COURSE SYLLABUS
RT 2442 – RADIOLOGY SEMINAR I

CLASS HOURS: 4  CREDIT HOURS: 4
LABORATORY HOURS: 2

CATALOG COURSE DESCRIPTION: This is the first of a two-course sequence in advanced radiographic science. The complete sequence presents an integrated coverage of radiation protection, equipment operation and maintenance, image production and evaluation, radiographic positioning and procedures, patient care and management, and quality assurance; focus is on the development of skills and knowledge necessary to exercise independence judgement and discretion in the technical performance of medical imaging procedures.

Topics covered in this course include but are not limited to:
1. Comprehensive review of anatomy, function and radiographic procedures of the cranium, face, orbits and eyes, temporal bones, sinuses, salivary glands and cranial foramina.
2. Comprehensive review of x-ray physics, x-ray production, imaging technology and analysis, and image processing and quality assurance.
3. Special emphasis on non-routine procedures in each exam category area and the modification of standard projections to better demonstrate pathology and accommodate patient’s condition.
4. Evaluation of the performance of radiologic systems to affect the best diagnostic results with the least cost and radiation exposure to the patient – special emphasis is placed on film processing analysis and quality assurance using sensitometry.

ENTRY LEVEL STANDARDS: A grade of “C” or better in all completed radiography courses is required for progression to this course. Having successfully completed one year of didactic and clinical course work, the student should demonstrate the skills and knowledge necessary to function with limited supervision in all routine areas of radiologic technology. In addition, the student should demonstrate a responsible attitude toward attendance, independent learning activities, class and laboratory participation, and course preparation.

PREREQUISITE AND / OR COREQUISITE: All previous course material scheduled in the radiography curriculum prior to the Fall Semester of the second year.

TEXTBOOKS(S) AND OTHER REFERENCE MATERIALS BASIC TO COURSE:
2. Radiographic Science for Technologists (Bushong), latest edition
3. An Analysis of Radiographic Quality (Donohue), latest edition

Required Student Learning Outcomes:
(PSLO 1-9 are covered in different courses. If a PSLO is not identified here it is not addressed in this course.)

PSLO #1 Provide basic patient care and comfort, well-being, safety, procedural materials appropriate to quality care and exam performance using proper sterile or aseptic technique to prevent contamination of patients, self, sterile trays, instruments or fields.
CSLO #1 Demonstrate knowledge of postioning, terminology and anatomy of the cranium and face.
CSLO#2 Given simulated situations, which apply to the following topics, identify or describe accepted professional practice:
   1. evaluation of radiographic orders
   2. room preparation
   3. condition of patient
4. patient care and management

PSLO#2 Apply the principles of x-ray production, x-ray interactions with the body, and the biological effect of exposure to ionizing radiations in the performance of medical imaging procedures to protect the patient, self and others.

CSLO#7 Given an explanation of the nature of our surroundings, demonstrate an understanding of the concepts of radiation.

CSLO#8 Identify the exposure factors which control the numbers of x-rays (quantity) reaching the imaging media and explain their influence; identify the exposure factors which control the penetration (quality) of the x-ray beam and explain their influence.

CSLO#16 Demonstrate knowledge of the following aspects of image intensification using intensifying screens:
   1. screen construction
   2. luminescence
   3. screen characteristics
      a. resolution
      b. speed
   4. screen-film combinations (spectral matching)
   5. screen care and cleaning
   6. fluoroscopic screens

CSLO#17 Identify the prime factors of radiography and describe their influence on the radiographic image.

CSLO#18 Given an explanation of the interaction of radiation with matter, demonstrate an understanding of how the interactions of x-ray with body structures contribute to the radiographic quality of an image.

PSLO#3 Apply knowledge of human anatomy, physiology, pathology, positioning and radiographic technique to demonstrate anatomical structures on a radiograph or other imaging receptor utilizing equipment and accessories while maintaining the overall diagnostic quality of radiographs.

CSLO #1 Demonstrate knowledge of positioning, terminology and anatomy of the cranium and face.

CSLO# 3 Following the criteria below, demonstrate knowledge of and perform radiographic positioning of the cranium, orbits, facial bones, paranasal sinuses, temporal bones, cranial foramina and the salivary glands.
   1. Part
      a. position of body
      b. structure(s) visualized and function(s) demonstrated
      c. pathology demonstrated
   2. Film size/placement/identification and R and L markers
   3. Technique formulation/selection
      a. mA
      b. time
      c. kVp
      d. FFD
      e. screen/film
   4. Beam, film, patient alignment and CR angulation
   5. Radiation protection and film quality – beam limitation/shielding
   6. Patient instructions
      a. respiration
      b. other

CSLO# 5 Given diagrams, anatomic structures or radiographs, identify and/or locate component parts.

CSLO#6 Locate anatomy from the standpoint of the topography of anatomy and explain the relationship of organs to each other.

PSLO#4 Apply quality assurance principles and perform quality control tests in order to maintain equipment and perform procedures with appropriate positioning and image quality.
CSLO#4 Critique radiographs to determine proper positioning, collimation, identification, R and L markers, image quality, evidence of radiation protection and structures shown for, basic projections of the head and facial structures. (I, II, III, VI)

CSLO#19 Recognize an image of radiographic quality as one that possesses sharpness and visibility of the recorded body structures.

PSLO#5 Process x-ray films according to established protocol for double or single emulsion film and operate imaging plate readers, technologist workstations and PACS systems.

CSLO#9 Understand radiographic and photographic terminology and be able to use the terms properly.

CSLO#10 Know the composition of x-ray film and describe the effects of light and radiation on the film formation of the latent image.

CSLO#11 Understand the importance of good darkroom procedure and proper darkroom construction.

CSLO#12 Describe the conversion of the latent image to the manifest (visible) image.

CSLO#13 Identify the film processing solution ingredients and describe their function and affect on image quality.

CSLO#14 Understand the need for standardization of film processing and explain the use of sensitometry as a mechanism to control or monitor film processing quality in an x-ray department.

PSLO#15 Demonstrate knowledge of the various systems of an automatic processor and describe the chemical and electrical safety precautions to be followed in the use of the processor.

A LIST OF SPECIFIC OBJECTIVES WHICH INCLUDE 1) SKILLS, 2) KNOWLEDGE, AND 3) ATTITUDES THAT THE STUDENT WILL OBTAIN OR BE ABLE TO PERFORM UPON COMPLETION OF THE COURSE.

The student will:

Anatomy of the Head and Face (A-F) – 80% Minimum Mastery Level Required
1. Name the two major divisions of the skeleton of the head and list/identify the bones which make up each division.
2. Define the following:
   a. suture
   b. diploe
   c. meningeal grooves
   d. sulci
   e. fontanel
   f. bregma
   g. lambda
   h. clivus
3. Describe a typical newborn cranium with respect to mineralization and areas of incomplete ossification.
4. Describe a typical first to third month after birth cranium.
5. Describe a typical second year after birth cranium.
6. Describe a typical adult cranium and discuss its characteristics comparing subject to subject and the atrophy of old age.
7. Describe an average (normal) cranium relative to width, length and depth.
8. With respect to the normal width-to-length measurement of the external cranium, describe the correction for internal deviation based on a one cm change in the 3 cm width-to-length measurement.
9. Given a description, diagram, anatomic model or radiograph of the cranium or face, identify and/or locate the following:

   CRANIUM (8 bones)
   a. frontal bone
      1) vertical portion (squama)
      2) horizontal portion
3) superciliary arches
4) glabella
5) nasion
6) frontal air sinuses

b. ethmoid
   1) horizontal plate (cribriform plate)
   2) crista galli
   3) vertical plate
   4) lateral masses
      a) ethmoidal air sinuses
      b) superior and middle nasal conchae

c. parietals
   1) parietal eminence
   2) bregma
   3) lambda

d. sphenoid
   1) body
      a) sphenoid sinus
   2) sella turcica
      a) tuberculum sellae
      b) dorsum sellae
      c) anterior and posterior clinoid processes
   3) optic groove
   4) small wings
      a) posteromedial portion of the roofs of the orbits
      b) posterior portion of anterior cranial fossa
      c) upper margin of superior orbital fissures
      d) anterior clinoid processes
      e) optic canals
      f) sphenoid strut
   5) great wings
      a) middle fossa of cranium
      b) posterolateral walls of orbits
      c) lower margin of superior orbital fissure
      d) posterior margins of inferior orbital fissure
      e) foramina rotundum
      f) foramina ovale
      g) foramina spinosum
      h) pterygoid processes

e. occipital
   1) squama
   2) internal/external occipital protuberance (inion)
   3) lateral portions
   4) foramen magnum
   5) occipital condyles
   6) jugular process (jugular foramen)
   7) hypoglossal canal
   8) basilar portion

f. temporals
   1) squamous portion
   2) zygomatic process
   3) tympanic portion
   4) styloid process
5) mastoid portion
6) petrous portion
   a) external ear and component parts
   b) middle ear and component parts
      i. malleus
      ii. incus
      iii. stapes
   c) inner ear
      i. labyrinth
      ii. vestibule
      iii. semicircular canals
      iv. cochlea
d) internal auditory canal

