COURSE SYLLABUS
RT 2542 – RADIOLOGY SEMINAR II

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

CATALOG COURSE DESCRIPTION:
The second 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 placed on the development of skills and knowledge necessary to exercise independent judgment 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 radiologic procedures of the upper and lower extremities, shoulder girdle, bony thorax to include sternum and ribs, pelvic girdle and upper femora and the vertebral column.

2. Comprehensive review of equipment characteristics and function, x-ray physics, imaging technology and analysis and radiation protection to include the following topics:

   A. Radiographic Quality or Definition
   B. Distortion
   C. Density
   D. Contrast
   E. Generator Types and Output
   F. Control Console
   G. Influence of Current, Voltage, Target Characteristics
   H. Filtration
   I. Thermal Rating and Cooling Characteristics
   J. Health Physics
   K. Radiation Protection

3. Special emphasis is placed on non-routine procedures in each exam category area and the modification of standard projections to better demonstrate pathology or accommodate patient's condition.

4. Evaluation of the performance of radiographic systems to effect the best diagnostic results with the least cost and radiation exposure to the patient. Special emphasis is placed on x-ray equipment analysis and quality control and the development of exposure guides (fixed kV, optimal kV, variable kV, automatic exposure control).

ENTRY LEVEL STANDARDS: A grade of "C" or better in all completed radiography program courses, is required for progression to this course. Having successfully completed all previous course work of the program, the student should demonstrate the skills and knowledge necessary to function, with limited to minimal 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: All previous course material completed in the radiography curriculum prior to the spring semester of the second year.

TEXTBOOKS AND OTHER REFERENCE MATERIAL BASIC TO COURSE:
1. Merrill's Atlas of Radiographic Positions and Radiologic Procedures: Ballinger, latest edition.
2. Radiographic Science for Technologists: Bushong, latest edition.
3. An Analysis of Radiographic Quality: Donohue, latest edition.

Required Student Learning Outcomes (Program Student Learning Outcomes and Course 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#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 #15 Demonstrate knowledge of the derivation of exposure factors to make an x-ray exposure guide. (I, II, III, VI)

CSLO #16 Describe the significance of limiting the irradiated field of coverage and explain the influence of beam restricting devices on the density and contrast of the image. (I, II, III, VI)

CSLO #18 Understand the importance of proper calibration and operation of the x-ray machine to assure proper emission of the x-ray tube, image quality and minimum patient exposure. (I, II, III, VI)

CSLO #20 Understand the influence of filtration on the following and describe the various types of filtration used in radiography: (I, II, III, VI)

1. X-ray emission spectrum
2. Exposure rate
3. X-ray beam quantity/quality
4. Contrast, density
5. Minimum wavelength
6. Patient exposure
7. HVL

CSLO #22 Understand the method of operation of automatic exposure devices and appreciate the importance of centering, collimation and selection of chamber(s). (I, II, III, VI)

CSLO #23 Demonstrate an understanding of the three cardinal principles of radiation protection and demonstrate knowledge of radiation protection methods and guidelines. (I, II, III, VI)

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 extremities, shoulder and pelvic girdles, bony thorax and vertebral column. (I, II, III, VI)

CSLO #2 Given simulated situations which apply to the following topics identify or describe accepted professional practice: (I, II, III, VI)

1. Evaluation of radiographic orders
2. Room preparation
3. Condition of patient
4. Patient care and management

CSLO #3 Following the criteria below, demonstrate knowledge of and perform radiographic positioning of the extremities, shoulder and pelvic girdles, bony thorax and vertebral column. (I, II, III, VI)

1. Part
    a. position of the 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 (image receptor)
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 #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 extremities, shoulder and pelvic girdles, bony thorax and vertebral column. (I, II, III, VI)

CSLO #5 Given diagrams, anatomic structures or radiographs, identify and/or locate component parts. (I, II, III, VI)

CSLO #6 Locate anatomy from the standpoint of the topography of anatomy and explain the relationship of organs to each other. (I, II, III, VI)

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 #7 Recognize an image of radiographic quality as one that possesses sharpness and visibility of the recorded body structures. (I, II, III, VI)

CSLO #8 Associate geometric properties of a radiograph with sharpness of structural details. (I, II, III, VI)

CSLO #9 Associate photographic properties of a radiograph with visibility of structural details. (I, II, III, VI)

CSLO #10 Associate those factors which control or influence recorded detail or distortion with the sharpness of details in a radiographic image. (I, II, III, VI)

CSLO #11 Associate those factors which control or influence density or contrast with the visibility of details in a radiographic image. (I, II, III, VI)

CSLO #12 Explain the controlling and influencing effects of each of the factors which affect each of the radiographic qualities. (I, II, III, VI)

CSLO #13 Define and discuss the following and state the factors which influence them: (I, II, III, VI)

1. Sharpness of details (geometric properties)
2. Visibility of details (photographic properties)
3. Density
4. Contrast
5. Recorded detail
6. Distortion
7. Magnification
8. Macroradiography

CSLO #14 Demonstrate the ability to solve mathematical problems and/or make adjustments in technique to accomplish the following: (I, II, III, VI)

1. Optimal penetration of structures
2. Optimal density
3. Optimal contrast
4. Optimal sharpness
5. Minimal radiation exposure
6. Correction for patient factors, equipment changes and macroradiography

CSLO #17 Explain the purpose, limitations and exposure adjustment for the various grids. (I, II, III, VI)

CSLO #19 Demonstrate knowledge of the x-ray circuit and circuit components to include:

1. Location in circuit
2. Type of device
3. Principle of operation
4. How each component supports x-ray production
5. HVL

CSLO #21 Be able to discuss the conditions which result in overheating of the x-ray tube and demonstrate the correct use of thermal rating charts to avoid tube failure. (I, II, III, VI)

CSLO #24 Demonstrate knowledge of the basic tomographic and stereoradiographic principles and understand the diagnostic significance of their application. (I, II, III, VI)

Other Learning Indicators or Objectives (optional): The student will be able to:

Terminology (A) 80% Minimum Mastery Level Required

1. Define the following terms used to describe body positions or planes:
   a. decubitus
      1) dorsal
      2) ventral
      3) left lateral
      4) right lateral
   b. recumbent
      1) dorsal
      2) lateral
   c. prone or ventral
   d. prone

e. supine
f. anatomic position
g. sagittal plane
h. coronal plane
i. transverse plane

2. Define the following standard terms used to describe part, location, or position.
    a. Anterior
    b. Ventral
    c. Dorsum or dorsal
    d. Central
    e. Distal
    f. External
    g. Inferior
    h. Caudal
    i. Internal
    j. Lateral
    k. Medial or mesial
    l. Parietal
    m. Peripheral
    n. Posterior
    o. Plantar
    p. Superior
    q. Cranial
    r. Cephalic
    s. Proximal
    t. Visceral
3. Define the following terms of positioning:
    a. Projection
    b. View
    c. Method (example-Towne)
    d. Lateral-position, view, projection
    e. RAO- position, view, projection
    f. LAO- position, view, projection
    g. LPO- position, view, projection
    h. AP- position, view, projection
    i. PA- position, view, projection
    j. Oblique- position, view, projection
    k. Tangental projection
    l. Axial projection
    m. Decubitus- position, view, projection
4. Define the following terms which are used to describe movement:
    a. Abduction
    b. Adduction
    c. Evert or eversion
    d. Extension
    e. Flexion
    f. Invert or inversion
    g. Pronate
    h. Supinate
5. Define the following anatomic terms which are used to describe processes or projections that extend beyond the main body of a structure:
    a. Condyle
    b. Coracoid
    c. Coronoid
    d. Crest
    e. Epicondyle
    f. Facet
    g. Head

h. Malleolus
i. Protuberance (process)
j. Spine
k. Styloid
l. Trochanter

6. Define the following anatomic terms which are used to describe depressions or hollow areas of a structure:
   a. fissure
   b. foramen
   c. fossa
   d. groove
   e. sinus
   f. sulcus
7. Define the following anatomic terms:
   a. anatomy
   b. physiology
   c. long bones
   d. diaphysis
   e. epiphyses
   f. short bones
   g. flat bones
   h. irregular bones
   i. appendicular bones
   j. axial skeleton
   k. synarthrosis
   l. amphiarthrosis
   m. diarthroses

General Positioning Considerations (B)- 80% Minimum Mastery Level Required

1. State the importance of the following information found on the x-ray request for examination:
   a. patient identification and information
   b. procedure ordered
   c. clinical history
   d. patient symptoms
2. State the importance of the following to good patient care and management:
   a. room preparation
   b. patient/technologist interaction
   c. patient comfort and safety
   d. patient preparation
   e. patient monitoring
   f. caliper use
   g. radiation protection

Upper Extremity Positioning (B, C, D, E AND F) – 80% Minimum Mastery Level Required

A. Hand-Fingers

****Indicates advanced position objectives**

1. When given a drawing, skeletal part, or radiograph of the hand, label or locate the following bones and identify bones which articulate.
   a. phalanges
      1) distal
      2) middle
      3) proximal
   b. metacarpals (1^{st}-5^{th})
   c. capitatum (os magnum)
   d. pisiform
   e. triquetrum (cuneiform)
   f. lunate (semilunar)
   g. lesser multangular (trapezoid)
   h. greater multangular (trapezium)

i. navicular
j. radius
k. ulna

2. State the type of screens which would be used for radiographic examinations of the hand and fingers.
3. State the routine projections commonly taken of the hand, fingers (1^{st}-4^{th}), and thumb

**4. Be able to discuss or answer questions concerning the following positioning considerations:
a. part position – (examples –AP, oblique, lateral, or other)
b. structure(s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen combination used
e. film size/placement/identification/markers
f. beam alignment/angulation
g. beam limitation/shielding
h. patient instructions
1) respiration
2) other

5. Describe the difference in pathologic conditions and structures demonstrated of a hand in lateral extensions as opposed to a hand in lateral flexion.
6. List three reasons why most radiographic examinations of the skeletal system require a minimum of two projections (at right angles) 90 degrees to each other.
7. Explain the variation in exam procedure necessary when doing the extremity radiographic examinations portable, in surgery, or in an intensive care unit as opposed to the department.
8. Describe the position of the thumb in a PA projection of the hand.

**9. Explain the benefit of a fan lateral projection of the hand.
**10.Describe the condition which can be demonstrated using the palmar flexion lateral projection.
**11. Define “carpe bossu” (carpal boss).
**12. Relative to structures demonstrated, differentiate an oblique projection of the hand with the fingers extended and supported on a foam wedge and an oblique projection of the hand so that the fingertips touch the cassette.
**13. Describe the diagnostic purpose of an AP oblique bilateral exam of the hands (Norgaard method) and explain why this arrangement works.
**14. When evaluating for rheumatoid arthritis, locate the point of interest when viewing the AP bilateral oblique projection of the hands in either the finger-extended or cupped position.
**15. Explain the reason for slight abduction or the thumb when performing the bilateral “ball-catcher” projection.
**16. Explain the use of detail film/screen and low kV when radiographing hands for earling detection of rheumatoid.
**17. Describe the position of a particular finger or the thumb for the frontal, oblique and lateral projections.
**18. Describe the aspect of the hand best demonstrated in the radial-shift carpal canal position.

B. WRIST

****Indicates Advanced Position Objectives**

1. State the type of screen which should be used for an examination of the wrist.
2. State the routine projections commonly taken of the wrist.

**3. Be able to discuss or answer questions concerning the following positioning considerations:
a. part positions-(examples- AP, oblique, lateral, or other)
b. structure(s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen combinations used
e. film size/placement/identification/markers
f. beam alignment/angulation
g. beam limitation/shielding
h. patient instructions
1) respirations
2) other

4. Describe the difference in structures demonstrated in the PA and AP projections of the wrist.
5. State the purpose of the ulnar and radial flexion projections and identify the structures demonstrated in each.
6. Describe the differences in structures demonstrated in the posterior and anterior oblique projections of the wrist.
7. State the purpose of the carpal canal and carpal bridge tangential projections and identify the structures demonstrated in each.
8. Describe the purpose of the Stecher method to exam the wrist and discuss the variations of this method.

