uses of radiation therapy.
3. Identify the equipment used in radiation therapy.
4. Explain how radiation is administered for radiation therapy.
5. Describe the benefits of radiation therapy.
6. Describe the disadvantages and side effects of radiation therapy.
7. Summarize radiation safety techniques used in radiation therapy for the patient and therapist.
8. Explain the radiation therapy workflow and those who are involved in creating a radiation therapy treatment plan.
9. Define the unit of measurement that radiation therapy utilizes.
10. Explain proton therapy and Braggs peak.
11. Define simulation and why it is used in radiation therapy.
12. Differentiate between PET and SPECT imaging seen in radiation therapy.
13. Explain the difference between fusion imaging and structural imaging used in radiation therapy.

Methods of Evaluation:
1. Take-home assignments
2. Tests/quizzes
3. Midterm/final exam
4. Class presentations
5. Written reports
6. Computer laboratory assignment(s)
7. Online assessments or tools

Course Content Outline:
1. Fluoroscopy
   a. Conventional Fluoroscopy
      i. Origin
      ii. Equipment
      iii. Radiation safety concerns
      iv. Image intensified fluoroscopy
1. Image intensification
   a. Origin
   b. Development
   c. Equipment
   d. Multifield image intensification
   e. Uses in Radiography
   f. Radiation safety and measurements
      i. Techniques
2. Viewing Systems
   a. Film
   b. Optical mirror system
   c. Thermionic TV camera tube
   d. Video monitor
      i. Frames
      ii. Interlacing
      iii. 525 line system
   e. Cineradiographic camera
   f. Coupling
3. Recording systems
   a. Cassette-loaded spot film
   b. Photospot camera
   b. Digital Flouroscopy
      i. Digital imaging process in fluoroscopy
         1. Origin
         2. Development
         3. Equipment
         4. Image acquisition
         5. Uses in Fluoroscopy
         6. Radiation safety and measurement
      ii. Viewing systems
         1. Digital camera
         2. Digital monitor
            a. 1024 line system
            b. Spatial resolution
            c. Pixel size
         3. Cineradiographic camera
         4. Charged coupled device
         5. Flat Panel Image Receptor
         6. Digital Subtraction
            a. Mask mode
            b. Road mapping
            c. Subtraction
      iii. Recording systems
         1. Digital Image recording Systems
            a. ADC and DAC storage systems
         2. Digital Image Storage Systems
            a. Types of storage and review media
2. Conventional Tomography
   a. Origin
   b. Development
   c. Equipment
      i. Linear Tomography
      ii. Specialized techniques
         1. Panoramic
         2. Wide angle
         3. Zonography
   d. Tomographic principles
      i. Tomographic Arc
      ii. Exposure Amplitude
iii. Fulcrum
iv. Blur
v. Section thickness
vi. Section interval
e. Uses in radiography
f. Radiation safety and measurements
  i. Techniques

3. Computerized Tomography
   a. Origin
   b. Development
      i. Generations
   c. Equipment
      i. Table
      ii. Gantry
      iii. X-ray tube
      iv. Image detectors
      v. Operator console
      vi. Image storage
d. Uses in radiography
   i. Contrast
e. Radiation safety and measurements
   i. Techniques
   ii. Dose
f. Image creation
   i. Hounsfield units
   ii. Windowing
   iii. Leveling
   iv. Matrix
   v. Pixel vs Voxel
   vi. Artifacts
   vii. Recons
g. Basic computed tomography physics
h. Spiral computed tomography
   i. Slip ring technology
   i. Multi detector array computed tomography systems
   i. Development
   ii. Pitch
   iii. Volume imaging
   iv. Detector dose efficiency
   v. Grids
j. Digital Imaging Modality
   i. Recons
k. Current Trends
   i. Research
   ii. Health Concerns

4. Magnetic Resonance Imaging
   a. Origin
   b. Development
   c. Equipment
      i. Main magnet
      ii. RF subsystem
         1. Transmitter
         2. Receiver coils
      iii. Gradient Coils
      iv. Couch
      v. Operator console
      vi. Computer
      vii. Faraday cage
      viii. Shim system
d. Basic Magnetic Resonance Physics
   i. Hydrogen
   ii. Magnetic movement
   iii. Precession
   iv. B0 and B1 fields
   v. Resonance
   vi. Larmor frequency

e. Digital Imaging Modality
   i. See M. Digital Image Processing

f. 3 Plane Direct Imaging
   i. Cartesian Coordinates
   ii. Parameters
      1. Intrinsic
      2. Extrinsic
   iii. Sequences
   iv. Protocols
   v. Advantages provided by Magnetic Resonance Imaging

g. MRI Safety
   i. Patient
   ii. Public
   iii. Personnel

h. Current Trends
   i. Research
   ii. High field magnets
   iii. Health concerns

5. Mammography
   a. Origin
   b. Breast anatomy
   c. Breast Cancer
      i. Types
      ii. Statistics
      iii. Risks
      iv. Treatment options
   d. Development
   e. Equipment
      i. Digital equipment for Mammography
      ii. Digital storage systems for Mammography
      iii. Digital viewing systems for Mammography
         1. Image manipulation
         2. Exam enhancements for diagnosis
   f. Protocols
      i. Techniques
      ii. Positioning
      iii. Compression
      iv. Magnification
   g. Uses of Mammography in Radiology
      i. Current trends in Mammography
         1. Ultrasound
         2. Surgical alternatives
         3. Positioning techniques
   h. Radiation safety in Mammography
      i. FDA Guidelines
         1. BSE- Breast Self Exam
         2. CBE- Clinical Breast Exam
      ii. OSHA Guidelines