FACE (14 bones)
a. nasals (two)
b. lacrimals (two)
c. maxillae (two)
   1) maxillary sinus
   2) alveolar process
   3) canine fossa
   4) anterior nasal spine (acanthion)
d. zygoma/malar (two)
   1) part of side wall and floor of the orbits
   2) temporal process
e. palatines (two)
   1) posterior ¼ of the roof of the mouth
   2) part of nasal cavity
   3) small portion of the posteromedial part of the orbital cavities
f. interior nasal conchae (two)
g. vomer
h. mandible
   1) body
   2) rami
   3) mental protuberance
   4) alveolar process
   5) mental foramina
   6) coronoid
   7) condyloid process
   8) mandibular notch
   9) hyoid – not really a portion of the mandible

10. Associate the nasion as being the frontonasal suture.
11. Identify the following as being the paranasal sinuses:
   a. frontal
   b. ethmoid
   c. sphenoid
   d. maxillary
12. State the location of each paranasal sinus.
13. Identify the superior and middle nasal conchae or turbinates as being part of the lateral mass of the ethmoid bone.
14. Identify the arched ridges which correspond in position to the eyebrows.
15. Identify the sinuses which are not paranasal sinuses.
16. Identify the structure which is perforated by many foramina for the transmission of the olfactory nerves, which are the nerves of smell.
17. Identify the thickest, most dense bone in the cranium.
18. Identify the portion of the temporal bones which contain the organs of hearing.
19. Describe the development of the mastoid processes of the temporal bone.
20. Associate the crista galli as being a thick, conical process of the ethmoid bone.
21. Associate the pterygoid processes as being inferior basilar projections of the sphenoid bone.
22. Identify the aperture of the occipital bone which transmits the medulla oblongata.
23. Identify the depression on the superior surface of the body of the sphenoid bone which lodges a gland known as the pituitary body.
24. When given a description of the following structures, identify them:
   a. external ear
   b. middle ear
   c. internal ear
      1) malleus
      2) incus
      3) stapes
25. Match the following foramina, processes or fissures with the appropriate bone or bones which forms them:
   a. optic canal
   b. foramina rotundum
   c. foramina ovale
   d. foramina spinosum
   e. pterygoid processes
   f. crista galli
   g. internal auditory canal
   h. jugular foramina
   i. hypoglossal canals
   j. foramen magnum
   k. foramen lacerum
   l. cribriform plate/foramina
   m. anterior/posterior clinoid processes
   n. tuberculum sellae
   o. dorsum sellae
   p. superior orbital fissure
   q. inferior orbital fissure
   r. zygomatic processes

Skull Topography and Morphology (A-F) – 80% Minimum Mastery Level Required
1. Given a description, diagram, anatomic model or radiograph of the cranium or face, identify and/or locate the following points or regions of the cranium:
   a. glabella
   b. nasion
   c. mentum
   d. canthus (inner and outer)
   e. gonion
   f. vertex
   g. superciliary arches
   h. parietal eminence
   i. lambda
   j. bregma
   k. inion (internal and external)
   l. mastoid tip
   m. external auditory meatus (EAM)
   n. tragus
   o. infraorbital margin
2. Given a description, diagram, anatomic model or radiograph of the cranium or face, identify and/or locate the following positioning lines:
   a. glabellomalar line
   b. glabellomeatal line
   c. orbitomeatal line (Radiographic Base Line)
   d. infraorbitomeatal line (Reid’s Base Line or Anthropological Base Line)
   e. acanthiomeatal line
   f. interpupillary line
3. Define the following terms:
   a. sagittal plane
   b. coronal plane
   c. transverse plane
4. Explain the importance/significance of localization points, planes and lines to radiography of the skull.
5. Describe the morphology of the cranium expressed by the definitions of the following terms:
   a. brachycephalic
   b. mesocephalic
   c. dolichocephalic
6. Explain why the morphology of the cranium is described based on the relationship of the petrous ridges and the sagittal plane.

Radiography of the Skeleton of the Head – Routine Projections (B,C,D) – 80% Minimum Mastery Level Required

**Indicates Advanced Radiographic Projections

1. Explain the importance of correct body position to radiography of the cranium.
2. When doing a lateral projection of the cranium, describe the body adjustment which is necessary for:
   a. a hyposthenic patient
   b. a hypersthenic patient
3. When doing an AP projection of the cranium, describe the body adjustment necessary for a round-shouldered patient.
4. When doing a PA projection of the cranium, describe the body adjustment necessary for:
   a. hyposthenic patient
   b. hypersthenic patient
5. Be able to discuss or answer questions concerning the following positioning considerations for all projections demonstrating lateral cranial structures, anterior cranial structures, posterior cranial structures and basal cranial structures:
   a. part position (e.g. – AP, PA, lateral and submentovertex/verticosubmental)
   b. film size/placement/identification/markers
   c. beam angulation and alignment to part and film
   d. structure(s) visualized and function(s) demonstrated
   e. pathology demonstrated
   f. patient instructions
      1) respiration
      2) other
6. Identify the projections which would completely demonstrate every aspect of the general skeleton of the head – anterior, posterior, lateral and basilar.

** 7. Explain what is meant by a reverse duplicate; given examples of situations which may necessitate reverse duplicates; explain the importance of placing the structure as close to the film as possible; and, explain how one would be able to recognize a projection in which the part was NOT placed in contact with the film.
8. Give examples of cranial projections which, if small modifications such as more collimation or different centering are applied, may be used for the demonstration of more than one structure.
9. Evaluate a lateral, PA, AP or basilar projection of the cranium for positioning or procedural accuracy.
10. Explain the value of cross-table (horizontal ray) lateral projection of the skull relative to sphenoid sinus effusion.
11. Explain how a sphenoid sinus effusion may indicate a basal skull fracture.

12. For a lateral projection of the cranium, explain the importance/significance of the following:
   a. parallelism of sagittal plane and film
   b. head flexed to place the infraorbitomeatal line parallel with the transverse axis of the film
   c. interpupillary line perpendicular to the film plane

13. Given a diagram, anatomic model or radiograph of the cranium, identify and/or locate the following:
   a. lateral projection
      1) frontal bone
      2) parietal bones
      3) coronal suture
      4) lambdoidal suture
      5) squamous suture
      6) sella turcica (dorsum sellae/tuberculum sellae)
      7) posterior/anterior clinoid processes
      8) sphenoid sinus
      9) diploe
      10) TMJ and mandibular rami
      11) mastoid region of the temporal bone
      12) EAM (external auditory meatus)

   b. PA projection
      1) frontal bone
      2) parietal bones
      3) sagittal suture
      4) frontal and ethmoid sinuses
      5) crista galli
      6) petrous ridge
      7) orbital shadows

   c. AP projection
      1) parietal bones
      2) occipital bone
      3) foramen magnum
      4) petrous ridge (internal auditory canal)
      5) posterior clinoid processes/dorsum sellae
      6) lambdoidal suture

   d. basal projection
      1) maxillary
      2) ethmoid sinus
      3) mandible
      4) vomer
      5) sphenoid sinus
      6) clivus
      7) foramen spinosum
      8) foramen magnum
      9) foramen ovale
      10) petrous ridge (internal auditory canals)
      11) carotid canals
      12) sphenoid and occipital bones

14. Relative to the petrous ridge and orbits and other structures which may be better demonstrated, compare and contrast a PA projection of the cranium using:
   a. 15 degree caudal angulation of the beam
   b. a perpendicular beam (CR)
   c. a 20-25 degree caudal angulation
   d. a 25-30 degree caudal angulation
15. Identify a specific projection of the skull with the method of examination (proper name).
16. Identify the projection(s) or positioning method(s) which would demonstrate the following structures:
   a. internal auditory canals
   b. sella turcica
   c. foramen ovale
   d. foramen spinosum
   e. foramen lacerum
   f. carotid canals
   g. anterior, posterior, lateral and basal cranial structures
17. Differentiate the “Modified Caldwell” from the “True Caldwell” position.
 ** 18. Identify the following as being reverse duplicates:
   a. R lateral – L lateral
   b. AP-PA perpendicular CR
   c. AP, CR angle of 30-37 degrees caudal – PA, CR angle of an average 25 degrees cephalad (Haas method) or PA infraorbitomeatal line 50 degrees to film plane, CR perpendicular to film plane
   d. submentovertical-verticosubmental
   e. PA, CR angle 15 degrees caudal – AP, CR angle 15 degrees cephalad
19. Identify the projection in which the infraorbitomeatal line is always placed parallel to the film plane or the CR is angle to accomplish the parallelism.
20. For the Grashey method of posterior cranial demonstration, explain a 30 degree caudal angulation of the CR when the orbitomeatal line is used as opposed to a 37 degree caudal angulation of the CR when the infraorbitomeatal line is used.
21. Give the method of cranial evaluation which will demonstrate the dorsum sellae and posterior clinoid processes within or slightly above the shadow of the foramen magnum and the tuberculum sellae and anterior clinoid processes just below this point.
22. For all projections of the cranium, explain the significance/importance of the petrous aspect of the temporal bone and describe its influence on radiographic positioning of the cranium.