9. Explain the importance of the clenched fist when doing a radiograph of the wrist.
**10. Explain the need of doing an AP projection of the wrist when the carpal interspaces are points of interest.
**11. Explain the importance of elevating the fingers on a suitable support when doing an AP projection of the wrist.
**12. When a lateral view of the navicular bone is of interest, describe the action that should be taken to rotate the bone anteriorly into a dorsovolar position.
**13. Describe the variations of the Stecher method of navicular demonstration which would better show a superinferiorly angled fracture of this bone.
**14. Describe the projection which may be used to demonstrate the greater multangular bone free of superimposition of other carpal bones with the exception of the navicular.
**15. Identify the two projections which free the pisiform of the superimposition and demonstrate it in profile.
**16. Identify the pathology involving the dorsum of the wrist which may be shown in the tangential carpal bridge projection.

C. FOREARM

**** Indicates Advanced Mastery Level Required**

1. When given a drawing, skeletal part or a radiograph of the forearm, label or locate the following bones:
    a. Ulna
        1) Semilunar notch
        2) Coroniod
        3) Head
        4) Styliod
        5) Shaft
        6) Olecranon process
    b. Radius
        1) Head
        2) Neck
        3) Tuberosity
        4) Shaft
        5) Styliod
2. State the type of screen which should be used for an examination of the forearm and explain.
3. Be able to discuss or answer questions concerning the following positioning considerations:
    a. part position – (examples – AP and lateral)
    b. structure (s) visualized and functions demonstrated
    c. pathology demonstrated
    d. film/screen combination used
    e. film size/ placement/ identification/ markers
    f. beam alignment/ shielding
    g. patient instructions
        1) respiration
        2) other
4. Explain why the hand must be supinated for a frontal projection of the forearm.
5. Explain the importance of placing the whole upper extremity in the same horizontal plane for both the frontal and lateral projection of the forearm.**

D. Elbow

**Indicates Advanced Position Objectives

1. When given a drawing, skeletal part, or radiograph of the elbow, label or locate the following bones:
    a. ulna
        1) Semilunar notch
        2) Coronoid process
        3) Olecranon process
        4) Radial notch
    b. radius
        1) head
        2) neck
        3) tuberosity
    c. humerus
        1) trochlea

2) capitellum
3) medial and lateral condyle
4) medial and lateral epicondyle
5) coronoid fossa

**2. Be able to discuss or answer questions concerning the following positioning considerations:
a. part position-(example –AP, obliques, lateral)
b. structure(s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen/placement/identification/markers
e. beam alignment/angulation
f. beam limitation/shielding
g. patient instructions
1) respiration
2) other

3. Explain why the hand must be supinated for an AP projection of the elbow.
4. Explain the purpose of oblique views of the elbow.
**5. Contrast the radiologic examination of the partially and acutely flexed elbow with the routine AP and lateral projections of the elbow.
**6. Explain the rationale for the following methods of x-ray examination to demonstrate the radial head.
a. lateromedical rotation
b. Schmitt's angled projections, (Ballinger)
c. axial projections (hand supinated –hand pronated)
**7. For an axial projection of the olecranon, explain the difference in structures demonstrated for the 90 degree as opposed to the 20 degree angulation of the CR.
**8. Identify the specific oblique projection of the elbow which (1) demonstrates the coronoid process of the ulnar free of superimposition and demonstrated in profile (2) demonstrates the radial head free from superimposition.

E. HUMERUS

****Indicated Advanced Positioning Objectives**

1. When given a drawing, skeletal part, or radiograph of the humerus, label or locate the following bones:
a. head
b. greater tuberosity (tubercle)
c. lesser tuberosity (tubercle)
d. shaft
e. medial condyle
f. medial epicondyle
g. trochlea
h. capitellum
i. lateral condyle
j. lateral epicondyle
k. coronoid fossa
l. surgical neck
m. anatomic neck
n. bicipital groove

**2. Be able to discuss or answer questions concerning the following positioning considerations:
a. part position – (examples –AP, lateral, transthoracic lateral)
b. structure(s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen/placement/identification/markers
e. beam alignment/angulation
f. beam limitation/shielding
g. patient instructions
1) respiration
2) other

3. For an AP and lateral projection of the humerus, describe the position of the coronal plane passing throughout the epicondyles in relation to the plane of the film.
4. Describe the variation in exposure factors when performing projections of the humerus bucky as opposed to non-bucky.

5. Describe the importance of correct part/film/grid/CR alignment when performing a humerus examination in the bucky.
6. State the patient conditions that would indicate projections of the humerus being performed erect rather than recumbent and vice-versa.
7. Explain the breathing instructions which should be given to the patient when performing exams of the humerus and the reason for special breathing instructions.
8. Associate the term Lawrence method with the transthoracic lateral projections of the humerus.
9. Identify patient conditions that would indicate performing a transthoracic lateral projection of the humerus instead of a routine lateral projection.
10. Compare the anatomic definition seen in a radiograph of the upper humerus using the transthoracic lateral projection with the definition seen in the routine lateral or axial projection.
11. State the preferred patient position for the transthoracic lateral projection.
12. State the reason for instructing the patient to hold his breath on full inspiration instead of full expiration when using a non-breathing technique for the transthoracic lateral projection of the humerus.
13. When doing a transthoracic lateral projection of the humerus, explain the conditions under which an extended exposure time would be advisable.

F. SHOULDER GIRDLE (Shoulder, Clavicle, Acromioclavicular Articulations, and Scapula) – 80% Minimum Mastery Level Required

**** Indicated Advanced Positioning Objectives**

1. When given a drawing, skeletal part, or radiograph of the shoulder girdle, label, locate, or identify the following:
    a. Clavicle
        1) Shaft
        2) Sternal extremity
        3) Acromial extremity
    b. Scapula
        1) Axillary border
        2) Vertebral border
        3) Coracoid process
        4) Acromion
        5) Glenoid fossa
        6) Body
        7) Medial angle
        8) Intraspinatus fossa
        9) Supraspinatus fossa
        10) Inferior angle
        11) Scapular notch
        12) Anterior surface
        13) Posterior surface

**2. Be able to discuss or answer questions concerning the following positioning considerations:
    a. part positions (examples- AP, coracoid process and glenoid fossa, axial projection, acromioclavicular articulations, clavicle and scapula)
    b. structure(s) visualized and functions demonstrated
    c. pathology demonstrated
    d. film/screen/combination used
    e. film size/placement/identification/markers
    f. beam alignment/angulation
    g. beam limitation/shielding
    h. patient instructions
        1) respiration
        2) other
3. Identify patient conditions that would indicate performing radiologic examinations of the shoulder in the erect position as opposed to the recumbent position.
4. Describe the difference in structures demonstrated in the AP internal, external, and neutral projections of the shoulder and explain when rotation of the arm would be contraindicated.
5. State the special breathing instructions that should be given to the patient when radiographing the shoulder girdle and explain.
6. Describe the adjustment in exposure factors which is necessary when performing projections of the shoulder girdle bucky as opposed to non bucky.

7. For an AP projection of the shoulder, explain the difference in structures demonstrated with a CR angulation of 90 degrees as opposed to a caudad angulation of 25 to 15 degrees.

**8. Explain the centering and direction of the central ray and the position of the cassette for an AP axial projection of the coracoid process.

**9. Explain the importance of rotating the body approximately 45 degrees toward the affected side when examining the glenoid fossa.

10. Associate the term Lawrence method with the inferosuperior axial projection of the shoulder.

**11. Explain the significance of a 35 degree cephalic angulation (axial projection) of the shoulder.

12. Explain the rationale for placing the patient in an erect position when radiographing the acromioclavicular joints.

13. Define dislocation and subluxation.

14. Explain the significance of equal weight in each hand when examining the acromioclavicular joints.

**15. Differentiate the Pearson method of A.C. joint demonstration with the Alexander methods.

**16. Explain the significance of CR angulation when using Alexander's method of unilateral AP and lateral demonstration of the acromioclavicular articulations.

17. Identify the preferred position of the body when doing a clavicular x-ray examination.

18. Describe the indications for examination of the clavicle in the PA position.

19. Describe the position of the head for examination of the clavicle in the PA position.

20. Explain why a PA projection of the clavical produces a more detailed view of the clavical than the AP projection.

**21. Explain the purpose and significance of an axial projection of the clavicle.

22. State the reason for requiring the patient to suspend respiration on full exhalation when radiographing the clavicle in the AP or PA projections.

23. State the reason for requiring the patient to suspend respiration on full inhalation when radiographing the clavicle in the AP axial projection.

24. Describe the position of the arm when radiographing the scapula in the AP projection.

25. State the reason for requiring the patient to continue normal breathing when radiographing the scapula in the AP projection.

**26. Compare structures demonstrated of the scapula using the PA oblique projection (Lorenz method) with the structures demonstrated using the PA oblique projection (Lilienfeld method).

**27. Describe the difference in arm and hand adjustment using the Lorenz method of scapula demonstration as opposed to using the Lilienfeld method.

28. When doing a lateral projection of the scapula, describe the variations in arm adjustment necessary to demonstrate (1) the scapular body, (2) the acromion and coracoid processes, and (3) the glenohumeral joint.

**29. When examining the scapula in the AP oblique projections, describe the variations in arm adjustment which result in (1) an AP oblique demonstration, (2) an oblique later demonstration, (3) a direct lateral demonstration.

30. Describe the two major reasons for examining the scapula in body positions other than the AP positions.

**31. Describe the major objective of all bicipital grove projections.

**32. State the diagnostic value of the scapular Y projections.

**33. In the scapular Y projection of the scapula, identify the anatomic structures making (1) the vertical component of the Y, (2) the medial component of the upper limbs, (3) the lateral component of the upper limbs.

**34. Describe the appearance of the humeral head (1) in a normal shoulder, (2) in an anterior dislocation, and (3) in a posterior dislocation.

**35. Describe the benefit derived by doing the tangential projections of the clavicle.

**36. Identify the projections which will demonstrate the spine of the scapula projected in profile and free of bony superimposition.

LOWER EXTREMITY POSITIONING (B, C, D, E, and F) - 80% Minimum Mastery Level Required

****A. Be able to discuss or answer questions concerning the following positioning considerations: (All positions of the lower extremities)**

a. Part position – (examples- AP, oblique, lateral, dorsoplantar)
b. Structure (s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen combination used
e. film size/placement/identification/markers
f. beam alignment/angulation
g. beam limitation/shielding
h. patient instructions
    1) respirations
    2) other

B. FOOT- TOES- ANKLE

**** Indicates Advanced Positions**

1. When given a drawing, skeletal part, or radiograph of the foot or ankle, label or locate the following bones and identify bones which articulate:
    a. foot
        1) phalanges (phalanx
            a) distal
            b) middle
            c) proximal
        2) metatarsals (1^{st}-5^{th})
        3) tarsus
            a) internal or 1^{st} cuneiform
            b) middle or 2^{nd} cuneiform
            c) external or 3^{rd} cuneiform
            d) cuboid
            e) navicular or scaphoid
            f) talus or astragalus
            g) clacaneous or os calcis
    b. ankle
        1) talus
        2) tibia
            a) medical malleolus
        3) fibula
            a) lateral malleolus
    c. Articular facets of Calcaneus (subtalar joints)
        1) tuberosity
        2) anterior articular facet
        3) middle articular facet
            a) floor of sinus tarsi
            b) sustentaculum tarsi
        4) posterior articular facet
2. State the type of screens which should be used for radiographic examinations of the foot and ankle.
3. Describe the structures demonstrated when radiographing the toes in the three routine positions.
4. State why a 15 degree angle should be used when the toes are radiographed in the dorsoplantar projection and why no angulation is needed in the plantodorsal projections.
5. State which type of oblique projection of the toes will better demonstrate the phalanges and joint space.
6. Describe the structures demonstrated when radiographing the foot in three different positions.
7. State the differences in structures demonstrated in a dorsoplantar projection of the foot when a 10 degree angle (posteriorly) is used opposed to no angulation of the C.R.
8. Compare structures demonstrated in the medial oblique view of the foot with structures demonstrated in the lateral oblique view of the foot.
9. State why the lateromedial projection of the foot is a more accurate projection than the mediolateral projection.

