JEFFERSON COLLEGE

COURSE SYLLABUS

RAD140

Radiographic Exposures

3 Credit Hours

Revised by: Janet E. Akers BS RT (R)(M)
Date: September 30, 2013

Kenny Wilson, Director, Health Occupation Programs
Dena McCaffrey, Dean, Career & Technical Education
I. CATALOGUE DESCRIPTION

A. Prerequisites: Acceptance to Radiologic Technology Program, and reading proficiency.

B. Credit hour award: 3

C. Description: This course introduces the student to the fundamental principles of radiographic exposure: radiation production, equipment function, collimation and filtration of the beam, control of secondary radiation, and automatic processing technique. In addition, the application of anatomical and pathological conditions affecting image quality will be addressed. (F)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

<table>
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<tr>
<th>Expected Learning Outcomes</th>
<th>Assessment Measures</th>
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| Analyze the technical and patient factors which modify the x-ray beam and govern and influence the production of the radiographic image on radiographic film. | Written Assignments
Class Discussion/Activity
Written Examinations |
| Calculate principle factors of exposure technique for image resolution.                    | Class Discussion/Activity
Written Examinations
Written Assignments |
| Define the advantages and disadvantages of grids in relation to construction, patient radiation exposure and image quality. | Class Discussion/Activity
Written Examinations
Written Assignments |
| Describe the effects of SID, OID, focal spot size and exposure on image quality.           | Class Discussion/Activity
Written Examinations
Written Assignments |
| Describe the characteristics/advantages and disadvantages of film-screen, CR and DR on image production. | Class Discussion/Activity
Written Examinations
Written Assignments |

III. OUTLINE OF TOPICS

A. X-rays and X-ray production
   1. What are x-rays?
      i. Electromagnetic spectrum
      ii. Photons: Bundles or packets of energy
      iii. Discovery and history of x-rays
iv. How x-rays are produced
   1. Conditions necessary for x-ray production
   2. Brem’s production
   3. Characteristic radiation
v. Properties of x-rays

2. X-ray tubes
   i. Crookes tube
   ii. Coolidge tube
   iii. Anode
   iv. Cathode
   v. Tube housing
   vi. X-ray tube care

3. The x-ray beam
   i. Primary radiation
   ii. Exit (remnant) radiation
   iii. Absorption factors

B. Film and Processing

1. Film base
   i. Purpose, support emulsion
   ii. Composition: glass, cellulose nitrate, cellulose acetate, polyester
   iii. Must be transparent but is usually tinted blue

2. Emulsion
   i. Purpose
   ii. Composition: Silver Bromide (AgBr) crystals dissolved in gelatin
   iii. Structure of AgBr crystals
      1. Ag and Br ions
      2. Sensitivity spec

3. Subcoat
   i. Glues emulsion to base

4. Protective coat

5. Latent image
   i. Absorption of photons
   ii. AgBr crystal ionized
   iii. Sensitivity speck collects Silver (Ag) atoms

6. Development – makes latent image visible
   i. Reducing agent
   ii. Bromine barrier

7. Fixation
   i. Stops reduction
   ii. Removes underdeveloped AgBr crystals

C. Photographic properties

1. Density
   i. Definition of density
   ii. Effects of density changes
2. Contrast
   i. Definition of contrast
   ii. Scale of contrast
3. Recorded detail
   i. Unsharpness
   ii. SID/OID (source-to-image distance / object-to-image distance)
   iii. Focal spot size
4. Distortion
   i. Size, magnification
   ii. Shape, elongation or foreshortening
5. Radiographic quality
   i. Visibility functions: density, contrast, noise
   ii. Recognizability functions: sharpness, distortion
D. Properties of x-ray film
   1. Characteristics Hurter & Driffield (H&D) curve
      i. Density formula
      ii. Toe
      iii. Straight line portion
      iv. Shoulder
      v. D-Max
      vi. Solarization
   2. Film Speed
   3. Film contrast
   4. Film latitude
   5. Effects of development on H&D curve
   6. Double coated film, non-screen, and screen film
E. Computed Radiography and Digital Imaging Processing
   1. Definition
   2. Image Characteristics
      i. Bit
      ii. Pixel
      iii. Matrix
      iv. Spatial frequency resolution
   3. Direct/ Indirect
   4. Photostimulable phosphor plates
   5. Image plate construction
F. Interactions of x-ray with matter
   1. Photoelectric effect
      i. Responsible for radiographic contrast
      ii. Process – Absorption of photon with ejection of inner shell electron
      iii. Factors affecting occurrence of interaction
   2. Compton Scatter
      i. Responsible for scatter fog
      ii. Process – Photon dislodges outer shell electron, photon’s path changes
iii. Factors affecting interaction