Cranium and Sella Turcica (continued) (A-F) – 80% Minimum Mastery Level Required
** Indicates advanced radiographic projections
**1. Be able to discuss or answer questions concerning the following positioning considerations:
   PA axial projection – Valdini method
   Lateral
   AP axial projection – Grashey method
   PA axial projection – Haas method
   PA projection – 10 degree cephalad
   a. part position (e.g. – AP, lateral or PA)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identifications/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respiration
      2) other
2. Given a diagram, anatomic model or radiograph, identify and/or locate the following structures:
   a. sella turcica
   b. tuberculum sellae
   c. dorsum sellae
   d. posterior/anterior clinoid processes
 ** 3. Describe the positive outcome of examining the dorsum sellae using the Valdini method.
**4. Explain the need for elevation of the thorax for the recumbent projection of the dorsum sellae using the Valdini method.**

**5. Describe the following structures relative to the Valdini method:**
   a. dorsum sellae
      1) IAC (internal auditory canals)
      2) labyrinths of the ears
   b. EAM (external auditory meatus)
      1) tympanic cavities
      2) bony portion of eustachian tubes

**6. Describe the adjustment in CR centering for Valdini method:**
   a. dorsum sellae demonstration
   b. petrosae

**7. Describe the evaluation criteria used to determine the accuracy of positioning when radiographing the sellae turcica or petrosae using the Valdini method.**
8. Compare and contrast a lateral projection of the head with a lateral projection of the sellae turcica.
9. Describe the evaluation criteria used to determine the accuracy of positioning when radiographing the sellae turcica in the lateral position.
10. Compare and contrast an AP axial projection (Grashey method) of the cranium with the same projection of the sellae turcica.

**11. Describe the change in the head position which must be made if one were to use a 30 degree angulation of the CR (AP axial projection) as opposed to a 37 degree angulation of the CR.**
12. Describe the evaluation criteria used to determine the accuracy of positioning when radiographing the sellae turcica using the AP axial projection (Grashey method).

**13. Describe the demonstration of the sellae turcica using the Haas method with that for the entire cranium using the same method.**
14. Describe the evaluation criteria used to determine the accuracy of positioning of the sellae turcica using the Haas method.

**15. Describe the demonstration of the sellae turcica when the PA projection with a 10 degree cephalad angulation is used.**
16. Describe the evaluation criteria used to determine the accuracy of positioning of the sellae turcica using the PA – 10 degree cephalad angulation projection.

Anatomy and Radiography of the Orbits (A-F) – 80% Minimum Mastery Level Required

**Indicates advanced radiographic projection**
1. Identify/list the bones which form the orbits.
2. Identify the structure which majorly forms the following:
   a. roof of the orbit
   b. floor of the orbit
   c. apex of the orbit
3. Describe the general location of the orbit relative to its long axis relationship to the midsagittal plane and the orbitomeatal line.
4. Describe the bones which form the following orbital clefts:
   a. superior orbital/sphenoidal fissure
   b. inferior orbital/sphenomaxillary fissure
6. Explain what clouding of the maxillary sinus following trauma to the eye may indicate.
7. Identify the most routine radiographic methods of demonstrating a blowout fracture of the orbit.
8. Identify the foramina which transmits the optic nerve and ophthalmic artery from the brain of the eye.
9. Identify the root of bone which forms the floor and part of the lateral wall of the optic canal.
10. Identify the BEST projection to demonstrate a blowout fracture of the orbit.

**11. Identify the radiographic technique or procedure used most often to demonstrate the extent of a blowout fracture of the orbit.**
12. Be able to discuss or answer questions concerning the following positioning considerations: projections for the bones of the orbit, optic foramina, superior orbital fissures and inferior orbital fissures
   a. part position (e.g. – parieto-orbital oblique and orbitoparietal oblique)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respirations
      2) mouth open
      3) phonation
      4) other

13. Identify from a list or list the projections which may be used to demonstrate the optic foramina.

14. When examining the optic foramina, give the reason for the rotation and extension of the head such that the sagittal plane forms a 53 degree angle with the plane of the film and the acanthomeatal line is perpendicular to the film plane.

15. For the Rhese, reverse Rhese or Alexander methods, describe the location of the optic canal relative to the whole orbit.

16. Give the positioning error which may be indicated by:
   a. a lateral deviation of the optic foramen from the outer quadrant
   b. longitudinal deviation of the optic foramen from the lower quadrant

17. Compare and contrast the routine Rhese method of optic foramina demonstration with that of an exact reverse Rhese.

18. Compare and contrast the reverse Rhese method of optic foramina demonstration with the Alexander method.

19. Differentiate the modified Lysholm method of the optic foramina demonstration with the other methods of demonstration of this structure.

20. Explain the importance/significance of the radiographic demonstration of the sphenoid strut.

21. Associate the sphenoid strut with the inferior root of the lesser wing of the sphenoid bone.

22. Associate the Hough method with the radiographic demonstration of the sphenoid strut.

23. Relative to demonstration of the superior orbital fissures and the petrosae, compare and contrast a modified Caldwell of the cranium with a PA axial projection of the superior orbital fissures.

24. Evaluate a PA axial projection of the orbits for positioning and procedural accuracy.

25. Compare and contrast the Haas method of cranial demonstration with the PA axial projection (Bertel method) of inferior orbital fissure demonstration.

26. Evaluate a PA axial projection (Bertel method) for positioning and procedural accuracy.

27. Given a diagram, anatomic model or radiograph, identify and/or locate the following structures/portions of the orbit:
   a. floor
   b. roof
   c. medial aspect
   d. lateral aspect
   e. optic foramen
   f. superior orbital fissure
   g. inferior orbital fissure

28. Describe the location of the superior orbital fissure when projected by the PA axial projection; describe the location of the inferior orbital fissure when projected by the PA axial 20-25 degree cephalad projection.
2. Identify the purpose of bone-free studies of the eye.

3. Outline the requirements for bone-free studies of the eye.

4. Identify radiographic projections which may be used to demonstrate foreign body(s) in the eye.

5. Given the following methods used for the radiologic examination of the eye, demonstrate knowledge of the principle of operation and value as an aid to localize foreign bodies of the eye:
   a. Vogt method (Historical significance)
   b. parallax motion method
   c. Sweet method (Historical significance)
   d. Pheiffer-Comberg method (Historical significance)
   e. Computed tomography

Dacryocystography – 75% Minimum Mastery Level Required

Features advanced radiographic projections

1. Define dacryocystography.

2. Identify the radiographic contrast medium used for examination of the nasolacrimal ducts.

3. Identify pathology which may be demonstrated by dacryocystography.

4. Give the standard radiographic projections used to demonstrate the nasolacrimal system.

Facial Bones (A-F) – 80% Minimum Mastery Level Required

Features advanced radiographic projections.

1. Be able to discuss or answer questions concerning the following positioning considerations (all bones of the face):
   a. part position (e.g.– parieto-orbital oblique and orbitoparietal oblique)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respiration
      2) mouth open
      3) phonation
      4) other

2. Name the most common projections done to survey the facial bones.

3. Compare and contrast the lateral projection of the facial bones with the lateral projection of the cranium.

4. Evaluate a lateral projection of the facial bones for positioning and procedural accuracy.

5. Describe the method which may be used to demonstrate the relation between the bony and soft tissue structures of the face with only one exposure.

6. Identify the overall best projection to demonstrate the bones of the face.

7. For a Waters projection, explain the importance/significance of a 37 degree placement of the orbitomeatal line with the plane of the film.

8. Associate the AP axial projection using a 30 degree cephalad angulation as being the reverse of the standard Waters method of facial bone demonstration.

9. State when the reverse Waters method would be indicated and explain the drawbacks of using this projection.

10. Identify the PA oblique projection of the facial bones as being similar to the Rhese method which is used to demonstrate optic foramina. Compare and contrast the two methods.