**10. Explain the purpose of weight-bearing studies of the foot and describe the structures shown.

**11. Explain the need for bilateral examination of the feet for longitudinal arch studies.

**12. State the point of centering of the film and CR in weight-bearing studies of the foot.

**13. Explain the significance of equal distribution of weight on the feet for longitudinal arch studies.

14. Explain the significance of placing the sole (plantar surface) of the foot perpendicular to the plane of the film (horizontal) in examinations of the calcaneus.
15. Describe, locate, and identify the component aspects of the calcaneus when it is shown in an axial and lateral projection.
16. Compare central ray angulation for a plantodorsal axial projection of the calcaneus with CR angulation for a dorsoplantar axial projection of the calcaneus.
17. State the relation of the malleolar plane to the plane of the film in an AP, oblique, and a lateral projection of the ankle.
18. Explain why the foot is flexed to place its long axis in the vertical position for each of the three projections of the ankle.
19. Explain the purpose of slight inversion of the foot, using care not to rotate the leg, in AP projections of the ankle.

20. Explain the importance of perfect centering over the ankle joint for all views of the ankle.
21. State the external bony prominence which is at the level of the ankle joint.
**22. List two advantages to radiographing the ankle with the medial surface against the film rather than the more common practice of placing the lateral surface against the film.
23. List the three routine projections of an ankle.
24. Describe the structures shown in a medial oblique of the ankle.
**25. Describe the procedure for performing an AP stress examination of the ankle and reason for performing such study.
**26. Describe the appearance of the ankle with a torn ligament in an AP stress study.
**27. Identify the stress maneuver to test for rupture of (1) the lateral ligament and (2) the middle ligament of the ankle.
**28. Describe the projections which will demonstrate the sesamoids of the first metatarsal free of superimposition or overlap.
**29. Describe the anatomic structures which are shown in the dorsoplantar, medial and lateral obliques of the foot and identify the plantodorsal equivalent of the projections.
**30. Describe the structures which are shown in the 45 degree plantodorsal oblique projection of the foot.
**31. Describe the radiologic procedure which will demonstrate the entire foot free of superimposition of the lower leg (tibia and fibula) and explain the diagnostic value of the projection.
**32. Define the following terms:
    a. Clubfoot
    b. Talipes equinovarus
    c. Equinus
    d. Varus
    e. Valgus
**33. Identify the typical (3) three deviations from the normal alignment of the foot when the patient has clubfoot.
**34. Name the primary objective of Kite's methods of demonstrating clubfoot.
**35. Identify the clubfoot deviation shown by each of the following projections of the foot:
    a. Dorsoplantar
    b. Lateral
**36. Describe the benefit of doing a suroplantar (axial) projection for clubfoot analysis (Kandel method).
**37. Describe the diagnostic significance of an oblique projection of the calcaneus.
**38. Define subtalar joint.
**39. Describe the projection which will demonstrate the anterior and posterior subtalar joint and how the sinus tarsi "end-on".
**40. Describe Broden's methods of radiographically demonstrating the posterior articular facet of the calcaneus. Explain the diagnostic value of the projections.
**41 Identify the subtalar joint demonstrated by each of the projections described by Isherwood:
    a. Oblique lateral
    b. Medial oblique
    c. Lateral oblique
**42. Explain the diagnostic value of a lateral oblique projection of the ankle.

C. LEG – KNEE – PATELLA

****Indicates Advanced Radiographic Projections**

1. When given a drawing, skeletal part, or radiograph of the leg, knee, patella, or femur label or locate the following bones which articulate:
    a. leg
        1) tibia
            a) spines
            b) medial condyle
            c) lateral condyle
            d) tuberosity
            e) shaft
            f) medial malleolus
        2) fibula
            a) styloid
            b) head
            c) shaft
            d) lateral malleolus
    b. knee

1) lower leg (proximal end)
    a) tibial spines
    b) styloid of fibula – (not part of knee joint proper)
    c) head of fibula – (not part of knee joint proper)
    d) lateral condyle (tibia)
    e) medial condyle (tibia)
2) femur (distal part)
    a) lateral condyle
    b) medial condyle
    c) lateral epicondyle
    d) medial epicondyle
    e) intercondylar fossa
3) patella
    a) base
    b) apex
    c) body

2. Lower Leg (tibia and fibula)
    1. State the two routine projections used to demonstrate the lower leg.
    2. State the relation of the malleolar plane or the condylar plane to the plane of the film in an AP, oblique, and a lateral projection of the lower leg.
    3. State the centering and direction of the central ray for the AP and lateral projections of the lower leg.
    4. State the relation of the intercondylar plane to the plane of the film in an AP, oblique, and a lateral projection of the knee.
    5. Explain the reason for a 5 to 7 degree cephalad angulation of the CR when radiographing the knee joint in the AP/PA or lateral projection.
    6. Describe the lateral and medial interspace of the knee joint if the AP or PA projection of the knee is correct.
    7. State the degree of flexion of the knee normally used in lateral survey studies and explain the reason for the degree of flexion.
    8. State what the degree of flexion should be in a lateral projection of the knee when there is a new or unhealed patellar fracture.
    9. Describe to interspace between the patella and femoral condyles if the lateral projection of the knee is correct.
    10. Identify the PA and AP oblique projections of the knee which demonstrates the head of the fibula and the proximal tibiofibular articulation.
    **11. Explain the significance of weight-bearing AP projections of the knees checking for arthritis.
    **12. Define the terms varus, valgus, and osteotomy.
    **13. Contrast the examination of bilateral arthritic knees with that for unilateral examination in terms of centering the CR and weight-bearing.
    14. State the three methods that can be used to demonstrate the intercondyloid fossa and which ones are AP projections or PA projections; which are superoinferior projections or inferosuperior projections.
    15. State which method of intercondyloid fossa demonstration will give a more open view of the fossa.
    16. Describe the relation of the CR to the long axial of the tibia (leg) for demonstration of the intercondyloid method; using the Holmblad method.
    17. State the point of centering of the CR for all three methods of intercondyloid fossa examination.
    18. State three pathologic conditions of the knee which may be shown with an intercondyloid projection.
    19. Explain the rationale for a PA projection of the patella as opposed to an AP projection.
    20. State why the heal is rotated 5 to 10 degrees laterally in the PA projection of the patella.
    21. State what can be done to the patient to help relieve pain when positioned for a PA projection of the patella.
    **22. State the prime objective in demonstrating the patella using the Kuchendorf method.
    23. Describe why caution should be taken in flexing the knee for a tangential (Settegast method) projection of the patella.
    24. Describe the variations in body position that can produce a tangential projection of the patella.
    25. State the traditional term used to denote a tangential projection of the patella; an intercondyloid fossa projection.
    26. State the purpose of tangential projections of the patella.
    **27. Describe the diagnostic value of a weight-bearing knee AP projection), and also describe the projection.
    **28. Explain the need for equal weight distribution on both feet when doing weight-bearing projections of the knees.

FEMUR – PELVIS AND UPPER FEMURS (B, C, D, E, F) 80% Minimum Mastery Level required

*1. Be able to discuss or answer questions concerning the following positioning considerations: (All positions of the femur and pelvis and upper femora)
   a. part position – (examples – AP, lateral, axiolateral)
   b. Structure(s) visualized and functions demonstrated
   c. pathology demonstrated
   d. film/screen combination used
   e. film size/placement/identification /markers
   f. beam alignment/angulation
   g. beam limitation/shielding
   h. patient instructions
      1) respiration
      2) other

*2. When given a drawing, skeletal part, or radiograph of the femur or pelvis and upper femora, label or locate the following bones and identify bones which articulate:
   a. femur (proximal and distal aspect)
      1) Head
      2) Greater Trochanter
      3) Lesser Trochanter
      4) Neck
      5) Shaft
      6) Medial epicondyle
      7) Medial condyle
      8) Lateral epicondyle
      9) Lateral condyle
      10) Intercondylar fossa
      11) Fovea capitis
      12) intertrochanteric crest and line
   b. pelvis
      1) ilium
         a) iliac crest
         b) posterior superior and inferior spine
         c) anterior superior and inferior spine
         d) ala
         e) body
      2) ischium
         a) spine of ischium
         b) inferior and superior ramus
         c) ischium tuberosity
      3) pubis
         a) inferior and superior ramus of pubis
         b) symphysis pubis
      4) general
         a) greater sciatic notch
         b) lesser sciatic notch
         c) obturator foramen
         d) acetabulum (ilium, ischium and pubis)
         e) sacrum
         f) sacroiliac joints
      5) hip joint (ball and socket joint)
         a) acetabulum (os coxae or os innominatum)
         b) femoral head

3. Identify the two bony points of localization for the hip joint.
4. Describe the method of localizing the long axis of the femoral neck and hip joint.
5. Describe the structural difference of the pelvis with stature and with sex.
6. Define false pelvis; true pelvis.
7. Define inlet of true pelvis and describe the measurement for it.

8. Define outlet of true pelvis and describe the measurement for it.
9. Identify the bony palpable landmarks used in radiography of the pelvis and hips.
10. Identify the spinal interspace or disk space at the level of the iliac crest.
11. Identify the sacral segment at the level of the anterior superior iliac spine.
12. Identify the structures of the pelvis at the level of the highest point of the greater trochanter.
13. Identify the structure of the pelvis at the level of the most prominent point of the greater trochanter.
14. Explain the importance of including one or both joints on radiographs of the extremities.
15. Explain the need to invert the foot 15 degrees on studies of the femur or pelvis.
16. State the anterior and superior angle the average adult femoral neck will form.
17. Describe radiation protection techniques which should be used when examining the femur or upper femora and pelvis.
18. Describe the difference in lower extremity (leg) placement when radiographing the femur in the lateral position to include the knee as opposed to the hip.
19. Describe the variation in exposure factors when performing projections of the femur bucky as opposed to non-bucky.

**20. Explain the objective of two projections of the pelvis, one with a perpendicular CR and one with a 45 degree cephalic angulation of the CR, to demonstrate the relationship of the femoral head to the acetabulum in patients with congenital dislocation of the hip.

21. Describe the leg placement and central ray angulation for studies of the femoral necks using Cleaves method of femoral neck examination.
22. Associate the term frog with the Cleave's method of femoral neck examination.
23. Describe an exact lateral position of the pelvis relative to acetabular shadows and femoral heads.
24. Explain what precautions should be taken when performing a "Frog" lateral of the hip, and when an axiolateral projection should be preformed.
25. Explain the significance of using a large enough film to include the entire pelvic girdle and upper femora when doing the initial examination of the hip.
26. Explain when inversions of the foot in hip or pelvis studies is contraindicated.
27. Explain the need for examining the hip both in the AP and lateral projections.
28. Explain the special precautions that must be taken when using a stationary grid.
29. In studies of the anterior pelvic bones (AP axial projection) compare angulation of the CR for male and female patients.

**30. Compare the AP axial projection of the anterior pelvic bones (Taylor method) with the AP axial projection (Lilienfeld method).

**31. Associate the PA projection (Staunig method) with being the reverse (exact duplicate) of the AP axial projection (Taylor method).

**32 Associate the PA projection of the anterior pelvic bones with being the reverse (exact duplicate) of the AP axial projection (Taylor method).

**33. Describe the diagnostic value of the axial projection, Chassard-Lapine method of radiographing the pelvis and hip joints.

**34. Compare a modified Cleaves method of femoral neck examination with the original Cleaves method.

**35. Compare the Lauenstein and Hickey methods of hip radiography with the Cleaves methods.

**36. Explain when the Clements-Nakayama method of lateral hip demonstration would be appropriate to use.

**37. Identify the special requirement of the Leonard-George method of lateral hip radiography.

**38. Describe the Friedman method of lateral hip radiography.

**39. Explain when the PA oblique, Hsieh method of hip radiography would be appropriate to use.

**40. Explain when the AP oblique, Urist method of hip radiography would be appropriate to use.

**41. Describe the posterolateral projection (Lilienfeld method) of hip radiography and give the precautions which should be taken with this position.

**42. Identify the projection which will demonstrate the fovea capitis and the superior posterior wall of the acetabulum.

**43. Describe the projection which will demonstrate the acetabula in profile from a plane at right angles to the frontal plane and the relationship of the femoral heads to the acetabula.

**44. Identify the projection of the ilium which will demonstrate an unobstructed image of the iliac wing and of the sciatic notches and a profile image of the acetabulum.