G. Technical Factors

1. Milliamperage
   i. Effect of milliamps (mA) on tube current

2. Time
   i. Reciprocity Law
   ii. Rules of thumb for density changes
   iii. Motion unsharpness

3. Kilovoltage
   i. Effect on photon energy/wavelength
   ii. Effect on radiographic quality
   iii. 15% rule and 5% changes
   iv. Exposure Latitude
   v. Optimum kilovolt peak (kvp) and penetration
   vi. Advantages of high kvp techniques

4. Distance
   i. Terminology and abbreviations
   ii. Effects on image quality
   iii. Inverse Square Law
   iv. Square Law

H. Patient Status and Contrast Media

1. Body types
   i. Hypersthenic
   ii. Sthenic
   iii. Asthenic
   iv. Hyposthenic

2. Body Tissues
   i. Inorganic vs. organic
   ii. Fat
   iii. Muscle
   iv. Bone

3. Evaluation of patient
   i. Age
   ii. Sex
   iii. Body type
   iv. Pathology
   v. Calipers

4. Respiration

5. Contrast Media
   i. Negative
   ii. Positive

I. Grids

1. History
   i. Gustav Bucky – 1913
   ii. Hollis Potter – 1920

2. Types
   i. Stationary or moving
   ii. Linear or cross hatched
iii. Focused

3. Grid Specifications
   i. Grid ratio
   ii. Frequency
   iii. Focusing Distance

4. Grid Efficiency
   i. Grid ratio
   ii. Grid Frequency

5. Effect on density and contrast
   i. Calculating exposure factors
   ii. Contrast Improvement factor

6. Grid Cutoff

J. Intensifying Screens
   1. History
   2. Composition
      i. Calcium tungstate
      ii. Rare earth materials
   3. Cassette Construction
   4. How screens work
      i. Absorb x-rays
      ii. Convert x-ray energy to light energy
      iii. Emit light

5. Screen speed
   i. Screen thickness
   ii. Crystal size
   iii. Rare earth materials

6. Effect of screens on density and technique conversion factors

7. Effect on contrast

8. Effect on sharpness of detail
   i. Lateral diffusion
   ii. Screen crossover
   iii. Screen film contact
   iv. Screen speed

9. Spectral matching of screen with film

10. Screen lag – phosphorescence

11. Screen care
    i. Artifacts
    ii. Cleaning

12. Image noise – Quantum mottle

K. Focal Spot
   1. Focal spot size
   2. Anode angle
      i. Line focus principle
      ii. Anode heal effect

L. Source-to-image Distance (SID) Film Focal Distance (FFD)
   1. Effect of SID on sharpness of detail and penumbra
   2. Effect of SID on magnification
   3. Effect on SID on shape distortion
4. Effect of SID on density
   i. Inverse Square Law
   ii. Direct Square Law

M. Object to Image Distance (OID), Object to Film Distance (OFD)
   1. Effect of OID on detail, magnification, distortion, contrast, density
   2. Magnification percentage factor
   3. Air gap technique
   4. Macroradiography, magnification technique

N. Beam Limiting Devices
   1. Definition
   2. Purpose
      i. Reduce Patient exposure
      ii. Improve Image Quality
   3. Types of Beam Limitation Device (BLD)
      i. Cones/cylinders
      ii. Apertures/Diaphragms
      iii. Collimators
      iv. Automatic collimation system, Positive Beam Limitation Device (PBLD)

O. Beam Filtration
   1. Effect on filtration
      i. On the x-ray beam, quality and intensity
      ii. On patient dose
      iii. On film quality
   2. Half-value layer (HVL)
   3. Types of filtration
      i. Inherent
      ii. Added
      iii. Compensating

P. Radiographic Processing
   1. Processing steps
      i. Development process
      ii. Fixing Process
      iii. Wash
      iv. Dryer

Q. Technique Charts
   1. Purpose
   2. Goals
   3. Advantages/disadvantages
   4. Types

IV. METHOD(S) OF INSTRUCTION

This course is taught using a variety of instructional methods, which include but are not limited to interactive lectures, computer presentations, group activities and exercises, videos, supplemental handouts and student presentations. Students are expected to be ACTIVE participants in the learning process. Students are expected to read the assigned readings prior to scheduled class meetings and come to class
prepared to actively participate in all activities.