11. Given a diagram, anatomic model or radiograph of the facial bones, identify and/or locate specified structures.

12. Evaluate a lateral, parietoacanthial (Waters), AP axial and PA oblique for positioning or procedural accuracy.

13. Explain the diagnostic significance of the PA oblique axial projection of the face (Law method).

14. Explain the benefit of using a direct exposure for nasal bone demonstration in the lateral projection.
15. Explain the significance/importance of using intensifying screens to demonstrate the nasal bones in the lateral projection.
16. Explain the overall importance of a lateral projection of the nasal bones; of a superior-inferior projection of the nasal bones.
17. Describe the method used to demonstrate the zygomatic arches bilaterally.
18. Compare and contrast the submentovertical projection of the skull with the submentovertical projection of the zygomatic arches.
19. Describe the patient or patient injury which will negate the use of the submentovertical projection for zygomatic demonstration. Describe the other options which may be used to demonstrate the arches.
20. Identify the most common projections used for a survey of the zygomatic arches.
21. Compare and contrast the PA axial (superoinferior) projection (modified Titterington method) with a Waters method of zygomatic arch demonstration.
22. Identify the patient who is best examined using a slight oblique axial projection – tangential of the zygomatic arches.
23. Identify the zygomatic arch which will be demonstrated using the following:
   a. AP oblique axial (tangential)
   b. PA oblique axial (tangential – May method)
24. Compare and contrast the AP axial projection of the zygomatic arches with the Grashey-Towne methods of posterior cranial structure demonstration. (examples – film size and placement, collimation and CR)
25. For mandibular procedure, differentiate a PA/PA axial projection with the patient’s head rested on the nose and chin with the PA/PA axial projection with the patient’s head rested on the forehead and nose.
26. Relative to an intra-oral evaluation of the maxillae, compare the projection of the hard palate and dental arch to the projection of the anterior part of the hard palate.
27. Describe the projection which will demonstrate the posterior part of the hard palate and alveolar process.
28. Describe the intra-oral radiographic projection which demonstrates the mandibular body and dental arch.
29. Compare the intra-oral and extra-oral radiographic evaluation of the mandibular symphysis.
30. Describe a frontal projection which may be used when demonstration of the mandibular body is the main objective.
31. Describe a frontal projection which may be used when demonstration of the mandibular rami and temporomandibular joints are the main objective.
32. Describe how filling the mouth with air may be helpful in a PA axial projection of the mandible.
33. Describe a frontal projection which will provide a general survey of the mandible, particularly the rami. With the same positioning of the head, describe the adjustment which must be made to demonstrate the mandibular condyles.
34. Identify the projection which will demonstrate “best” any medial or lateral displacement of the fragments in fractures of mandibular rami.
35. Evaluate all frontal projections of the mandible for positioning and procedural accuracy.
36. Explain why the mentum of the mandible is not well visualized in frontal projections of the mandible.
37. State the main objectives of a PA/AP axiolateral projection of the mandible.
38. Describe the film/mandibular body relationship in both the AP/PA axiolateral projections of the mandible.
39. For an AP axiolateral projection of the mandible, describe the adjustment in positioning when:
   a. the posterior two-thirds of the mandibular body is the objective
   b. the anterior third of the mandibular body is the objective
   c. the mandibular ramus is the main objective
40. For a PA axiolateral projection of the mandible, describe the adjustment in positioning when:
   a. the body of the mandible from the angle to the region of the canine is the main objective
   b. the symphysis mentum is the main objective
   c. the mandibular ramus (except the condyle) and the angle and posterior part of the body of the mandible are the primary objectives.
41. For a verticosubmental or submentovertical projection of the mandible, describe the variation in structures demonstrated:
   a. when the CR is directed perpendicular to the occlusal plane
   b. when the CR is directed perpendicular to the infraorbitomeatal line
42. Evaluate all axiolateral and basal projections of the mandible for positioning and procedural accuracy.
43. Explain the significance/importance of making sure a patient is occluding the posterior rather than the anterior teeth during TMJ studies in the closed mouth position.
44. Explain the significance/importance of making sure for an open-mouth projection of the TMJ’s that the mandible does not jut forward.
45. Give a contraindication for an open-mouth maneuver of the mandible and give the reason for the contraindication.
46. Identify the radiologic procedure which may be indicated for examination of TMJ’s when a fracture or dislocation is suspected.
47. Compare and contrast an AP axial projection of the mandible with an AP axial projection (Grashey-Towne method) of the cranium or zygomatic arches.
48. Give the location of the TMJ relative to the EAM (External Auditory Meatus).
49. For radiographic demonstration of the TMJ’s in a lateral position, explain the need for a 25 or 30 degree caudad angulation of the central ray. Give the significance/importance of the sagittal plane being parallel to the film plane.
50. Explain the significance of examining the TMJ’s in both an open and closed mouth position and of examining both TMJ’s even if only one is affected.
51. State the primary objective of any projection designed for demonstration of the temporomandibular articulations.
52. Evaluate all radiographic projections of the TMJ’s for positioning or procedural accuracy.

** 53. Compare a lateral transcranial projection of the TMJ’s to an axial transcranial projection.

** 54. Compare an inferosuperior transfacial projection of the TMJ’s to an axial transcranial projection.

** 55. State the objective of the oblique transfacial projection (Zanelli method).

** 56. State the objective of panoramic tomography of the mandible and describe the procedure.

Anatomy and Radiography of the Paranasal Sinuses (A-F) – 80% Minimum Mastery Level Required

** Indicates advanced radiologic projections.

1. Explain the term paranasal when referring to the sinuses.
2. Explain why a limited paranasal sinus study is performed on infants.
3. Give the sinuses which are sufficiently well developed and aerated at birth.
4. Give the average age of full development of the paranasal sinuses.
5. In terms of a specific name for the paranasal sinuses, explain the reference to a particular bone.
6. Given a list of the paranasal sinuses correctly identify their drainage into the nasal cavity.
7. Associate the maxillary sinuses as being the antra of Highmore.
8. Relative to radiography of the paranasal sinuses, be able to discuss or answer questions concerning the following positioning considerations:
   a. part position (e.g. – Waters, PA, lateral and submentovertical projections)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respirations
      2) other
9. Given a diagram, anatomic model or radiograph, identify and/or locate the following structures and describe their relationship to each other and surrounding parts:
   a. frontal sinuses
   b. ethmoid sinuses
   c. sphenoid sinuses
   d. maxillary sinuses
10. In terms of proper density, give the criterion used to judge a properly exposed sinus radiograph.
11. For projections of the sinuses, explain the problem of overexposure, under-penetration and too much contrast.
12. Explain the significance/importance of erect positioning when the sinuses are radiographed.
13. Explain the need to position the patient for the demonstration of a particular paranasal sinus and waiting several minutes before the exposure is made.
14. Give the standard projection(s) which adequately demonstrate all of the paranasal sinuses and describe the radiographic value of each.

** 15. From the following projections, identify the projection(s) which best demonstrate(s) particular paranasal sinus group(s):
   a. Caldwell
   b. Waters
   c. lateral
   d. submentovertical
   e. verticosubmental
   f. PA
   g. axial transoral (Pirie method)
   h. PA oblique (Rhese method)
   i. PA oblique (Law method)

** 16. Identify the projections commonly employed after the sinuses have been injected with a opaque medium.

** 17. Define sinography.
18. Explain the significance/importance of removing dentures, hairpins, earrings and necklaces before proceeding with any facial or craniofacial procedures.
19. Identify the projection of the cranial vault which will demonstrate the depth and extent of the paranasal sinuses.
20. Explain the use of a 72” FFD when a lateral projection of the paranasal sinuses is to be used for preoperative measurements.
22. State the main objective of the Waters method of maxillary sinus demonstration. Explain how this is accomplished, including head position and orbitomeatal line angulation to the film plane.
23. Compare and contrast the routine projections of the paranasal sinuses with similar corresponding projections of the facial bones or cranial bones.

** 24. Give the method of sphenoid sinus examination which will demonstrate the sinuses through the open mouth.
25. Evaluate all projections used for the examination of the paranasal sinuses for positioning or procedural accuracy.
26. Explain the importance of demonstrating the relationship of the maxillary teeth to the antral floor before extraction of a tooth.

Radiography of the Temporal Bones (A-F) – 80% Minimum Mastery Level Required

** Indicates advanced radiographic projections

1. Given an anatomical or physiological description of the specific portions of the temporal bone, identify or locate a particular aspect or part.
2. Identify the structure which collects sound waves and directs them inward by way of the external auditory meatus to the ear drum.
3. Identify the structure which connects the middle ear with the nose and nasopharynx.
4. Relative to external, middle or internal ear, locate the auditory ossicles.
5. Name the three auditory ossicles.
6. Identify the auditory ossicle which attaches the ear drum and the incus.
7. Properly associate the following:
   a. malleus – hammer (outermost ossicle)
   b. incus – anvil (middle ossicle)
   c. stapes – stirrup (innermost ossicle)
8. Identify the auditory ossicle which attaches the hammer-shaped bone with the stirrup-shaped bone.
9. Identify the auditory ossicle which connects the incus with the inner ear.
10. Identify the portion of the ear and temporal bone which contains the sensory apparatus of hearing and equilibrium.
11. Name the three areas of the inner ear.
12. Identify the structure which communicates with the middle ear by way of the stapes and contains two sacs, the utricle and the saccule.
13. Identify the structure which contains the sensory apparatus of equilibrium.
14. Properly associate the sensory nerve of hearing as being the auditory nerve, the acoustic nerve or the 8th cranial nerve.
**15. Relative to radiography of the temporal bones, be able to discuss or answer questions concerning the following positioning considerations:
   a. part position (e.g. – lateral, Stenvers, Mayers and Schullers)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respiration
      2) other
16. Identify the projections of the temporal bones which require that the auricle of the ear be folded forward. Explain the purpose of this maneuver.
17. Give the criteria which must be met to obtain projections of sharp outlines of the thin, fragile walls of the mastoid cells.
18. For a lateral projection of the mastoid region as described by Law, give the specifics concerning angulation of the central ray. Describe two other methods which may be used to simulate the Law method.
19. Describe the measures which must be taken to obtain an unobstructed lateral image of the mastoid portion of the temporal bones.
20. Given a lateral radiograph or diagram of the mastoid portion of the temporal bone, identify/locate the following structures:
   a. tegmen tympani
   b. mastoid antrum
   c. mastoid air cells
   d. superimposed internal and external auditory meatuses
   e. mandibular condyle
   f. mastoid process
**21. Explain the purpose of the Hickey method of mastoid tip demonstration and describe the side which is shown in the AP tangential projection; in the PA tangential projection.
22. Relative to CR angulation and placement of film, compare the following projections of the mastoid and petrous portions of the temporal bone:
   a. Henschen
   b. Schuller
   c. Lysholm
23. Given a list of cranial projections, select those which are good for demonstration of the internal auditory canals.
24. Compare and contrast the following projections of the temporal bones with similar projections done of other areas of the cranium:
   a. PA – transorbital method
   b. AP – axial projection (Grashey method)
   c. PA axial projection – Haas method
   d. PA axial projection – Valdini method
   e. submentovertical (subbasal) projection
25. State the value of the Mayers and Owen methods of petrous portion demonstration and differentiate with the Schullers or Laws methods.
26. Give two methods which are routinely used to demonstrate the internal auditory canals in profile. Identify the method which is better to use and explain the choice.
27. For the Stenvers or Arcelin methods or temporal bone study, describe the position of the petrosa relative to the film plane.
28. Evaluate projections of the temporal bones for positioning or procedural accuracy.
29. Associate the following methods with specific anatomic demonstration of portions of the temporal bone:
   a. Chausse III method
   b. Sansregret modification of Chausse III method
   c. Low-Beer method
   d. Lysholm method
30. Identify the medical indication for doing eustachianography.
31. Identify the contrast medium used in tympanography.