**45. Identify the projection which shows an oblique image of the ilium and of the proximal end of the femur.

BONY THORAX (B, C, D, E, AND F) 80% Minimum Mastery Level Required
**** Indicated Advanced Positions**

1. Be able to discuss or answer questions concerning the following positioning considerations: (All positions of the sternum, sternoclavicular articulations, and ribs)
   a. part position – (examples AP, PA oblique, lateral)

b. structure (s) visualized and functions demonstrated
c. pathology demonstrated
d. film/screen combination used
e. film size/placement/identification/markers
f. beam alignment/angulation
g. beam limitation/shielding
h. patient instructions
1) respiration
2) other

2. When given a drawing, skeletal part, or radiograph of the sternum or bony thorax, label or locate the following bones and identify bones which articulate:
a. sternum and sternoclavicular joints
1) manubrium (articulates with clavicle and 1st costal cartilage)
2) gladiolus (body) (articulates with costal cartilage 3rd -7th)
3) Xiphoid (ensiform)
4) sternal angle (articulation of manubrium and gladiolus)
5) suprasternal notch (superior border of manubrium)
b. ribs
1) head – articulates with vertebral bodies to form costovertebral joints (1st, 10th, 11th, and 12th ribs each articulates with one vertebral body.
2) neck
3) tubercle (articulates with the transverse process of a thoracic vertebra to form costotransverse articulations except in the 11th and 12th ribs)
4) shaft
5) anterior, posterior, and axillary aspect
c. sternoclavicular joints
1) sternal ends of clavicles
2) clavicular notches of the manubrium

A. Sternum
1. State the rationale for using the RAO position for sternal radiography as opposed to (1) the LAO position and (2) the PA position.
2. State the rationale for using breathing motion in radiographic examination of the sternum in the frontal projection.
3. Explain the use of deep inhalation for radiographic examination of the sternum in the lateral position.
4. Explain the reason for rotating the shoulders posteriorly and having the patient lock his hands behind his back in radiographic examinations of the sternum in the lateral projection.
5. Identify the circumstance when it may be necessary to examine the sternum in the horizontal ray (cross-table) lateral projection.
**6. Describe radiographic procedures which may be used to radiograph the sternum in the frontal position.

B. Sternoclavicular Articulations
1. Identify the spinous process of the 3rd thoracic vertebra as the point to center the CR to the manubrial notch or the sternoclavicular articulations.
2. State the rationale for asking the patient to turn his head to face the affected side when unilateral radiographic examinations of the sternoclavicular is done.
3. Describe the benefit for using a short focus – film distance in radiographic examination of the sternoclavicular joints in the PA projection.
4. Explain the reason for radiographic examination of the sternum in an oblique projection using the CR angulation method.
5. Identify the problem associated with radiographic examination of the sternum in an oblique projection using the central ray angulation method, joints in the oblique projections.
6. State the benefit of using the CR angulation method of oblique sternal examination.
**7. State the rationale for the placement of the shoulders in the radiographic examination of the sternoclavicular joint in the lateral position (Kurzbauer method).
**8. State the rationale for (1) exposure at the end of full inhalation and (2) 15 degrees caudad angulation of the sternoclavicular joint in the lateral position (Kurzbauer method).

C. Ribs
1. State the projection which should be done to demonstrate the following:
a. anterior aspect of the ribs
b. axillary aspect of the ribs
c. posterior aspect of the ribs

d. costal joints

2. State the appropriate AP or PA oblique position of the body for radiographic demonstration of (1) the right axillary aspect of the ribs; (2) the left axillary aspect of the ribs.
3. Explain the reason for suspension of respiration at the end of deep exhalation for ribs below the diaphragm and at the end of full inhalation for ribs above the diaphragm.
4. Explain the reason for an oblique projection to demonstrate the axillary aspect of the ribs.
5. State the rationale for high centering of the CR when the 7^{th}, 8^{th}, and 9^{th} ribs are to be demonstrated.
6. State the angle, centering point and direction of the CR for radiographic examination of the costovertebral and constotransverse joints.

**7. Describe the placement of arms for radiography of the ribs above and below the diaphragm and give the rationale.

Anatomy of Vertebral Column (A,E, and F) 80% Minimum Mastery Level Required

1. Name the five major groups of vertebrae and state the number of vertebra normally found in each group.
2. Define the following terms:
   a. lordotic curve
   b. kyphotic curve
   c. primary curve
   d. secondary or compensatory curve
   e. scoliosis
3. Differentiate the lumbar-pelvic curve of a male with a lumbar-pelvic curve of a female.
4. Describe the two types or joints found in the vertebral column and identify the joints which represent each type.
5. State the four types of movements permitted in the vertebral column and describe each movement.
6. Given a diagram, anatomic structures or radiograph, identify and/or locate the following parts of a typical vertebra.
   a. body
   b. vertebral arch
   c. vertebral canal
   d. pedicles
   e. laminae
   f. spinous processes
   g. apophyseal joints
   h. superior inferior articulating facets
   i. transverse processes
   j. vertebral formina
7. Associate the term atlas with the first cervical vertebra and the term axis with the second cervical vertebra.
8. Compare and contrast the first cervical (atlas) with the other cervical vertebrae and the vertebral segments in general.
9. Compare and contrast the second cervical (axis) with the other cervical vertebrae and the vertebral segments in general.
10. Differentiate the typical cervical vertebra from the rest of the vertebrae in the vertebral column.
11. Compare and contrast the seventh cervical vertebra (vertebra prominens) with other cervical vertebrae.
12. Identify the radiographic projection which will best demonstrate the following structures of the cervical vertebrae:
    a. cervical bodies (AP) (lateral)
    b. transverse processes (AP)
    c. spinous processes (lateral)
    d. apophyseal joints (lateral)
    e. intervertebral foramina (oblique)
    f. pedicles (lateral, oblique)
    g. laminae (oblique, pillar)
    h. intervertebral disc (AP, lateral, oblique)
13. Compare and contrast the typical thoracic vertebra from the rest of the vertebrae in the vertebral column.
14. Define the following:
    a. demifacet
    b. facet
    c. costovertebral joint
    d. costotransverse joint
15. Identify the radiographic projection which will best demonstrate the following structures of the thoracic vertebrae:
    a. thoracic bodies (AP, lateral)
    b. transverse processes (AP)
    c. spinous process (lateral)
    d. apophyseal joint (oblique)

e. intervertebral foramina (lateral)
f. pedicles (lateral)
g. costovertebral/costotransverse joints (AP-CR angled toward head)
h. laminae (AP superimposed and tomography)

16. Compare and contrast the typical lumbar vertebra from the rest of the vertebrae in the vertebrae column.
17. Identify the radiographic projection which will best demonstrate the following structures of the lumbar vertebrae:
    a. lumbar bodies (AP, lateral)
    b. transverse processes (AP)
    c. spinous process (lateral)
    d. apophyseal joints (oblique and AP superimposed)
    e. intervertebral foramina (lateral) (1-4 only)
    f. pedicles (lateral)
    g. laminae (oblique and AP superimposed)
    h. L-5/S-1 intervertebra foramen (oblique, axial)
18. Differentiate the male sacrum from the female sacrum.
19. Explain the purpose of intervertebral foramina and sacral foramina.
20. Given a diagram, anatomic model, or radiograph, identify and/or locate the following parts of the sacrum and coccyx:
    a. body (sacrum)
    b. sacral promontory (sacrum)
    c. ala (sacrum)
    d. articular surface for articulation with the iliac bone (sacrum)
    e. sacral cornua
    f. coccygeal vertebrae
    g. coccygeal cornua
    h. sacral canal

Radiography of the Spinal Column - 80% Minimum Mastery Level Required

A. Occipitocervical Articulations (B, C, D)

**** Indicates Advanced positions or Understanding**

1. Be able to discuss or answer questions concerning the following positioning considerations: AP oblique or bilateral PA projection
    a. part position (examples- AP, oblique, lateral, or other)
    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. Explain the evaluation of criteria use to determine the accuracy of positioning when radiographing the L or R occipitocervical articulations unilaterally.
3. In the AP oblique projection of the occipitocervical articulation, identify the articulation which is demonstrated (the one closer or farther from the film).
4. Describe the evaluation criteria used to determine the accuracy of positioning when radiographing the occipitocervical articulations bilaterally.
5. Given a diagram, anatomic model, or radiograph, identify and/or locate the following :
    a. occipital condyle
    b. superior facets (atlas)

** 6. Identify the projection which demonstrates the occipitocervical articulations shown projected through the antra.

B. ATLAS AND AXIS (B,C, and D)

**** Indicates Advanced Positions or Understanding**

** 1. Be able to discuss or answer questions concerning the following positioning considerations:
    a. part position (examples- AP, oblique, lateral, or other)
    b. structure(s) visualized and functions(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

2. Explain the rationale for placing the midsagittal plane perpendicular to the film and having the patient open his/her mouth for an AP projection (open mouth) image of the atlas and axis.
3. Explain the rationale for placing a line from the lower edge of the upper incisors to the tip of the mastoid process perpendicular to the film when doing an open mouth projection of the atlas and axis.
4. Explain the rationale for phonation during an open mouth projection of the atlas and axis.
5. Describe the head type which presents the most problems in projecting the entire atlas.
6. Describe an image of the atlas and axis (open mouth) which is not capable of being improved.
7. Explain the correction in head position which must be made if the upper incisors are superimposed over the odontoid process.
8. Explain the correction in head position which must be made if the base of the skull is superimposed over the odontoid process.
9. Describe the evaluation criteria used to determine the accuracy of positioning in an open mouth (AP projection) of the atlas and axis.
10. Given a diagram, anatomic model or radiograph, identify and/or locate the following:
a. odontoid
b. base of skull
c. axis
d. atlas
e. atlas-axis articulation

C. Odontoid Process (Atlas) (B,C, and D)

**** Indicates Advanced Positions or Understanding**

**1 Be able to discuss or answer questions concerning the following positioning considerations:
(All projections of the cervical vertebrae)
a. part position (examples – AP, PA, oblique, lateral or other)
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. patient instructions:
1) respiration
2) other

**2. In Fuch's method for odontoid demonstration, explain the rationale for placing the sagittal plane perpendicular and extending the chin until the tip of the chin and mastoid process are vertical.
**3. Explain the rationale for suspended respiration (Fuch method-odontoid).
**4. Describe the conditions in which the Fuch's, Judd or Kasabach method for odontoid demonstration is contraindicated.
**5. Explain the reason for using Fuch's, Judd or Kasabach method of odontoid demonstration. Give the alternate procedure.
**6. Describe the evaluation criteria used to determine the accuracy of positioning in the Judd, Kasabach and Fuch's method of odontoid demonstration.
7. Given a diagram, anatomic model or radiograph, identify and/or locate the following:
(Judd and Fuch's method)
a. anterior arch of the atlas
b. odontoid process
c. foramen magnum
d. posterior arch atlas
e. occipital bone

**8. When a patient's condition contraindicates that his/her head be rotated, describe what can be done to obtain the demonstration of the odontoid using the Kasabach method.

9. Describe the evaluation criteria used to determine the accuracy of a lateral projection of the atlas and axis.
10. Discuss the improvement in definition obtained with a lateral projection of the atlas and axis.

D. Cervical Vertebrate (B,C, and D)

**** Indicates Advanced Positions or Understanding**

1. Be able to discuss or answer questions concerning the following positioning considerations:
    a. part position (examples – AP, PA, oblique, lateral, or other)
    b. structure(s) visualized and function(s) demonstrated
    c. pathology demonstrated
    d. film size/ placement/ identification/ markers
    e. beam angulation and alignment to part and film
    f. patient instructions:
        1) respiration
        2) other
2. For an AP projection of the cervical vertebrae, explain the significance of the following:
    a. extension of head so that the occlusal plane and mastoid tips are in the same transverse plane.
    b. angle CR through fouth cervical body 15-20 degrees cephalad.
3. Describe the evaluation criteria used to determine the accuracy of the AP projection of the cervical vertebrae.
4. Given a diagram, anatomic model, or radiograph of an AP projection of the cervical vertebrae, identify and/or locate the following:
    a. occipital bone
    b. interpediculate space
    c. intervertebral disc
    d. spinous processes
    e. body
    f. transverse processes
5. For a lateral projection of the cervical vertebrae, explain the significance/ importance of the following:
    a. equal weight bearing on each arm
    b. rotation of shoulders anteriorly or posteriorly (rounded shoulders and kyphosis)
    c. parallelism of cervical vertebrae (sagittal plane)
    d. slight elevation of patient's chin
    e. exposure taken on full exhalation
    f. 60-72 inch SID/FFD
6. Given a diagram, anatomic model, or radiograph of an lateral projection of the cervical vertebrae, identify and/or locate the following:
    a. cervical bodies
    b. intervertebral spaces
    c. articular pillars
    d. lower five articular facets (apophyseal joints)
    e. spinous processes
    f. pedicles
7. Describe the evaluation criteria used to determine the accuracy of the lateral projection of the cervical vertebrae.