V. REQUIRED TEXTBOOK(S)


SUPPLEMENTAL TEXTBOOK(S)


VI. REQUIRED MATERIALS

A. A computer with internet access and basic software to include Word and PowerPoint (available through Jefferson College labs)
B. Course homepage available through Blackboard
C. Binder, paper, pens, pencils with erasers, highlighters

VII. SUPPLEMENTAL REFERENCES

A. Class Handouts
B. Library Resources
   1. Textbooks
   2. Periodicals
   3. Films On Demand Videos
C. Internet Resources
   1. On-line references
   2. Textbook companion website

VIII. METHOD OF EVALUATION (basis for determining course grade)

GRADES – Grades will be based on the percentage of total points earned out of total points possible for this semester. The assignments will vary in the number of possible points based upon amount of work involved and complexity of material. A final semester grade of 80% or above must be achieved in this course to successfully complete this course.

EXAMS – All exams with scores less than 75% must be retaken until a score of 75% or above is achieved to complete course requirements. The original score will be used to figure the semester grade. The student will be allowed to retake an exam a maximum of two times. If the student has not passed an exam within the three designated attempts, the student will present to the review board and may be dismissed from the program. The student must contact the instructor prior to any absence to make arrangements for retesting.
Until course requirements are met the final grade will be an incomplete.

If an exam is not taken at the scheduled time and arrangements for a make-up exam have not been made prior to the designated exam time, the grade for that exam will be zero. No make-up exam will be considered unless the instructor is personally notified prior to the absence. If a student arranges to take the exam at other than the scheduled time, 5% will be deducted from the grade on that exam. Make-up exams are scheduled at the convenience of the instructor.

Student’s grade will also be based on participation in class and attendance.

ASSIGNMENTS – In order to be prepared for each class meeting, the student should complete each homework assignment prior to the following class meeting. Assignments will consist of worksheets, textbook reading, review questions and other activities to enhance the learning experience.

Evaluation tools will include research projects, written and oral communication projects, class attendance/participation, homework assignments, and exams.

All assignments must be typewritten and are due at the beginning of class on the assigned due dates. Late assignments will not be accepted. In-class quizzes and assignments cannot be made up.

Grading Scale: *(Jefferson College Radiologic Technology Program’s)*

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<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>100-92%</td>
</tr>
<tr>
<td>B</td>
<td>91.9-86%</td>
</tr>
<tr>
<td>C</td>
<td>85.9-80%</td>
</tr>
<tr>
<td>D</td>
<td>79.9-70%</td>
</tr>
<tr>
<td>F</td>
<td>69.9 and below</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete</td>
</tr>
<tr>
<td>W</td>
<td>Excused withdrawal from course</td>
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IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT

All students are responsible for complying with campus policies as stated in the Student Handbook (see College website, [http://www.jeffco.edu](http://www.jeffco.edu)).
XI. ATTENDANCE STATEMENT

Students earn their financial aid by regularly attending and actively participating in their coursework. If a student does not actively participate, he/she may have to return financial aid funds. Consult the College Catalog or a Student Financial Services representative for more details.

Student’s grade will also be based on participation in class and attendance.

XII. OUTSIDE OF CLASS ACADEMICALLY-RELATED ACTIVITIES

The US Department of Education mandates that students be made aware of expectations regarding coursework to be completed outside the classroom. Students are expected to spend substantial time outside of class meetings engaging in academically-related activities such as reading, studying, and completing assignments. Specifically, time spent on academically-related activities outside of class combined with time spent in class meetings is expected to be a minimum of 37.5 hours over the duration of the term for each credit hour.