Radiography of the Temporal Styloid Processes, Jugular Foramina and Hypoglossal Canal (A-F) – 80% Minimum Mastery Level Required
** Indicates advanced radiographic projections
** 1. Relative to radiography of the temporal styloid process, the jugular foramina and the hypoglossal canals, be able to discuss questions concerning the following positioning considerations:
   a. part position (e.g.s – modified Fuchs method, Cahoon method, Wigby-Taylor method, lateral Fuchs method, Kemp Harper method, Eraso modification, Chausse II method, Miller method)
   b. structure(s) visualized and function(s) demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification/markers
   f. beam angulation and alignment to part and film
   g. beam limitation/shielding
   h. patient instructions
      1) respirations
      2) other
** 2. Given a diagram, anatomic model or radiograph, identify and/or locate the following structures:
   a. temporal styloid processes
   b. jugular foramina
   c. hypoglossal canals
** 3. Identify the projection which will demonstrate the temporal styloid processes projected free of the superimposition of the condyles of the mandible and within the shadows of the maxillary sinuses. Identify the positioning line which is used for this projection.
** 4. Compare and contrast Cahoon’s method (PA axial projection) of bilateral temporal styloid demonstration with the Haas method of posterior cranial demonstration.
** 5. Identify the projection which will unilaterally show the temporal styloid process overlying the soft tissues of the neck. Explain the importance of having the patient open his/her mouth during the exposure.
** 6. Identify the projection which will unilaterally demonstrate the temporal styloid process projected into the space above the mandibular notch. Explain the importance of having the patient open his/her mouth during the exposure. Explain why this projection requires direct exposure rather than grid exposure.
** 7. When radiographing the jugular foramina in submentovertical position, explain the need for either a 20 degree caudal angulation of the CR or a 25 degree placement of the orbitomeatal line.
** 8. Describe the radiographic method which may be used to demonstrate the jugular foramen through the shadow of the open mouth between the shadows of the upper and lower molars. Identify the other foramen which may be demonstrated by using this projection.
** 9. Identify the cranial nerve which is transmitted through the hypoglossal canals.
** 10. Explain the need for a 45 degree rotation of the head and a 12 degree caudal angulation of the CR when radiographing the hypoglossal canal using the Miller method.
**11. Compare and contrast the Miller method of hypoglossal canal examination with the Arcelin method of internal auditory canal examination.**

**12. Evaluate all methods of radiographic demonstrations of the temporal styloid processes, jugular foramina and hypoglossal canals for positioning the procedural accuracy.**

Anatomy and Radiography of the Salivary Glands –75% Minimum Mastery Level Required

**Indicates advanced radiographic projections**

**1. Given a description, anatomic model or diagram of the salivary glands, identify each gland.**

**2. For each salivary gland, identify the efferent duct and its place of opening in the mouth.**

**3. Associate the term sialography with radiographic examination of the salivary glands.**

**4. Identify the type of contrast medium used in the radiographic examination of the salivary glands.**

**5. Explain the purpose of the oral administration of a lemon wedge before examination of the salivary glands.**

**6. Identify pathologic conditions which opacification of the salivary glands will demonstrate.**

**7. Give the standard radiologic projection used to visualize the individual salivary glands.**

EXPOSURE AND PHYSICS

A. Concepts of Radiation (G, H) Exposure and Physics (80%) Minimum Mastery Level Required

1. Given that all things visible and invisible can be classified as matter or energy, demonstrate an understanding of the concepts of radiation by defining and identifying examples of the following:
   a. matter
   b. mass
   c. weight
   d. energy
      1) potential
      2) kinetic
      3) chemical
      4) electrical
      5) thermal
      6) nuclear
      7) electromagnetic energy

2. Distinguish the difference between the weight of an object on earth and the weight of the object on the moon.

3. Differentiate between the term mass and the term weight.

4. Describe how both PE (potential energy) and KE (kinetic energy) depends on the mass of an object.

5. Given an x-ray machine’s operating voltage and the number of joules per KeV, calculate at what fraction of the velocity of light that the operating voltage electrons travel.

6. Describe the characteristics of electromagnetic radiation and give examples of the radiation.

7. Define the following terms:
   a. speed of light
   b. frequency
   c. wavelength
   d. photon (quantum)
   e. angstrom (Å)
   f. eV (electron volt)

8. State the formula which proves that frequency is inversely proportional to wavelength.

9. State the unit of frequency; the units of wavelength

10. Discriminate between x-rays and visible light

11. Describe the interaction of electromagnetic radiation with matter as a function of wavelength.

12. Define the following terms related to light:
   a. refraction
   b. transmission/transparent
c. attenuation
d. translucent
e. absorption/opaque

13. Define the following terms related to x-ray:
   a. radioparent
   b. radiolucent
   c. radiopaque

14. List and be able to recognize the properties of x-rays.

15. State the inverse square law and be able to compute the intensity of the x-ray beam when the distance is changed.

16. Describe the speed with which all electromagnetic waves travel.

17. Properly associate the terms wavelength, frequency, energy, and penetration.

B. X-Ray Tube (H) (80%) Minimum Level Required

1. Given a diagram of an x-ray tube, identify and explain the function of the following parts:
   a. protective housing
   b. evacuated glass envelope
   c. cathode
      1) filament
      2) focusing cup
   d. anode
      1) target
   e. high voltage supply

2. Explain the meaning of isotropic emission of x-rays.

3. Define useful beam.

4. Define leakage radiation.

5. Name four functions of an x-ray tube housing.

6. Describe the problems associated with the incorrect handling of an x-ray tube housing.

7. Discriminate between a Crooke’s tube and the Coolidge hot filament tube.

8. Define thermionic emission and state what type of process it is.

9. Describe the characteristics of tungsten which make it an ideal filament and target material.

10. Explain the addition of 1% to 2% thorium to the tungsten filament of an x-ray tube.

11. Identify the factors which determine a focusing cup’s effectiveness in focusing the electron beam to pinpoint area of the target.

12. Discriminate between a stationary and rotating anode tube.

13. Describe the three functions of an x-ray tube anode.

14. Explain the signification of the invention of the hot cathode tube (by Dr. W.D. Coolidge) to the independent control of kV and mA.

15. Define inherent filter; define added filter; define total filtration.

16. Discriminate between single and dual focus rotation anode tubes.

17. Define the term space charge effect.

18. Identify the primary cause of off-focus (stem radiation).

19. State the main advantage of using a small focal spot.

C. X-ray Production (H, I, & J) - 80% Minimum Mastery Level Required

1. Explain the importance of each of the four conditions which are necessary for the production of x-rays;
   a. separation of electrons
   b. production of high speed electrons
   c. focusing of electrons
   d. interaction of high speed electrons with the target or declaration of high speed electrons

2. Define the term Bremsstrahlung radiation.

3. Define the term characteristic radiation.
4. Define ionization.
5. Discriminate between a homogeneous and a heterogeneous x-ray beam.
6. Define x-ray beam quantity, identify the technical factors which are used to control it; and describe how each of the factors control it.
7. Define x-ray beam quality; identify the technical factors which are used to control it; and describe how each of the factors control it.
8. Express by using a formula, the relationship of x-ray exposure to the following:
   a. mA
   b. time
   c. mAs
   d. kVp
   e. distance
9. Define each of the following radiographic or photographic terms:
   a. central ray (CR)
   b. focal spot (FS)
   c. source-image distance (SID)
   d. kilovoltage (kV)
   e. milliamperes (mA)
   f. milliampere-second (mAs)
   g. object-image distance (OID)
   h. primary radiation
   i. scatter radiation
   j. time in sec(s)
   k. screens
   l. collimators
   m. grid
   n. density
   o. contrast
   p. detail
   q. distortion