**8. Analyze projections of the cervical vertebrae in lateral extension and flexion as to function demonstrated.

**9. Describe the position of the spinous process in lateral flexion; in lateral extension.

**10. Describe the evaluation criteria used to determine the accuracy of an extension or flexion lateral projection of the cervical vertebrae.

11. For an oblique projection of the cervical spine, explain the significance/importance of the following:
    a. entire body rotated to 45 degrees to place the foramina parallel to the film plane
    b. slight extension of the head
    c. CR angulation of 15-20 degrees caudal- PA or 15-20 degrees cephalad- AP
    d. center film approximately one inch below/ above where CR enters (C-4)
12. Identify the intervertebral foramina demonstrated when a PA oblique projection of the cervical vertebrae is done; when an AP oblique projection of the cervical vertebrae is done.

**13. Explain the rationale for oblique flexion/extension projections of the cervical vertebrae.

14. Evaluate an oblique projection of the cervical vertebrae relative to positioning / procedure accuracy.
15. Given a diagram, anatomic model, or radiograph of an oblique projection of the cervical vertebrae, identify and/or locate the following:
    a. intervertebral foramina

b. intervertebral disc spaces
c. bodies
d. pedicles
e. spinous processes

E. Cervical and Cervicothoracic – Thoracic Vertebrae (B, C and D)

**** Indicates Advanced Radiographic Projections**

**1. Be able to discuss or answer questions concerning the following positioning considerations:
a. part position (examples – AP, PA, oblique, lateral or other)
b. structure(s) visualized and function(s) demonstrated
c. pathology demonstrated
d. film size/placement/identification/markers
e. beam angulation and alignment of part and film
f. patient instructions
1) respiration
2) use or control of motion
3) other

**2. State the major objective of the AP projection of the cervical vertebrae using Ottonello's method.

**3. Explain the exposure adjustment necessary to accomplish the goal of the Ottonello method of cervical vertebrae demonstration.

**4. For an AP projection (Ottonello method) of the cervical spine, explain the significance/importance of the following:
a. midsagittal plane perpendicular to film plane
b. extend the head such that the upper incisors and mastoid tips are in the same transverse plane

**5. Evaluate an AP projection of the cervical spine (Ottenello method) for positioning and procedure accuracy.

**6. State the major objectives of the vertebral arch projections.

**7. Associate pillar or lateral mass projections with radiographic studies of the vertebral arch.

**8. Know the significance/importance of hyperextension of the chin for AP projections of the vertebral arch.

**9. For an AP projection of the vertebral arch, describe the relationship of the beam angulation to the degree of lordosis of the cervical spine.

**10. For an AP pillar projection of the cervical spine, describe the method used to reduce an accentuated cervical curve.

**11. Evaluate an AP-vertebral arch projection of the cervical spine for positioning and procedure accuracy.

** 12. For an oblique axial projection of the vertebral arch of the cervical vertebre, explain the significance/importance of the following:
a. the examination of both sides
b. a 45-50 degree rotation of the patient's head
c. a 60-70 degree rotation of the patient's head
d. a 30-40 degree caudal angulation of the CR
e. patient condition

** 13. Identify the vertebral arch structures which will be demonstrated when an AP oblique axial projection of the cervical vertebrae is done; when a PA oblique axial projection is done.

** 14. Evaluate an oblique axial projection of the cervical spine for positioning and procedure accuracy.

** 15. Given a diagram, anatomic model or radiograph of an AP axial projection of the cervical vertebrae, identify and/or locate the following:
a. apophyseal joints
b. pillar or lateral mass
c. superior articular process
d. inferior articular process
e. lamina
f. spinous processes

** 16. Describe the precautions which must be taken when doing cervical spine examinations of a head or neck trauma patient.

** 17. For the head or neck trauma patient, describe appropriate methods which may be used to prevent superimposition of the shoulders over C-7.

** 18. Describe the procedure which must be followed to evaluate the cervical intervertebral foramina and pedicles in a head or neck trauma patient.

F. Cervicothoracic and Thoracic Vertebrae (A-F) – 80% Minimum Mastery Level Required

*Indicates advanced radiographic projections

1. Be able to discuss or answer questions concerning the following positioning considerations:
a. part position (e.g. – AP, PA, oblique, lateral)

b. structure(s) visualized and function(s) demonstrated
c. pathology demonstrated
d. film size/placement/identification/markers
e. beam angulation and alignment of part and film
f. patient instructions
    1) respiration
    2) others

2. Associate Twining with a method of cervicothoracic examination.
3. Relative to the radiologic examination of the cervicothoracic region of the vertebral column, explain the significance /importance of the following:
    a. adjustment of the sagittal plane parallel to the film plane
    b. adjustment of the midaxillary line of the body to the center of the film
    c. elevation of the arm adjacent to the film to the vertical position
    d. adjustment of the arm farther from the film to a hanging position so that the shoulder is depressed
    e. rotation of opposing shoulders in opposite directions
    f. suspended respirations
    g. adjustment of exposure factors to penetrate the shoulder region
4. Relative to the Twining method of cervicothoracic examination, describe the variation in CR angulation when the shoulder is well depressed as opposed to when it is not well depressed.
5. Explain why a specialized cervicothoracic examination of the vertebral column is necessary.
6. Given a diagram, anatomic model or radiograph of an oblique projection of the cervicothoracic region, identify and/or locate the following:
    a. elevated humerus
    b. elevated clavicle
    c. depressed clavicle
    d. depressed humerus
    e. C-5 – T-5
7. Evaluate a cervicothoracic examination of the vertebral column for positioning and procedural accuracy.
8. Compare and contrast the Pawlow and Twining methods of cervicothoracic region examination.
9. For a recumbent examination of the cervicothoracic region of the vertebral column, explain the importance of arranging the whole vertebral column parallel with the table surface. Describe how this may be attained.

G. Thoracic Vertebrae (A-F) – 80% Minimum Mastery Level Required

****Indicates Advanced Radiographic Projections**

1. Be able to discuss or answer questions concerning the following positioning considerations (e.g. - AP, lateral, oblique):
    a. part position (e.g. – AP. oblique and lateral)
    b. structure(s) visualized and function(s) demonstrated
    c. pathology demonstrated
    d. film size/placement/identification/markers
    e. beam angulation and alignment of part and fil
    f. patient instructions
        1) respirations
        2) other
2. For an AP projection of the thoracic vertebrae, explain the significance/importance of the following:
    a. avoidance of overflexing the head with thick pillow or head support
    b. flexion of the lower extremities enough to place the back in absolute contact with the table surface (recumbent position)
    c. equal distribution of weight on the feet
    d. elevation of a shorter leg on a support so that equal weight can be applied to each lower extremity
    e. shallow breathing during the exposure
    f. exposure at the end of full exhalation
    g. arrange chest under anode and abdomen under cathode
    h. adjust the SID to the center of the radius of the thoracic curve
    i. angulation of the CR so that it is perpendicular to the long axis of a particular vertebral area
    j. use of tight collimation
3. Identify the palpable bony landmark which locates a particular thoracic vertebra:
    a. T-2
    b. T-4
    c. T-9 – T-10

4. State how one might make the effects of the "Heel Effect" more pronounced.
5. Evaluate an AP projection of the thoracic vertebrae for positioning and procedural accuracy.
6. For a lateral projection of the thoracic vertebrae, explain the significance/importance of the following:
    a. left lateral position of the patient
    b. erect position of the patient with the patient in a normal position
    c. patient dressed in an open-backed gown
    d. parallelism of vertebral column with the plane of the film by using:
        1) firm support under patient's head
        2) firm radioparent support under lower thoracic region
        3) elevation of knees to hip level and place support between knees so that the knees are perfectly superimposed
        4) right angle box placement of the upper extremities
    e. exposure with shallow breathing or at the end of full exhalation
    f. angulation of CR 10-15 degrees cephalad as opposed to the typical perpendicular angled of the CR
    g. use of tight collimation and a lead blocker

**7. Given a diagram, anatomic model or radiograph of the thoracic vertebrae identify and/or locate the following:
    a. AP projection
        1) thoracic bodies
        2) intervertebral disc spaces
        3) transverse processes
        4) pedicles, lamina and spinous processes superimposed by thoracic bodies
        5) general location of costovertebral-costotransverse joints
    b. lateral projection
        1) thoracic bodies
        2) intervertebral foramina
        3) intervertebral disc spaces
        4) pedicles
        5) lower spinous processes
    **c. oblique projections
        1) thoracic bodies
        2) intervertebral disc spaces
        3) apophyseal joints
        4) spinous processes

**8. With rotation of the body (sagittal plane 20 degrees to the plane of the film/coronal plane 70 degrees to the plane of the film), identify the apophyseal joints which will be demonstrated with anterior rotation; with posterior rotation.
**9. Evaluate a lateral or oblique radiograph of the thoracic spine for positioning or procedural accuracy.
10. For projections of the spine which either demonstrate structures closer or farther from the film, explain the importance of proper placement of radiopaque left or right markers.
**11. For an oblique projection of the thoracic vertebrae, explain the significance/importance of the following:
    a. use of the same method of rotation bilaterally
    b. parallelism of the vertebral column with the plane of the film
    c. equal distribution of weight on the feet with head in line with the rest of the vertebral column
    d. respiration at the end of exhalation
    e. placement of the arms to avoid beam interference

H. Lumbar-Lumbosacral Vertebrae (A-F) - 80% Minimum Mastery Level Required

**** Indicates Advanced Radiographic Projections**

1. Be able to discuss or answer questions concerning the following positioning considerations (e.g. - AP, PA, lateral and obliques of the lumbar spine):
    a. part position (e.g. – AP, oblique and lateral)
    b. structure(s) visualized and function(s) demonstrated
    c. pathology demonstrated
    d. film size/placement/identification/markers
    e. beam angulation and alignment of part and film
    f. patient instructions
        1) respiration
        2) other

2. For an AP or PA projection of the lumbar vertebrae, explain the significance / importance of the following:
    a. abdominal and pelvic cavities being free of gas and fecal material
    b. use of an erect position as opposed to a recumbent position
    c. PA as opposed to an AP projection of the lumbar spine
    d. flexion of hips and knees when performing the AP projection
    e. gonad shielding and close collimation
3. Identify the palpable bony landmark which locates the following:
    a. L-4/L-5 interspace
    b. midsacral segment
    c. coccyx
4. When the patient's condition will not permit flexion of the knees and hips to overcome lordosis of the lumbar region, describe the maneuver which may be used to reduce the lordotic curve when the patient is lying supine.
5. Evaluate an AP or PA projection of the lumbar vertebrae for positioning and procedural accuracy.
6. Given a diagram, anatomic model or radiograph of the lumbar vertebrae, identify and/or locate the following:
    a. AP/PA projection
        1) lumbar bodies
        2) intervertebral disc spaces
        3) interpediculate spaces
        4) laminae
        5) spinous processes
        6) transverse processes
    b. lateral projection
        1) lumbar bodies
        2) intervertebral disc spaces
        3) spinous processes
        4) superior four intervertebral foramina
    c. oblique projections
        1) lumbar bodies
        2) apophyseal joints
        3) Scottie dogs
            a) superior articular process
            b) transverse process
            c) pedicle
            d) pars interarticulares
            e) lamina
            f) inferior articular process
7. Explain why the lumbosacral disc space is not well shown in direct frontal projections of the lumbar vertebrae. Describe what may be done to demonstrate this joint space.

**8. Explain why the L5/S1 intervertebral foramen is not well visualized in a lateral projection of the lumbar vertebrae.

9. Describe the appearance of the lumbar bodies with rotation of the spine or with nonparallelism of the spine to the plane of the film.
10. State the purpose of a localized lateral projection of the lumbosacral junction.

** 11. State the degree of body rotation and beam angulation which is necessary for the radiographic demonstration of L5/S1 intervertebral foramen.

** 12. Associate the Kovac method as being the procedure for demonstration of the L5/S1 intervertebral foramen.

13. Give the rationale for using the PA oblique projection as opposed to the AP oblique of the lumbar vertebrae; give the rationale for not using the PA oblique projection for lumbar vertebrae apophyseal joints.