6. Bone Densitometry
   a. Origin
   b. Development
   c. equipment
i. DEXA
d. Image acquisition
   i. Hip
   ii. Lumbar Spine
   iii. Forearm
   iv. Heel
e. Bone anatomy
   i. Cortical bone
   ii. Trabecular bone
f. How used in Radiology
   i. World Health Organization
   ii. T Score
   iii. Z Score
   iv. Osteoporosis
      1. Risk factors
      2. Indicators
g. Radiation safety
   i. Dose to patient
   ii. Dose to personnel
7. Ultrasonography
   a. Origin
   b. Development
      i. History of ultrasonography
      ii. Accreditation
c. Equipment
   i. Transducers
   ii. Crystal
   iii. Computer system
   iv. Operator console
d. Image acquisition
   i. Sound waves
      1. Compression
      2. Rarefaction
      3. Variables
      4. Types
      5. Parameters
   ii. Law of conservation of energy
   iii. Attenuation
e. How used in Radiology
   i. Doppler ultrasound
   ii. Types of exams
   f. Ultrasonographic safety
8. Nuclear Medicine
   a. Origin
   b. Development
c. Equipment
   i. Gamma camera
      1. Hot spots
   ii. SPECT
   iii. PET
   iv. Hybrid scanners
d. Image acquisition
   i. Radiopharmaceuticals
      1. Tc-99m
      2. Half life
      3. Uptake
         a. Vehicles
      4. Nuclear decay
      5. Radioactive isotopes
         a. Positrons
e. How used in Radiology
   i. Common exams

f. Radiation safety
   i. Patient
   ii. Technician
   iii. Lab
      1. Radiation detectors

9. Radiation Therapy
   a. Origin
   b. Development
      i. Workflow
      ii. Prescription
      iii. Treatment plan
   c. Equipment
      i. Linear Accelerator
   d. Image acquisition
      i. Simulation
      ii. Image fusion
         1. PET
         2. SPECT
         3. CT
         4. MRI
      iii. Image Guided Radiation Therapy (IGRT)
         1. Side effects
      iv. Proton Therapy
         1. Braggs peak
   e. How used in Radiology
   f. Radiation safety

10. Digital Image Processing
   a. Origin
   b. Development
      i. History
      ii. Generations
      iii. Analog vs Digital
   c. Equipment
      i. Semiconductors
      ii. Transistors
      iii. Integrated circuits
      iv. Hardware
      v. Software
         1. Binary
         2. Compilers
         3. Applications
   d. Image acquisition
      i. CR
         1. Photostimilation
         2. Photomultiplier
         3. Analog to Digital converter
         4. H & D Curve
      ii. DR
         1. Flat panel detection
         2. Thin film transistors
         3. Matrix
   e. Utilization in Radiography
      i. Digital Modalities
         1. Diagnostic X-Ray
         2. CT
         3. MRI
         4. Mammography
         5. DEXA
6. US
7. NM
8. Radiation Therapy

ii. Digital Storage Systems
   1. DICOM
   2. PACS
   3. Archiving

iii. Digital Viewing Systems
   1. PACS
   2. Monitor
   3. Night hawking

iv. Digital Software
   1. Image Manipulation
      a. Windowing
      b. Leveling
   2. Exam enhancements to aid in diagnosis

11. Educational and Certification Requirements
   a. Computed tomography
   b. Magnetic resonance imaging
   c. Mammography
   d. Bone Densitometry
   e. Ultrasonography
   f. Nuclear Medicine
   g. Radiation Therapy

12. Cross-Sectional Anatomy
   a. Anatomy Nomenclature
      i. Terms of direction
      ii. Body planes
      iii. Body cavities
      iv. Body quadrants
      v. Body regions
   b. Cross-sectional anatomy of structures and their locations
      i. Head/Cranium
         1. Surface anatomy of the brain
         2. Sinuses
         3. Bones/Cranium
         4. Lobes of brain
         5. Head/face muscles
         6. Cranial nerves
         7. Brain stem
         8. Circle of Willis
         9. Veins
      ii. Thorax
         1. Neck/Chest
            a. Bones
            b. Respiratory organs
            c. Circulatory organs
            d. Vasculature
            e. Musculature
      iii. Abdomen
         1. Surface landmarks
         2. Main Arteries/Veins
         3. Bony structures
         4. Abdominal/GI organs
      iv. Pelvis
         1. Reproductive organs
         2. Bony structures
         3. Pelvic vasculature
      v. Musculoskeletal
1. Upper/Lower extremities
   a. Bony anatomy
   b. Muscles
   c. Tendons
   d. Ligaments
   e. Main Arteries/Veins
   f. Nerves
   g. Mediastinum

Resources


Resources Other
1. American Society of Radiologic Technologists Radiography Curriculum
   www.asrt.org (http://www.asrt.org)
2. American Registry of Radiologic Technologists Certification Handbook containing examination content
   specifications www.arrt.org (http://www.arrt.org)

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