D. Intensifying Screens (P) 80% Minimum Mastery Level Required
1. Explain why there is less patient exposure, less motion problems and less stress on an x-ray tube using screens as opposed to direct-exposure radiography.
2. Describe the overall construction of a typical x-ray intensifying screen and state its functions.
3. Describe the protective coating layer of an intensifying screen and state its function.
4. List or identify the ideal characteristics of an intensifying screen phosphor and state its primary purpose.
5. Describe the reflective layer of an intensifying screen and describe its primary function.
6. Explain the purpose of adding dyes to the phosphor layer of intensifying screens, and describe their influence on the speed of the screens, exposure needed to effect a desired density, and resolution of the image.
7. Describe the base of an intensifying screen and explain its function.
8. Discuss the physical qualities that a material must possess to be used as a screen base material.
9. Discuss the two types of luminescence and how they are associated with intensifying screens and fluoroscopic screens.
10. Define or otherwise identify the following:
    a. Afterglow
    b. Lag
    c. Isotropically
    d. Resolution
    e. Phosphor
    f. Emission spectrum
    g. Sensitivity spectrum
    h. Luminescence
    i. Fluorescence
j. Phosphorescence
k. Intensification factor
l. Screen speed

11. Explain the phenomenon of luminescence.
12. List or identify the intrinsic and extrinsic factors which control the speed of intensifying screens. Explain their control and affect on resolution and speed.
13. Given the type of an intensifying screens, state or otherwise identify the screen characteristics relative to color or emission, approximate speed, and resolution.
14. Given the exposure without screens and the exposure with screens, calculate the intensification factor.
15. Discuss the importance of spectral matching of screens and films.
16. Describe the composition of rare earth screens.
17. Explain the purpose of terbium activation of a rare earth screen.
18. Distinguish between a rare earth and calcium tungstate screen relative to speed, absorption (detective quantum efficiency) and conversion efficiency.
19. Describe a system for proper maintenance and care of intensifying screens.
20. Describe the method used to test screen-film contact and explain why there should be good film-screen contact.
21. List or otherwise identify common causes of poor film-screen contact.
22. State the difference between a conventional fluoroscopic screen and a radiographic intensifying screen.
23. Explain why the front surface of a cassette, the side facing the tube, should be made of a material with a low atomic number (Z#).
24. Give 4 examples of ideal or appropriate cassette front material.
25. Explain the need for compression of one screen on another and give 3 examples of appropriate compression methods.
26. Explain the need for using heavy metal as the back cover of a screen.
27. Explain the influence of backscatter radiation on image quality; explain how it can be minimized and how it can be recognized.
28. Distinguish between carbon fiber and aluminum or plastic as cassette or table top material.
29. List or otherwise identify the advantages and disadvantages or screen use.

E. Prime Factors of Radiography (Q) 80% Minimum Mastery Level Required Milliamperage

1. Define milliamperage
2. Explain the relationship between current to the filament and temperature of the filament; temperature of the filament and electrons emitted from the filament; x-ray tube current and numbers of x-ray produced; and the numbers of x-rays produced and the radiographic density and patient exposure.
3. Describe the method used to select tube current.
4. State the ratio which correctly describes the relationship of x-ray quantity and mA.
5. Explain why the mA meter is placed in series with the secondary winding of the step-up or high-voltage transformer.
6. Explain why the mA meter is grounded at the center of the high voltage transformer.

* mAs or Time X mA
1. Given any mAs value, be able to calculate a time and milliamperage to solve a problem.
2. Associate the total number of x-rays reaching the film with the x-ray tube current and time.
3. Given a mA value and time value, calculate mAs.
4. Express the relationship of mA and time for the control and maintenance of radiographic exposure.
5. Identify the ratio which correctly describes the relationship of x-ray quantity and time or mAs.

* Kilovoltage
1. Identify the factors which are affected by a change in kV.
2. Identify the ratio which correctly describes the relationship of x-ray intensity (quantity) to kVp.
3. Explain why kVp can influence both quality and quantity of radiation.
4. Associate the x-ray quality influence of kVp with the contrast of the image.
5. Associate the x-ray quantity influence of kVp with the density of the image.
6. Describe the fundamental criteria to be used in the selection of kVp for any radiologic examination.
7. State the rule which describes the relationship of kVp to x-ray output intensity and resultant density of an image.
* Focus-Film Distance
1. Identify the ratio which correctly describes the relationship of intensity of exposure to distance.
2. Explain the decrease in intensity (quantity of x-ray photons) as the distance from a point source is increased.
3. Given the distance of a point source of radiation and the area of coverage of radiation on a surface, calculate the square area of coverage on that surface if the point source is moved. Given the same information, calculate the intensity of radiation if the point source is moved.
4. Given the distance of a point source of radiation and the intensity of radiation at that distance, calculate the exposure adjustment necessary to maintain exposure of an image if the point source is moved.

* X-ray Quantity and Quality
1. State the three calculable factors that affect x-ray quantity (image exposure and density) and describe the influence.
2. State the factors which control beam quality (penetration) and describe how beam quality is measured.
3. Associate HVL (half-value layer) with x-ray beam quality.

F. Automatic Exposure Control – 80% Minimum Mastery Level Required
1. State the purpose of automatic exposure controls.
2. Describe the two types of automatic exposure control:
   a. phototimers
   b. ionization chamber devices
3. Describe the placement of the two exposure control devices;
   a. phototimers
   b. ionization chamber devices
4. Explain the significance of the technologist knowing the exact size, shape and position of the ionization chambers.
5. Define the following:
   a. Minimum reaction/response time
   b. Backup time
6. Solve problems for exposures given minimum response time and/or backup time.
7. Define Silicon Controlled Rectifiers (SCRs).
8. State the minimum response time capability of modern ionization chambers.
9. Identify factors for which the AEC can make corrective adjustment.
10. Identify factors for which the AEC cannot make corrective adjustment.
11. Explain the importance of proper calibration of the AEC devices.
12. Explain the quality control assessment of automatic exposure control devices.
13. Explain the need(s) for a backup time for AEC devices.
14. Explain why backup times should not exceed the following:
   a. tube limit
   b. 150 percent of the anticipated manual exposure mAs
   c. Public Law 90-602
      1) exposure must terminate at 600 mAs for exposures 50 kVp
      2) exposures must terminate at 2000 mAs for exposures below 50 kVp
15. Given assessment of radiographs which reveal exposure problems using AEC; demonstrate the ability to provide a solution.

G. X-Ray Interaction with Matter - 80% Minimum Mastery Level Required
1. State the five interactions that can occur between a photon and matter; describe the interaction; and state the energy ranges at which each occur.
2. Of the five basic interactions of x-ray with matter, identify the interactions which are more likely to occur when the energy of the x-rays are within the diagnostic radiology range.
3. Identify the two interactions most critical to diagnostic radiology.
4. Describe the processes which occur within an atom upon interaction with an incident photon to produce secondary and/or scatter radiation by the following methods:
   a. Thompson (classical) scattering
b. Compton effect
c. Photoelectric effect

5. Relative to the interaction of radiation with matter, describe the influence of atomic number and energy of the x-ray beam on the interaction by Compton and photoelectric effect.

6. Compare the contributions of photoelectric effect and Compton effect to the making of a radiograph.

7. Define differential absorption and show how it varies with kVp, mA, atomic number and density of the absorber.

8. Examine the nature of a contrast examination and show why it is helpful.

9. State what is meant by exponential attenuation.

H. Radiographic Quality or Definition (S) 80% Minimum Mastery Level Required

1. Describe the important attributes and radiographic balance achieved by a film that is of radiographic quality.

2. Explain what is meant by the visibility of the structures within a radiographic image.

3. Explain what is meant by the sharpness of the structures within a radiographic image.

4. Of the four major factors contributing to radiographic quality, identify the factors that are referred to as the geometric properties of the radiographic image and provide reasons for your choice.

5. Of the four major factors contributing to radiographic quality, identify the factors that are referred to as the photographic properties of the radiographic image and provide reasons for your choice.

6. Describe the significance of the relationship between the sharpness of the recorded details and their visibility as it relates to radiographic quality.

7. Define the following terms:
   a. Sharpness of details
   b. Visibility of details
   c. Recorded detail
   d. Distortion
   e. Size distortion
   f. Shape distortion
   g. Density
   h. Contrast
   i. Scale of contrast
   j. Short scale
   k. Long scale
   l. Film contrast
   m. Film latitude
   n. Exposure latitude
   o. Subject contrast

QUALITY ASSURANCE LABORATORY

A. Radiographic Film (K) 80% Minimum Mastery Level Required

1. Define remnant radiation.

2. Explain what is meant by imaging media.

3. Differentiate between x-ray film and regular photographic film.

4. Describe the quality control used in the manufacture of radiographic film; explain the need to avoid radioactive contamination of the manufacturing process.