** 14. Identify the apophyseal joints demonstrated by an AP oblique; by a PA oblique of the lumbar vertebrae.

15. Evaluate a localized lateral projection of the lumbosacral junction, a PA oblique of L5/S1 and an AP or PA oblique projection of the lumbar vertebrae for positioning and procedural accuracy.

I. Sacroiliac Joints, Sacrum and Coccyx (A-F) – 80% Minimum Mastery Level Required

**** Indicates Advanced Radiographic Projections**

1. Be able to discuss or answer questions concerning the following positioning considerations:
    a. part position (e.g.- AP, oblique and lateral)
    b. structure(s) visualized and function(s) demonstrated
    c. pathology demonstrated
    d. film size/placement/identification/markers

e. beam angulation and alignment of part and film
f. patient instructions
1) respiration
2) other

2. Identify the sacroiliac joint demonstrated by a 25-30 degree AP oblique and by a 25-30 degree PA oblique.
** 3. Describe the main purpose of weight-bearing on alternate legs when examining the symphysis pubis for sacroiliac slippage or relaxation.
4. Differentiate an AP projection of a sacrum or coccyx with a PA of the sacrum or coccyx relative to angulation and centering of the CR, placement of the film, and detail of the image.
5. Give the rationale for angulation of the CR in examinations of the sacrum and coccyx.
6. Evaluate an AP, PA, PA oblique and AP oblique projection of the sacroiliac joints for the positioning and procedural accuracy.
7. For a lateral projection of the sacrum or coccyx, explain the significance/importance of the following:
a. adjustment of the long axis of the spine parallel to the film
b. adjustment of pelvis in exact lateral
c. use of a lead blocker
d. use of close collimation
8. Evaluate a lateral projection of the sacrum or coccyx for positioning and procedural accuracy.
9. Give the rationale for the use of Nolke method of sacrum examination.
10. Give the rationale for the use of weight-bearing bending studies of the lumbar vertebrae.
11. Define spondylolisthesis, subluxation and dislocation.
12. To evaluate scoliosis, explain the significance/importance of the following:
a. adjustment of the cassette to include about one inch of the iliac crest
b. elevation of the hip or foot of the convex side of the curve
c. PA/AP projection as opposed to lateral projection
13. Identify the projection which would best demonstrate exaggerated degrees of kyphosis or lordosis in patients who have scoliosis.
14. Explain the rationale for employing left, right, forward and backward bending of the lumbar vertebrae.

EXPOSURE AND PHYSICS

A. Radiographic Quality or Definition (G-Q) – 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

B. Sharpness of Details – Recorded Detail (H, J, L, M, N) – 80% Minimum Mastery Level Required

1. Explain what is meant by the geometric qualities of a radiograph.
2. Define line pair.
3. State the average visual acuity of the human eye relative to the ability of the viewer to discriminate line pairs.
4. Name the three factors which influence the degree of unsharpness recorded in the image.
5. Identify the single most detrimental factor contributing to a lack of image sharpness.
6. Differentiate voluntary and involuntary motion.
7. State the methods which may be employed to control motion.
8. State the most effective method which may be used to control all motion problems.
9. Describe the adjustment in the following exposure factors to effect a reduction in time to control motion, and yet, maintain the radiographic density of the image.
    a. Ma/time
    b. intensifying screens speeds
    c. FFD
    d. kVp/mAs
10. State the three major factors influencing material unsharpness.
11. Define modulation transfer function; define line spread function.
12. Compare and contrast the terms sharpness and resolution.
13. Describe film's contribution to material unsharpness.
14. Describe screen's contribution to material unsharpness.
15. Compare the unsharpness effects of motion to the unsharpness effected by intensifying screens.
16. Describe the influence of film-screen contact on material unsharpness, and thus, sharpness of the image.
17. Considering that screens contribute to material unsharpness, explain why they are used in radiography.
18. Define parallax; define print through.
19. Compare image sharpness using direct exposure with image sharpness using intensifying screens.
20. Compare image sharpness using slow intensifying screens with image sharpness using fast intensifying screens.
21. Define quantum mottle and describe the set of factors which causes it.
22. Given the unsharpness in millimeters contributed by each of the following factors: film, intensifying screen and film-screen contact, calculate the total unsharpness.
23. Describe the method used to identify poor film-screen contact.
24. Identify the three major factors which control geometric sharpness.
25. State the geometric unsharpness formula.
26. Define penumbra; define umbra; edge gradient; edge contrast.
27. Explain why unsharpness is measured instead of sharpness.
28. Explain the influence of each of the following factors on the sharpness or recorded detail of the image:
    a. focus size (FS)
    b. object-film-distance (OFD) (OID)
    c. focus-film-distance (FFD) (SID)
29. Concerning the line-focus principle, define the following terms:
    a. actual focus
    b. effective focus
30. Assess the influence on expected focus size considering the following:
    a. manufacturer's assessment
    b. increasing milliamperage
    c. smaller target angle
    d. anode side of tube as opposed to the cathode side
31. Identify the unsharpness factor over which the technologist has very little control.
32. State the methods which may be employed to help eliminate structural shape unsharpness.
33. Having investigated the three major factors that affect the sharpness of the image – motion, material and geometric unsharpness – when given a list of the factors which influence these factors, arrange them in decreasing order of importance.
34. Given all factors of unsharpness which may be measured and evaluated, calculate the total unsharpness that will result from the effect of all of the factors together.
35. Given technical factors which produced a satisfactory radiograph, indicate the effect, if any, changes in each factor would make on the sharpness of the recorded detail if the changes are made one by one without compensation.

C. Sharpness of Details – Distortion (H, J, L, M, N) – 80% Minimum Mastery Level Required

1. Define distortion, size distortion and shape distortion.
2. State the two factors which control size distortion and describe their control.
3. State the formula which enables one to determine the degree of magnification in a recorded image.
4. State the formula which enables one to determine the percentage of magnification.
5. Using the formulas for degree of magnification and percentage of magnification, calculate the percentage of magnification when given the object size, the focus-film distance and the object-film distance.
6. Define macroradiography; microfocus radiography.
7. State three radiologic applications of macroradiography.
8. When macroradiographic techniques are employed, state the factors which must be used to offset the image sharpness loss.
9. Discuss macroradiography relative to the use of a grid and to patient exposure.
10. Describe at least two radiographic studies where magnification calculations must be made to determine the interpretative results of the examination.
11. State the factors which influence distortion and explain how those factors are applied in order to minimize their effects.
12. Give two reasons for purposely creating shape distortion and give examples of each.
13. Given technical factors which produced a satisfactory radiograph, indicate the effect (if any) changes in each factor would make on the distortion of the structures in terms of size or shape if the changes were made one by one without compensation.

D. Visibility of Details – Density (G, I, K, L, M, N, O) – 80% Minimum Mastery Level Required

1. Explain why of all the major factors influencing radiographic quality, density is the basic property and probably the most important.
2. State the mathematical relationship of each of the following factors has to density:
    a. mA
    b. time (sec)
    c. kVp
    d. Distance
3. State the exposure increase which is necessary to effect a visible change in radiographic density.
4. Explain why changing kVp to effect a change in density may alter other image qualities.
5. Explain the importance of a caliper to the correct selection of exposure factors to effect a desired radiographic density.
6. Identify the patient factors which deal with varying quantities of tissue and explain the exposure adjustment to produce a desired radiographic density.
7. Identify the patient factors which deal with varying opacities of tissue and explain the exposure adjustment to produce a desired radiographic density.
8. Integrate the knowledge of the anatomical and pathological conditions of the patient and apply it to the proper selection of exposures which will produce a diagnostic radiograph.
9. Describe the exposure adjustment which is necessary to correct for the addition of an orthopedic cast to a body part and explain why there is a different exposure adjustment for a wet as opposed to a dry cast.
10. Given the speed of intensifying screen-film combinations, properly calculate the exposure adjustment which is necessary to maintain radiographic density.
11. Associate milliamperage or time adjustments in exposure with the change in quantity of radiation.
12. Given an mAs value, be able to calculate a time and milliamperage to suit a specific problem.
13. State the relationship between time and milliamperage to maintain film density.
14. Describe the relationship between density and distance for a given set of radiographs.
15. Distinguish between the mAs distance formula and inverse square law.
16. Explain why kilovoltage is often referred to as the quality factor of the beam.
17. Explain the need to select the kilovoltage necessary to penetrate the part.
18. Describe the problem associated with kV adjustment to correct for density.
19. Explain the relationship between kilovoltage and contrast.
20. Associate the 15% rule with the adjustment in kVp to either effect an increase by 2 or decrease by ½ in exposure.
21. Apply the knowledge of mathematical applications to the determination of a specific set of exposure factors.
22. State, in progression, the body tissues that absorb the most radiation to those which absorb the least.
23. Explain the importance of the proper kVp selection for contrast and non-contrast procedures.
24. Explain the function of cones and collimators and describe their influence on the primary beam.
25. State the correction in exposure factors necessary to maintain density when one changes from a 14” x 17” field of coverage to an 8” x 10” field of coverage.
26. Describe the influence of filtration on density relative to its effect on the primary beam.

27. Explain the use of compensating filters in radiography.
28. Describe the influence of the angle of the target on the uniformity of the intensity of the x-ray beam.
29. Recognize the anode-heel effect's influence on radiographic density and explain how it can be used to advantage.
30. Describe the exposure adjustment which must be made when moving from a single phase to a three phase x-ray unit. Explain.
31. Compare an x-ray beam produced with single-phase x-ray equipment with that produced with three-phase x-ray equipment, or high frequency x-ray equipment.
32. Explain the significance of focus-film distance, length of body part, and film size in terms of taking advantage of the anode-heel effect.
33. Explain the purpose of grids.
34. Describe a grid's construction.
35. Concerning changes in grid ratio, describe the exposure adjustment which would be necessary to maintain radiographic density.
36. Given technical factors which produced a satisfactory radiograph, indicate the effect (if any) changes in each factor would make on the density of the image if the changes are made one by one without compensation.
37. Given increases in development time, temperature or activity of development, describe the effects on the overall density of an image.

E. Visibility of Details – Contrast (G, I, K, L, M, N, O, P, Q) – 80% Minimum Mastery Level Required

1. Define radiographic contrast.
2. Properly express the relationship between contrast and visibility of detail.
3. Define subject contrast and identify the exposure factor which may be used to manipulate and control it.
4. Explain the influence of patient factors such as density and opacity of tissue on radiographic contrast.
5. Identify areas of the body which have high subject contrast and areas of the body which have low subject contrast and explain. Explain the purpose of a contrast medium.
6. Explain the influence of kVp or quality of radiation on subject contrast.
7. Explain what is meant by scale of contrast.
8. Properly relate scale of contrast to film latitude and exposure latitude.
9. Describe a film exhibiting high contrast relative to scale of contrast and latitude.
10. Describe a film exhibiting low contrast relative to scale of contrast and latitude.
11. Associate latitude with both scale of contrast and margin for error.
12. Associate low kVp/high mAs with short scale, high contrast, and narrow latitude.
13. Associate high kVp/low mAs with long scale, low contrast and wide latitude.
14. Describe filtration's effect on the following:
    a. exposure rate
    b. quality and quantity of x-ray beam
    c. minimum wavelength
    d. density
    e. contrast
15. Define film contrast and film latitude.
16. Properly associate film contrast with scale of contrast and film latitude.
17. Explain the effect of development on film contrast.
18. Describe the effects of screen exposure on the contrast of the image.
19. Define fog.
20. Describe the sources of radiographic fog.
21. Explain the importance of scatter radiation control to the enhancement of radiographic contrast and control of radiation fog.
22. Identify the two devices which are used to improve contrast by controlling scatter radiation.
23. Describe a cone's method of scatter control.
24. Describe a grid's method of scatter control.
25. Contrast the use of a grid with the use of a cone for the control of scatter radiation and the reduction in patient radiation exposure.
26. Explain the purpose, limitations and exposure adjustment for the various routinely used grids.
27. Describe the influence of the following factors relative to the production of scatter radiation and radiographic fog:
    a. tissue
        1) volume
        2) thickness
        3) opacity

b. object-film distance
c. kVp/mAs relationship

28. Identify the two main methods of reducing radiation fog.
29. Describe the following beam restriction devices and the advantages and disadvantages of their use:
    a. aperture diaphragms
    b. cones
    c. collimators
    d. lead blockers
30. Given the distance from the tube focus to the bottom of a beam limiting device; the diameter or size of the opening of the beam limiting device; and the FFD; determine the beam size that would result.
31. Describe the purpose and operation of a positive beam limiting (PBL) device.
32. Explain what is meant by cone cut off.
33. Describe the operation and effectiveness of a grid relative to the following factors:
    a. design linear or cross-hatched; rhombic cross-hatch
    b. type: parallel or focused
    c. ratio: 8:1, 12:1
    d. number of lines per inch: 80 line/in; 100L/in
    e. use: stationary or moving
34. Describe image changes which will occur if the various types of grids are used improperly. Examples:
    a. parallel grid – short FFD
    b. parallel grid – CR off-centered
    c. parallel grid – CR angled perpendicular to grid lines
    d. crosshatch grid – CR angled
    e. focused grid – CR off-centered
    f. focused grid – FFD too much or too little
    g. focused grid – reversed, tube side down
35. Define grid ratio.
36. Define grid frequency.
37. Define lead content.
38. Explain how kVp can influence grid efficiency.
39. Explain the significance of properly following grid use recommendations:
    a. 8:1 – effective up to 85 kVp
    b. 12:1 – effective up to 100 kVp
    c. 16:1 – effective beyond 100 kVp
40. Relative to the functional characteristics of a grid, define the following:
    a. selectivity
    b. contrast improvement factor
41. Define grid cut off; define grid clean up

Tomography – 80% Minimum Mastery Level Required

1. List three methods of separating superimposed images through modification of ordinary radiography.
2. Describe the three basic principles of tomography.
3. Define the term tomographic section and describe the basic principles of tomography.
4. Explain the influence of exposure angle and focus-film distance on section thickness.
5. Using the formula: $h = \frac{s}{\tan \frac{1}{2} \text{ angle}}$ calculate the section a thickness

   when (h) is the maximum permissible unsharpness, (s) is 0.5 mm and the exposure angle (a) is:
    a. 10 degrees
    b. 20 degrees
    c. 40 degrees
6. List and diagram five types of tomographic motion.
7. Define the term zonography.
8. Define the term autotomography.
9. Compare the radiation exposure received in tomography to that received in conventional radiography.
10. Discuss the formation of a tomographic image: i.e., Is it cumulative or is it made all at one time?

11. Compare zonographic images with tomographic images relative to:
    a. thickness of section
    b. contrast
    c. detail
    d. blurring of overlying and underlying structures
12. Explain what is meant by unidirectional and pluridirectional motion.
13. For linear movement of the tube in tomography, describe the ideal relationship between the structure and motion of the tube.
14. Describe several clinical applications of tomography and discuss specific tomographic procedures relative to the following topics:
    a. examination part
    b. position of structure
    c. central ray position
    d. tomographic levels and thickness of sections
    e. other positioning or procedural considerations
15. Identify pararadiologic imaging procedures which are often used in the place of general tomography.
16. Define:
    a. axial transverse tomography
    b. panoramic tomography

Stereoradiography – 80% Minimum Mastery Level Required

1. Describe the advantages and disadvantages of stereoradiography and discuss its current use.
2. With respect to the following topics, discuss the criteria which must be met to ensure good stereoradiography:
    a. patient position and immobility
    b. film position and immobility
    c. total tube shift and direction of shift
3. Discuss the purpose and typical construction of a stereoscope.
4. Describe the correct method of viewing stereoradiographs.

Radiographic Exposure Guides – 80% Minimum Mastery Level Required

Refer to all objectives related to exposure.

QUALITY ASSURANCE LABORATORY

A. The importance of Proper Care and Use of X-Ray Equipment (R, S) – 80% Minimum Mastery Level Required

1. Name the two types of x-ray produced by an x-ray tube and plot a typical x-ray emission spectrum identifying the portion of the graph which represents each x-ray type, the coordinate which represents energy, and the coordinate which represents the number of photons produced.
2. Given a diagram of a curve which represents AC, DC, half-wave AC, full-wave AC, three phase AC, 6 pulse-three phase or 12 pulse-three phase, or high frequency identify each.
3. State the number of impulses per second going through an x-ray tube energized by:
    a. single phase, half-wave rectified current
    b. single phase, full-time rectified current
4. State the percent of ripple noted in the wave of:
    a. single phase, half-wave rectified current
    b. single phase, full-wave rectified current
5. State the percent of ripple noted in the wave of:
    a. three phase, 6-pulse rectified current
    b. three phase, 12-pulse rectified current
    c. high frequency
6. Compare single phase powered x-ray equipment with three phase powered x- ray equipment relative to the following:
    a. emission spectrum
    b. quantity of x-ray produced
    c. quality of x-ray produced
7. Compare the emission spectrum of a single phase, half-wave powered x-ray unit with the emission spectrum of a single phase, full-wave powered x-ray unit.
8. Given the mAs or kVp of an exposure using a single phase unit, adjust the mAs/kVp to maintain density using a three phase unit.
9. Identify the selectors, meters and x-ray unit components which are mounted or located in the x-ray control console.

10. State the reason for placing the electric circuits connecting the meters and controls located on the operating console at low voltage.
11. Considering that the mA meter is located in the high voltage circuit, state how one is protected from electrical shock.
12. Explain how the emission spectrum is affected by 1) a line surge and b) a line drop. Identify the control which adjusts for this problem thereby assuring proper x-ray emission.
13. Describe the effect on the density of an image with the following conditions:
    a. a line drop without compensation
    b. a line surge without compensation
14. Describe an autotransformer relative to the following:
    a. its location
    b. type of device
    c. principle of operation
    d. major purpose
15. Calculate the voltage inputed to the high voltage transformer if the autotransformer primary tap windings and secondary windings are given and the autotransformer is supplied with 240 volts.
16. Relative to the following factors, explain the result of improper calibration of kVp such that the actual voltage obtained is lower or higher than expected:
    a. intensity (quantity) of x-ray output
    b. energy of the beam
    c. density of the image
    d. contrast of the image
17. State the purpose of the high voltage section of the x-ray circuit.
18. Identify the principle circuit components which are located in the high voltage section of an x-ray unit.
19. Describe the high voltage transformer of an x-ray circuit relative to the following:
    a. its location
    b. type of device
    c. principle of operation
    d. major purpose
20. Calculate the secondary voltage and amperage supplied to the x-ray tube if the turns ratio of the high voltage transformer and supply voltage and amperage are given.
21. If given the necessary data, calculate the output intensity of an improperly calibrated x-ray unit.
22. Explain why the filament transformer is placed in the high voltage section of the x-ray circuit.
23. Describe the function of the filament transformer relative to the following factors:
    a. power to the filament
    b. heat of the filament
    c. current in the x-ray tube
24. If the turns ratio of the filament transformer is given, calculate the current and voltage flowing through the primary coil if the voltage and amperage to the x-ray filament are 10 volts and 6 amps.
25. Give the term which expresses the ionization of the filament upon heating it.
26. Identify the two principle exposure factors which are selected to control the number of electrons crossing from cathode to anode.
27. Explain the relationship of mAs or tube current to the heat of the filament and the number of electrons crossing from cathode to anode.
28. Describe the affect on the x-ray emission spectrum if the mA controls are out of calibration.
29. Define rectification and explain the purpose for it in the production of x-rays.
30. Explain how rectification of AC current in an x-ray circuit is accomplished.
31. Describe the function of a space charge compensator.
32. Describe what happens to mA if focus size is increased and why.
33. Give the relationship of the quantity of x-rays produced to:
    a. the kVp selected
    b. the mA selected
    c. the time selected
34. Describe a 1) rheostat, 2) choke coil or 3) saturable reactor relative to the following characteristics:
    a. type of device
    b. principle of operation
    c. location in x-ray circuit
    d. mA control

e. x-ray tube current control

35. Explain the main purpose of a timer.
36. Describe each of the following timing devices in terms of their principle of operation, location in the circuit and limitations:
    a. mechanical timer
    b. synchronous timer
    c. electronic timer
    d. mAs timer
    e. phototimer or ionic timer
37. Describe ways which may be used to check the accuracy of a timer and explain the limitations of the various methods.
38. Describe the mode of operation of a manual spinning top and contrast its mode of operation with that of a synchronous spinning top. Describe the images which are obtained with each method.
39. Given a power supply to an x-ray unit, identify the timer evaluation method which would adequately evaluate the accuracy of the timer and describe the image obtained.
40. Describe the principle of operation of a meter and describe a meter placement in a circuit based on:
    a. analyzing voltage
    b. analyzing amperage.
41. Describe the influence of the target material on the x-ray emission spectrum.

B. X-Ray Tube (R, S, U) – 80% Minimum Mastery Level Required

1. Name the two primary parts of an x-ray tube and describe the type of tube an x-ray tube is.
2. Explain why the filament of an x-ray is usually made of thoriated tungsten.
3. Explain what is meant by a "double focus" x-ray tube.
4. Describe the problem which could result from vaporization of the filament of an x-ray tube and explain how the vaporization of the filament can be reduced.
5. The filament of an x-ray tube is connected to both a low voltage supply and a high voltage supply. Explain the purpose of each supply.
6. Name the four functions of an x-ray tube.
7. Identify the area of the anode which is struck by the electrons from the cathode.
8. State the purpose of alloying the tungsten of the anode with rhenium.
9. Name the three main reasons why tungsten is the material of choice for the anode.
10. Explain how the heating capacity of the anode can be increased.
11. Explain the four major factors which contribute to the effectiveness of the focusing cup.
12. Describe the type of motor which is used to turn the anode of a rotating anode tube.
13. Explain why rotor bearing design and balance of the rotor is so important in a rotating anode tube.
14. Explain why the short exposure rating of an x-ray tube decreases as the target angle increases.
15. Define focal spot and describe the effect on the following if smaller focal spot is chosen:
    a. recorded detail (sharpness)
    b. heel effect
16. Explain the effect on focus size, field of coverage, and heel effect if the target angle is reduced.
17. Define:
    a. actual focus
    b. effective focus
    c. line-focus principle
18. Calculate the total target area of a rotating anode x-ray tube if the focal spot dimension and the diameter of the anode disk from the mid-target area are given.
19. Calculate the effective focus size if the target angle and actual focus size are given.
20. Define heel effect and describe the intensity of radiation from anode to cathode.
21. Explain the significance of focus-film distance and film size when attempting to us anode-heel effect.
22. Explain the purpose of the protective housing of the x-ray tube.
23. Define leakage radiation and give the permissible emission of this radiation.
24. Explain the purpose of the glass envelope of an x-ray tube.

C. Filtration (T) – 80% Minimum Mastery Level Required

1. State the purpose of filtration and describe the effects of filtration on radiation received by the patient.
2. Identify the metal usually employed as filters for diagnostic x-ray units and explain why it is employed.
3. Explain the influence of filtration on the quality and quantity of the x-ray beam.

4. Define the following and identify the materials which comprise each:
    a. inherent filtration
    b. added filtration
    c. total filtration (radiography and fluoroscopy)
    d. compensating filtration
5. State the minimum total filtration requirements for x-ray units operating at the following kVp levels:
    a. below 50 kVp
    b. between 50-70 kVp
    c. above 70 kVp
6. Differentiate the purpose of filters for therapy x-ray units as opposed to diagnostic x-ray units.
7. Describe the influence of filtration on each of the following factors:
    a. quantity of the x-ray beam
    b. quality of the x-ray beam
    c. HVL
    d. minimum wavelength
    e. effective energy
8. Describe the inherent filtration equivalent thickness of a typical x-ray tube and explain how this thickness often increases with extended and improper use of the x-ray tube.
9. Describe the placement of the added filtration relative to the tube, collimator and patient.
10. Describe the influence of a variable aperture, light localizing collimator on filtration of the x-ray tube and state the usual amount it contributes.
11. Define HVL and explain the influence on HVL when a change is made in either filtration or kVp.
12. Calculate the exposure from an x-ray tube when additional filtration is added if original filtration, exposure and HVL are known.
13. Describe the influence of added filtration on the emission spectrum of the x-ray beam and on the quality of the x-ray image.
14. State the total minimum filtration thickness which must be used for all general purpose diagnostic x-ray units.
15. Describe several compensating filters and state their purpose.
16. Relative to filtration used in mammographic x-ray units, describe and explain the following:
    a. minimum filtration – no less than 0.5 Al
    b. tungsten targeted tube – added filtration should be aluminum
    c. molybdenum targeted tube – added filtration should be molybdenum of approximately 30 micrometers
    d. molybdenum-tungsten allow target – aluminum or molybdenum may be used.
17. Explain why the added filtration of the x-ray tube is never zero.