5. Describe the basic construction of x-ray film and describe the function of each component.

6. Explain the meaning of duplitized and describe the positive and negative aspects.

7. Explain the importance of having the film base be radiolucent.

8. Explain the significance of the blue dye which is added to the film base.

9. Discuss the historical development of x-ray film base material.

10. Distinguish between a cellulose triacetate base and a polyester base.

11. Explain why gelatin is the material of choice for the emulsion portion of a film.

12. Explain the use of silver halide in the emulsion of x-ray film.
13. Name two often used silver halides.
14. Explain the role of the sulfur traces in the emulsion of x-ray film; identify the source of sulfur.
15. Define the term digestion (film manufacturing term).
16. Define the terms:
   a. blue sensitive
   b. orthochromatic
   c. panchromatic
   d. infrared radiation
17. Explain how the manufacturer of radiographic film sensitizes it to a specific portion of the light or electromagnetic spectrum.
18. Explain how the imaging property of a silver halide crystal is dependent on imperfections in the crystal.
20. Identify the emulsion characteristics which make a film suitable for radiography.
21. Define the following terms which are often used to describe emulsion characteristics.
   a. speed (sensitivity)
   b. latitude
   c. contrast
   d. resolution
22. Explain how emulsion characteristics are varied and controlled by the manufacture of radiographic film.
23. Identify at least 4 different types of x-ray film.
24. Distinguish between screen-type film and direct-exposure type film.
25. Explain the affects of the following on x-ray film:
   a. age
   b. humidity
   c. temperature
   d. light
   e. pressure
   f. ionizing radiations
   g. finger prints, scratches, dirty intensifying
   h. chemical fumes
26. Distinguish between sensitized artifacts and non-sensitized artifacts and give examples of each.
27. Describe the controls used in the handling of x-ray film to avoid static discharge.
28. Distinguish between film sensitivity before exposure (“raw”) as opposed to after exposure.
29. Define spectral sensitivity.
30. Explain the importance of using the correct safelight filter.
31. Explain the significance of correct installation of safelight filter.
32. Explain the importance of correct bulb wattage selection for safelights.
33. With respect to safelight use, discuss the affect of time, distance, and shielding to their proper use.
34. Describe the method used to analyze proper safelight use.
35. Describe the ill affects to the radiographic image when safelights are used improperly.
36. Explain the purpose of a film exposure holder.
37. Describe the two principal types of film holders.
38. Distinguish between a direct exposure holder and a cassette with screens in terms of:
   a. exposure of the film
   b. exposure to the patient
   c. time of exposure
39. Define latent image.
40. State the photographic effect formula.
41. Describe a silver halide crystal relative to charge, arrangement of silver ions and halide ions, and location of sensitivity speck.
42. Associate the formulation of the latent image with the Gurney Mott theory.
43. Describe the ionization phase of latent image formation.
44. Describe the entrapment stage of latent image formation.
45. Describe the latent image stage of the Gurney Mott theory.

B. Processing Radiographic Film – Creation of the Visible Image - 80% Minimum Mastery Level Required (K-O)

* The importance of good darkroom procedure and proper darkroom construction.

1. Determine when is the best time to decide on a location for a processing room.
2. Determine the best location for a processing room, if asked to design an entire radiology department.
3. Concerning the design and function of a darkroom, state the rationale for the following:
   a. plumbing and electrical service should be accessible
   b. windows should be avoided
   c. processing room walls should be lead lined when adjoining x-ray rooms
   d. all entrance doors must be made absolutely light-tight and have an inside lock
   e. darkroom walls and floors should be covered with chemical resistant material
   f. cleanliness of bench tops, accessories, and equipment should be maintained
4. Name and describe the three basic types of processing room entrances.
5. Explain the need for proper ventilation in a processing room.
6. Explain why the ventilating system should be completely light-proof.
7. Explain the need for passboxes and their mechanism of use.
8. Name three types of illumination needed in a processing room. Explain the purpose of each.
9. Explain the meaning of darkroom
10. Describe the proper safelight operation in terms of:
    a. time of film exposure
    b. type and condition of filter used
    c. maintaining the proper distance away from them
    d. using the proper intensity of bulb
11. Describe the spectral emission – spectral sensitivity concepts of safelight operation.
12. Describe the function of the following accessory equipment:
    a. film bins
    b. storage bins
    c. shelves
    d. hangers and racks
    e. water temperature control
    f. thermometers
    g. timers
    h. passboxes
    i. identification printer
    j. manual processing tanks
    k. stirring paddles
    l. dryer
    m. replenishment storage tanks
13. Discuss daylight processing with the regard to the efficient handling of x-ray film in room light, and the efficient and effective use of time, space and personnel.

* Film Processing (K-O)

1. Explain why the latent image is invisible.
2. List in the proper order, the steps involved in the processing of radiographic film and give a general explanation of what occurs in each step.

* Creation of the Visible Image (K-O)

1. Using a chemical formula, state the reaction that occurs in the development of radiographic film.
2. Define the following terms:
   a. reduction
   b. oxidation
c. reducing agent  
d. oxidizing agents  
e. oxidation-reduction reaction

3. Describe the action of the reducing agents on the exposed silver ions (latent image) to change them to black metallic silver.

4. Discuss the importance of giving proper attention to time, temperature, and activity in the development of x-ray films.

5. Explain the relationship between time of development and the temperature of development based on a specific activity of the developer.

6. Explain what happens to the bromide portion of the silver halide crystal during the creation or development of the manifest (visible) image.

7. Define bromide drag and describe its affects on the density of the image.

8. Explain the need to maintain the activity of the developer through:
   a. proper agitation  
      1) Rollers moving  
      2) Recirculation (3-5 gallons per minute)  
   b. replenishment (an average of 70cc per 14 inches of film)

9. Identify the individual developer solution ingredients and describe their function in the solution.

10. Define pH.

11. Define specific gravity.

12. Explain the importance of pH and specific gravity measurements to determine proper activity of the developer solution.

13. Describe the instruments used to check pH and specific gravity.

14. Identify four common contaminants of the developer solution and explain how each interferes with the development process.

15. Define chemical fog.

16. Correctly explain the function of the developer starter solution.

17. Explain the need to choose the correct starter solution based on the type of developer used.

* Fixation-Wash-Dry (K-O)

1. List three function of fixation.

2. List the basic ingredients of a fixing solution and describe the function of each ingredient.

3. Explain the importance of pH and specific gravity measurements to determine proper activity of the fixer solution.

4. Explain how one would determine clearing time; fixing time.

5. Given that the fixer activity is low due to under-replenishment, discuss the following:
   a. contamination by developer solution  
   b. pH  
   c. silver content

6. Given that the fixer activity is high due to over-replenishment, discuss the following:
   a. pH  
   b. fixer precipitation  
   c. silver content

7. Explain the function of wash water in film processing.

8. Properly associate hypo retention with archival quality of processed radiographic film.

9. Describe the standard for temperature control of the wash water.

10. Explain the need of water exchange in the wash tank to be at least 2.5 gallons per minute.

11. Explain the need for properly drying a film before handling.

* Safety - Electrical and Chemical (K-O)

1. Explain the need to wear eye protectors and protective clothing when working around processors.

2. Explain the need to cut off the incoming power source when working on a processor.
3. Describe the method used to reduce the possibility that the power will be inappropriately turned on.

C. Silver Recovery (O, P) 80% Minimum Mastery Level Required
1. Explain why the recovery of silver is desirable.
2. Explain what happens to the silver contained in the emulsion of a film during the processing of the film.
3. Name the three basic methods of silver recovery.
4. Describe the principle of operation of the metallic replacement silver recovery method; describe the advantages of using this recovery.
5. Describe the principle of operation of the electrolytic silver recovery method; describe the advantages of using this method.
6. Describe the principle of operation of the chemical precipitation silver recovery method; describe the advantages of using this method.
7. Describe the principle of operation of the ion exchange silver recovery method.
8. Describe the principle of operation of the reverse osmosis or dialysis silver recovery method.
9. Identify the federal governing board for silver emission to the environment.
10. Identify federal laws which establish standards for silver, developer, and fixer emissions to the environment.

D. The Basic Systems of an Automatic Processor (L, M, N, O) - 80% Minimum Mastery Level Required

* Chemical System - (Discussed in preceding sections)

* Transport System
1. State the two basic functions of the transport system.
2. Name the two subsystems of the transport system.
3. List or identify specific component parts of a roller subsystem and identify functions assigned to each.
4. Identify transport artifacts and explain the proper cleaning techniques and adjustments to eliminate transport system artifacts.
5. Explain how the speed of the drive motor is reduced.
6. Describe the method used to control transport speed.
7. Show an ability to properly associate gears to gears, sprockets to chains, pulleys to belts.

* Tempering System
1. State the function of the tempering system and explain its influence on film sensitometry.
2. Identify the mechanisms which control temperature in the processor and describe their function and operation.
3. Explain the differences between a thermostat and thermometer.
4. Explain why all display thermometers should be calibrated according to a standard thermometer.
5. Be able to evaluate the use of an alcohol thermometer or bimetallic-type standard calibrated thermometer versus the use of a mercury thermometer in monitoring chemical temperatures.
6. Describe the positive and negative aspects of cold water processing.
7. Explain the need to regulate water temperature relative to developer temperature.