D. X-Ray Tube Thermal Capacity (U) – 80% Minimum Mastery Level Required

1. Discuss the efficiency of x-ray production relative to percentage of projectile electron kinetic energy conversion to x-ray or heat energy.
2. Explain the set of circumstances which occur in the target after interaction with projectile electrons that generate extreme heat.
3. State the relationship between heat generated in an x-ray tube upon being energized to produce x-ray and each of the following:
    a. mA
    b. time
    c. kVp
4. Describe the relationship between efficiency of x-ray production and each of the following:
    a. changes in tube current
    b. changes in kVp
5. Describe an appropriate method of extending x-ray tube life and explain the role of the technologist in trying to accomplish this.
6. State three primary causes of tube failure.
7. Describe the damage to the anode when the temperature of the anode is excessive during a single exposure. Describe the effect on the radiographic image and on tube operation when the anode is damaged by excessive temperature increases.
8. Explain how abuse of the x-ray tube can result in increased filtration.
9. Explain why maximum radiographic techniques should never be applied to a cold anode. Explain why this caution is particularly important when using three phase equipment.
10. Explain how maintaining the anode at elevated temperatures for prolonged periods can cause rotor-bearing damage.

11. Describe the probable reasons for tube failure during fluoroscopy.
12. Identify the most frequent cause of x-ray tube failure.
13. Describe the condition of operation of an x-ray tube which most often is responsible for filament failure.
14. Describe the guides which can help the technologist to use x-ray tubes and avoid damage to them.
15. Describe the following tube rating charts and explain their use:
    a. radiographic rating chart
    b. anode cooling chart
    c. housing cooling chart
16. Demonstrate the ability to correctly analyze a tube rating chart.
17. Demonstrate the ability to correctly calculate the following:
    a. heat units (single phase operation of x-ray tube)
    b. heat units (three phase-6 pulse operation of x-ray tube)
    c. heat units (three phase-12 pulse operation of x-ray tube)
18. Describe typical maximum heat capacities for each of the following:
    a. x-ray tube anodes
    b. x-ray tube housings
19. Explain the importance of determining whether a set of tube rating charts are applicable for a given x-ray tube and describe the proper assessment procedure.
20. Compare and contrast cine, serial and fluoroscopic tube rating and cooling charts with a standard rating and cooling chart.
21. Describe the life expectancy of an x-ray tube.

E. Automatic Exposure Control (V) – 80% Minimum Mastery Level Required

1. State the basic function of the automatic exposure control (AEC).
2. Identify the principle component of the AEC and describe several types.
3. Name the two variables which determine the reference exposure level.
4. Explain the factors which must be taken into account relative to AEC calibration.
5. Identify the control which can be adjusted by the operator to vary receptor exposure (film density) within a limited range.
6. Explain the purpose of a back-up timer in an AEC system.
7. Given an expected exposure time, state an appropriate back-up time value.
8. Describe the problem associated with setting the value of the back-up timer too low.
9. Describe the problems associated with improper location of the sensor with respect to patient anatomy.
10. Associate the following as possible sources of exposure error that must be considered when using automatic exposure control:
    a. AEC not calibrated for a specific receptor
    b. density control not set to proper value
    c. back-up timer not set to proper value
    d. sensor field incorrectly positioned with respect to anatomy
    e. minimum response not taken into account

F. Radiation Protection – Fluoroscopy (W) – 80% Minimum Mastery Level Required

1. Relative to the following x-ray apparatus, give the appropriate design requirements:
    a. fluoroscopic, source-to-tabletop distance
        1) stationary fluoroscopes
        2) mobile fluoroscopes
    b. primary protection barrier
        1) image-intensifier assembly capable of operating above 125 kVp
        2) image-intensifier assembly and fluoroscopic tube
    c. filtration
        1) minimum equivalent requirement
        2) definition of total filtration
        3) HVL
    d. collimation
        1) requirements for manual collimator
        2) requirements for automatic collimator
    e. exposure switch type
    f. bucky slot cover – minimum lead equivalent

g. protective curtain – minimum lead equivalent
h. cumulative timer
    1) required type
    2) purpose
i. x-ray intensity
    1) maximum exposure rate for each mA of operation above 80 kVp
    2) maximum allowable exposure rate for fluoroscopy under all conditions

G. Radiation Protection/Health Physics (W) – 80% Minimum Mastery Level Required

1. Define health physics
2. Name the three cardinal principles of radiation protection and explain.
3. Define point source.
4. Explain what isoexposure lines represent.
5. Explain why in fluoroscopy, the technologist should remain as far from the examining table as practical.
6. Define half-value layer (HVL) and tenth-value layer (TVL).
7. Define TVL relative to HVL's.
8. Explain the ratio 1.2R/mA-min.
9. Define maximum permissible dose (MPD).
10. Identify the categories of the population for which dose limits are specified. Identify the type of exposure which is not specified.
11. Give the effective dose for a radiation worker:
    a. per week/per year
    b. per week/year who is pregnant
    c. per week/year when permitted by cumulative life time dose limit = (age x 1 rem))
    d. per week/year if under age 18
12. Associate MPD values with dose-limiting recommendations.
13. Define somatic response; define genetic response.
14. Define threshold dose; define linear, nonthreshold dose response.
15. Identify the dose response relationship that dose limits have been based on.
16. Give the formula which determines cumulative dose limit for occupationally exposed persons.
17. Properly associate the following radiologic units:
    a. activity-Becquerel (Curie)
    b. absorbed dose-Grey (rad)
    c. dose equivalent-Sievert (rem)
    d. exposure-Coulomb per kilogram (roentgen)
18. Give the dose limit per year:
    a. for the nonoccupationally exposed person
    b. for the population as a whole
19. Define whole body exposure and elaborate on the individual parts of the body included in this definition.
20. Define what is meant by:
    a. probabilistic (stochastic)
    b. deterministic (nonstochastic)
21. Know dose limits for selected organs of the body; i.e. hands, forearms and describe appropriate radiation monitors used to determine exposure to these areas of the body.
22. Define leakage radiation and state the acceptable R/min at 1 meter.
23. Describe the design specifications for the control panel.
24. Describe appropriate radiation protection standards relative to the following radiographic equipment:
    a. source-to-image receptor distance (SID/FFD)
    b. collimation
    c. filtration
    d. beam alignment
    e. positive beam limitation (PBL)
    f. personnel shield
    g. portable x-ray unit
    h. reproducibility
    i. linearity
25. Describe appropriate radiation protection standards relative to the following fluoroscopic equipment:
    Refer to Fluoroscopy – Radiation Protection Objectives

26. Define the following and give the minimum lead equivalent thickness of each:
    a. primary protective barrier
    b. secondary barrier
27. List the factors which must be considered when barrier thickness is being calculated.
28. Define the following and give the appropriate radiation protection unit and symbol for each:
    a. occupancy
        1) controlled area
            a) full occupancy
            b) partial occupancy
            c) occasional occupancy
    b. work load
    c. use factor
    d. penetrability
29. Associate pulse mode operation with radiation detection and integrate mode with measurement of the intensity or exposure of radiation.
30. Define the following terms:
    a. dosimetry
    b. dosimeter
31. Identify the four basic types of radiation detection devices used in diagnostic radiology and describe their characteristics and uses.
32. In reference to radiation detection devices, differentiate the term accuracy and the term sensitivity.
33. Give the phrase which is described by the acronym ALARA.
34. Identify the three procedures in radiography which result in the highest occupational exposure of x-ray personnel.
35. Identify a procedure in radiography which usually contributes minimally to patient and personnel exposure.
36. Identify the three ways that patient dose is generally reported.
37. Describe the use of the nomogram in estimating skin dose and give the percentage of accuracy assumed with this type procedure.
38. Define the following:
    a. mammographic skin/midline dose
    b. CT scanning dose
    c. genetically significant dose (GSD)
39. Describe the criteria used to determine the necessity of using personnel monitoring devices.
40. Discuss the advantages and disadvantages of using the following personnel monitoring devices:
    a. film badges
    b. thermoluminescent dosimeter
    c. pocket ionization chamber
    d. optically stimulated luminescence
41. Describe appropriate placement of radiation monitoring devices for:
    a. a fluoroscopist
    b. pregnant technologist
    c. special procedure or nuclear medicine technologists
    d. nuclear medicine technologists
42. Discuss radiation protection rules for x-ray personnel relative to the following considerations:
    a. protective apparel
    b. position during fluoroscopy
    c. patient holding
    d. portable (mobile radiography)
43. Discuss appropriate measures which can be taken to reduce unnecessary patient exposure.
44. Discuss appropriate precautions which should, if possible, be taken to reduce exposure of a pregnant technologist.
45. Discuss appropriate measures which should be taken to avoid exposure of a pregnant patient.

Required Assessments:
Assessment Names and Descriptions:

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

Mastery level for each unit must be 80% or greater. In addition, an objective type comprehensive final examination may be given and a 80% mastery is required.

B. Laboratory Expectations

Laboratory experiments and tests to determine and analyze the calibration of an x-ray unit and the uniformity of imaging devices (R).

Exercise 1:	Check the line voltage for fluctuation or stability.
Exercise 2:	Check the accuracy of the timer.
Exercise 3:	Check the accuracy of the milliampere-seconds meter.
Exercise 4:	Using a Wisconsin Test cassette, check the accuracy of kV calibration.
Exercise 5:	Using a x-ray mAs-time test tool, check the accuracy of the calibration of mA and time.
Exercise 6:	Using a focal spot test tool, check the focal spot size of an x-ray tube.
Exercise 7:	Using a beam alignment test tool and collimator test tool, check the accuracy of beam alignment and collimation.
Exercise 8:	Using various test tools, check the uniformity of intensifying screens, cassettes and illuminators.

CSLO/Assessment Alignment:

Course	CSLO 1	CSLO 2	CSLO 3	CSLO 4	CSLO 5	CSLO 6	CSLO 7	CSLO 8	CSLO 9	CSLO 10
RT 42	P tests 1-8; IE quiz 1-13; final exam	P tests 1-8; IE quiz 1-13; final exam	P tests 1-8; IE quiz 1-13; final exam	P tests 1-8; IE quiz 1-13; final exam	P tests 1-8; IE quiz 1-13; final exam	P tests 1-8; IE quiz 1-13; final exam	E tests 1 IE quiz 1-13; final exam	E tests 2 IE quiz 1-13; final exam	E tests 1-2 IE quiz 1-13; final exam	E tests 1-2 IE quiz 1-13; final exam
	CSLO 11	CSLO 12	CSLO 13	CSLO 14	CSLO 15	CSLO 16	CSLO 17	CSLO 18	CSLO 19	CSLO 20
	E tests 3-4; IE quiz 1-13; final exam	E tests 1-4; IE quiz 1-13; final exam	E tests 1-4; IE quiz 1-13; final exam	E tests 1-4; IE quiz 1-13; final exam	E tests 3; IE quiz 1-13; final exam	E tests 3-4; IE quiz 1-13; final exam	E tests 4; IE quiz 1-13; final exam	L test 1 IE quiz 1-13 Final exam	L test 2 IE quiz 1-13 Final exam	L test 3 IE quiz 1-13 Final exam
	CSLO 21	CSLO 22	CSLO 23	CSLO 24						
	L test 4 IE quiz 1-13 Final exam	L test 5 IE quiz 1-13 Final exam	L test 6-7 IE quiz 1-13 Final exam	E test 5-6 IE quiz 1-13 Final exam						

Grading Scale or Policy, Weekly Outline, Topics, or Instructional Activities:

1. 40% of the mean average for positioning and procedure unit exams.
   40% of the mean average for exposure, physics and quality assurance unit exams.
2. 20% of the composite grade:
   a. independent study and evaluation.
   b. comprehensive final exam, if applicable

There will be two (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 five (5) points added to the final grade.

Chattanooga State 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 the following courses is required for progression:

1. All RT prefixed courses
2. Human Anatomy & Physiology I, II (BIOL 2010, BIOL 2020)
3. Radiobiology and Radiation Protection (RT 2543)
4. Math 1710 if required

_____

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

_____