* Replenishment System
1. List 4 reasons for the need of chemical regeneration through chemical replenishment.
2. Differentiate replenishment and regeneration.
3. State the two functions of the replenishment system.
4. Explain the relationship between time, location, height, and cleanliness of the replenishing tank and proper maintenance of replenishment system.
5. Explain the purpose of a floating lid and dust cover for replenishing storage tanks.
6. Define replenishment rate and explain how rate is established.
7. Explain the meaning of high volume, low volume and normal volume processing and describe how the use factor of a processor influences replenishment rates.
8. Explain the relationship between under or over replenishment as each relates to sensitometry and cost containment.
9. List or identify the 4 types of replenishing pumps and describe the function of each.
10. Explain the need for a higher replenishment rate in the fixer than in the developer.

* Circulation/Filtration System
1. State the basic function of the circulation/filtration system.
2. List 4 functions performed by circulation pumps.
3. Explain the result of improper agitation and list or identify 5 causes of inadequate agitation.
4. Explain where and what size filters are needed on a processor.
5. List or identify and explain two reasons for not using filters in the fixer.
6. Explain why filters are not required for the wash tank.
7. Given a particular filter, identify the type of material which can be successfully filtered using it.

* Drying System
1. Explain the two basic functions of the dryer systems.
2. Explain the relationship between proper drying and visualization of the image.
3. Identify the components if the dryer system and explain the function of each component.

* Electrical System
1. State the main function of the electrical system.
2. Explain the reason for the lock-tag-test safety principles when working on electrical equipment.
3. Define schematic.
5. Give examples of electrical switching devices in an automatic processor.

E. Basic Sensitometry-Radiographic Quality (K-O) – 80% Minimum Mastery Level Required
1. Correctly define the following terms:
   a. sensitometry
   b. densitometry
   c. sensitometer
   d. gradient
   e. average gradient
   f. gamma gradient
   g. speed point
   h. density
   i. contrast
2. List and explain the four factors involved in sensitometry.
3. Explain the need for standardization of film processing and explain the use of sensitometry as a mechanism to control or monitor film processing quality in an x-ray department.
4. Explain the anatomy of the sensitometric curve and define the following terms which are used in the interpretation of the curve:
   a. Base plus fog
   b. D-Min
   c. D-Max
   d. Average gradient
   e. Speed point
5. Describe a good quality radiograph.
6. Distinguish between film contrast and subject contrast.
7. Identify the density point(s) on the characteristic curve that one should evaluate to determine:
   a. Contrast
   b. Speed
   c. Latitude
8. Define latitude.
9. Describe a film exhibiting:
   a. Wide latitude
   b. Narrow latitude
10. Describe the affects the following have on base fog:
    a. Developer activity
    b. Developer time
    c. Developer temperature
    d. Inappropriate safelights or film storage
11. Identify the factors which may cause the following:
    a. Increased contrast
    b. Decreased contrast
    c. Increased film speed
    d. Decreased film speed
12. Given that the developer activity is low due to under-replacement, discuss the following:
    a. Hydroquinone level
    b. Bromide level
    c. Film contrast and speed
13. Given that the developer activity is high due to over-replenishment, discuss the following:
    a. Hydroquinone level
    b. Bromide level
    c. Film contrast and speed
14. Solve film processing quality control problems by using critical thinking-problem solving grids provided by the manufacturer’s of the processing chemistry.

Required Assessments:
A. Testing procedure: An examination directly related to the instructional objectives will follow completion of the units indicated for each of the following: 1) Exposure and Physics, 2) Quality Assurance and 3) Radiograph Positioning and Procedures: (Test order is subject to change based on student progress and events beyond the control of the instructor or students.)

B. Laboratory Expectations: Laboratory exercises which relate to quality control of film processing will be completed.
   Exercise 1: Latent image formation
   Exercise 2: Manifest Image formation
   Exercise 3: Systems of an Automatic Processor
   Exercise 4: Analysis and Preventive Maintenance – Automatic Processor
   Exercise 5: Trouble shooting Developer and Fixer Solution Problems
   Exercise 6: Identification of Solution Unknowns
   Exercise 7: Basic Sensitometry

Specific Assessment:
1. Perform laboratory experiments and tests to determine and analyze the quality control parameters of the processing system. These measurements will determine if the processor is set for the optimum time, temperature and chemical activity. (F)
   a. Analyze the physical and chemical measurements of the processor (D).
      Determine:
      1) developer – immersion time
      2) fixer – immersion time
      3) dry to drop time
      4) developer – replenishment rates
      5) fixer – replenishment rates
      6) wash – replenishment rates
      7) developer – specific gravity and pH
8) fixer – specific gravity and pH
9) fixer – clearing time
10) total fixing time

b. Perform sensitometric evaluation (F)
   1) read a 21 step square root of 2 wedge and plot the characteristic curve on H & D curve plotting paper
   2) determine B + F
   3) determine D min and max
   4) compare speed and contrast with a “standard H + D curve
   5) determine processing quality control parameters by charting developer temperature, speed, B + F and a contrast index from exposed and processed test films
   6) determine processing quality control parameters by visual comparisons of exposed test films

c. Analyze replenisher solution (F).
   1) determine chemical mixing procedures by determining the specific gravity and pH of developer and fixer replenisher samples
   2) determine seasoned chemical activity by determining the specific gravity, fixing time and pH of developer and fixer working solution samples

Field Work: Self-study using:
1. Syllabus-course objectives
2. Independent evaluation review texts in preparation for ARRT exam.

Other Evaluation methods: Homework and worksheet assignments

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Notation indicating percentage of grade attributable to each of the above items:
1. 40% of mean average of the unit exams related to Positioning and Procedures.
2. 40% of the mean average of the unit exams related to Exposure, Physics and Quality Assurance
3. 20% of the combined grade as follows:
   a. Comprehensive Final – if applicable
   b. Independent Evaluation (ARRT preparation)

There will be 2 points deducted from the final grade for each absence exceeding the formula:

Excused days absence=1/15 (class hours) (number of weeks per semester)

Because promptness is as important as attendance, a combined frequency of tardiness of 50 minutes will equal one class absence.

One hundred percent (100%) attendance will be rewarded with 5 points added to the final grade.
Chattanooga State Technical Community College
Radiologic Technology Program
Statement of Understanding

Disabilities Statement
Students who have educational, psychological, and/or physical disabilities may be eligible for accommodations that provide equal access to educational programs and activities at Chattanooga State. These students should notify the instructor immediately, and ideally should contact Disabilities Support Services (S-113, phone 697-4452) within the first two weeks of the semester in order to discuss individual needs. The student must provide documentation of the disability so that reasonable accommodations can be requested in a timely manner. All students are expected to fulfill essential course requirements in order to receive a passing grade in a class, with or without reasonable accommodations.

Disruption Statement
Disruption or obstruction of teaching, research, administration, disciplinary proceedings, other college activities, including its public service functions on or off campus, or other authorized non-College activities, when the act occurs on College premises, is subject to disciplinary sanctions.

The terms classroom disruptions means behavior a reasonable person would view as substantially or repeatedly interfering with the conduct of a class. A student who persists in disrupting a class will be directed by the faculty member to leave the classroom for the remainder of the class period. The student will be told the reason(s) for such action and given an opportunity to discuss the matter with the faculty member as soon as possible. Prompt consultation will be undertaken by the faculty with the Department Dean and the College Judicial Officer.

If a disruption is serious, and other reasonable measures have failed, the class may be adjourned and the campus police summoned.

Pagers and Cell Phones – Activated pagers and cell phones are strictly prohibited when class is in session.

The RADIOLOGY TECHNOLOGY PROGRAM is a competency-based program. The goal of each instructor is to have students complete the competency requirements of each course. Completion of set competency areas of a course is greatly affected by student’s ability to progress through the material. If competencies are not mastered in a specific course, a subsequent course will be structured to assure competency attainment of those areas.

Each topic in each syllabus will indicate a mastery level for the objectives that correlate to the topic. Evaluation is criterion-referenced to the objectives for each topic. Mastery level criteria for each topic must be met. Remediation is permitted with restrictions. The first remediation test grade will be averaged with the original test grade. A second remediation will result in ten points being subtracted from the specific topic grade. Subject to the discretion of the instructor, further remediation and testing may result in a reduction of one letter grade for the course for each occurrence, which may lead to failure of the course.

A grade of “C” or better in each radiography course is required for progression.
I hereby acknowledge that I have read the syllabus and understand the policies regarding objectives, grading, performance, participation, absenteeism, tardiness, and conduct.

I understand the policy on NO activated cell phones or pagers during class time and agree to keep these devices enclosed in a container (such as a purse or backpack) so that they are not visible to anyone in the classroom.

Chattanooga State is committed to promoting a mode of individual conduct based on the principles of honesty, fairness, trust, respect and responsibility. I understand that academic integrity is demanded in ALL records, exercises, assignments and tests in the classes. Those who falsify records, copy other work or share such information inappropriately will receive an F in the course.

I understand that most courses in this program offer supplemental websites which are required on a routine basis. Computers with web access are readily available on campus and may be used to access this required component of the course.

My signature documents my agreement to abide by all policies and conditions stated in the course syllabus, as well as all program policies.

____________________________________       __________________________
Name in print                                                          Date

____________________________________
Signature