JEFFERSON COLLEGE

COURSE SYLLABUS

RAD175

Image Intensification and QA/QC

3 Credit Hours

Revised by: Janet E. Akers MET RT (R) (M)
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RADXXX Image Intensification & QA/QC

I. CATALOGUE DESCRIPTION

A. Prerequisites: Acceptance to Radiologic Technology Program, Reading Proficiency

B. Credit hour award: 3

C. Description: This course provides the student with the knowledge of x-ray equipment routinely utilized to produce diagnostic images as well as the quality control measures pertaining to them. An overview of various recording media and image intensification units used in radiology will be discussed. This course also provides the student with the principles of a Quality Management program including theory, tools, procedures, digital imaging equipment, and assessment of images. (F)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

<table>
<thead>
<tr>
<th>Expected Learning Outcomes</th>
<th>Assessment Measures</th>
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<tbody>
<tr>
<td>Identify the components and function of an image intensification unit</td>
<td>Written Assignments</td>
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<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<tr>
<td>Identify radiographic safety standards for fluoroscopic equipment</td>
<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<td>Written Assignments</td>
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<tr>
<td>Compare and contrast quality improvement, quality assurance and quality control</td>
<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<td>Written Assignments</td>
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<tr>
<td>Identify quality control tools and testing and explain the purpose of each quality control test</td>
<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<tr>
<td>Describe the components and function of automatic exposure control (AEC) devices</td>
<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<td>Written Assignments</td>
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<tr>
<td>Compare generators in terms of radiation production and efficiency</td>
<td>Class Discussion/Activity</td>
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<td>Written Examinations</td>
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<td>Written Assignments</td>
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III. OUTLINE OF TOPICS

A. X-Ray Generating System
   1. 3 main circuits of an x-ray generating system
2. Primary / low voltage circuit  
3. Secondary/ high voltage circuit  
4. Filament circuit  

B. Image Intensification  
   1. Basic Principles  
   2. Purpose  
   3. Advantages  
   4. Historical perspectives  
   5. Review of the anatomy and physiology of human eye  
   6. Components  
      i. Input phosphor  
      ii. Photo cathode  
      iii. Electron focusing lens  
      iv. Accelerating anode  
      v. Output phosphor  

C. Brightness Gain  
   1. Brightness gain equation  
   2. Flux Gain  

D. Image Quality  
   1. Vignetting  
   2. Resolution  
   3. Contrast  
   4. Distortion  
   5. Automatic brightness control  
   6. Multi-field intensifiers  

E. Fluoroscopic Equipment  
   1. Table  
   2. X-ray tube  
   3. Fluoroscopic tower  
   4. Image intensifier  
   5. Flat panel detectors  
      i. Direct  
      ii. Indirect  
   6. Recording device  
   7. Control panel  
   8. Safety requirements  

F. Imaging Viewing Systems  
   1. Video tubes  
   2. Charged-coupled device (CCD)  
   3. Complementary metal oxide semiconductor (CMOS)  
   4. Fiber optics  
   5. Liquid crystal display (LCD) monitor  

G. Image Recording Systems  
   1. Hardcopy display  
      i. Laser printers  
      ii. Dry processor
2. Softcopy display
   i. Cathode ray tube (CRT)
   ii. LCD
3. Tape recording
4. Cine recording

H. Digital fluoroscopy
1. Use
2. Equipment
   i. Tube
   ii. Charged coupled device (CCD)
   iii. Computers
3. Matrix size
4. Spatial resolution

I. Automatic Exposure Control (AEC)
1. Function
2. Types of phototimers
3. Measurement fields
4. Practical considerations
   i. Back-up timers
   ii. Minimum response time
   iii. Capacitor leakage
   iv. Proper selection of technical factors
   v. Density controls
   vi. Source-to-image distance
   vii. Part-field alignment
5. Compensation issues
   i. Contrast agents
   ii. Patient size
   iii. Pathology
   iv. Prosthetics / implants
   v. Collimation
   vi. Image receptor variations
6. Advantages of AEC
7. Disadvantages of AEC

J. Quality Assurance
1. Definition
2. Purpose

K. Quality Control
1. Definition
2. Purpose

L. Quality Experts
1. Dr. W. Edwards Deming
2. Joseph Juran

M. The Joint Commission (TJC)
1. Purpose
2. Continuous Quality Improvement (CQI)
3. TJC 10-step process
N. Reject-repeat analysis
   1. Importance of analysis
   2. Benefits of analysis
   3. Basic program setup
   4. Categorizing repeats reducing repeats
   5. Formula

O. Collimators
   1. Purpose
      i. Upper shutters
      ii. Lower shutters
   2. Beam centering device
      i. Components
      ii. Mirror angulation problems
      iii. Lateral / internal distance problems
   3. Beam alignment and light alignment
      i. Importance in exams
      ii. Acceptable limits
      iii. Test procedure
   4. Central beam versus center of light field
      i. Importance in exams
      ii. Acceptable limits
      iii. Test procedure

P. Focal spot size
   1. Review of anode components and materials
      i. Rotating
      ii. Stationary
   2. Focal spot
      i. Actual focal spot
      ii. Effective focal spot
   3. Line focus principle
   4. Focal spot size estimation and measuring devices
      i. Line pair resolution tool
      ii. Pinhole camera
      iii. Star test pattern
   5. NEMA specifications
      i. Focal spot testing tool requirements
      ii. Acceptable limits of results
      iii. Results

Q. Grid alignment and uniformity
   1. Grid purpose
   2. Grid inventors
   3. Grid construction
      i. Materials
      ii. Ratio
      iii. Frequency
      iv. Lead content
4. Grid patterns
   i. Linear
   ii. Criss-cross

5. Grid types
   i. Parallel
   ii. Focused

6. SID importance with grids
   i. Focused
   ii. Parallel

7. Grid alignment with central ray of x-ray beam
   i. Testing method
   ii. Results
   iii. Causes of grid misalignment

8. Grid uniformity
   i. Testing method
   ii. Results
   iii. Causes of poor grid uniformity

R. X-ray timer testing
1. Timer purpose
2. Time and x-ray quantity
3. Timer types
4. Timer inaccuracy problems
5. Rectification
   i. Single phase
   ii. Three phase

6. Single –phase timer testing
   i. Manual spinning top
   ii. Motorized synchronous top
   iii. Oscilloscope
   iv. Dosimeter

7. Three-phase timer testing
   i. Motorized synchronous top
   ii. Oscilloscope
   iii. Dosimeter

S. Reproducibility and linearity
1. Miliamperage (mA), exposure and density
2. Utilizing the high mA stations
3. Inaccurate mA stations
4. Evaluation of mA stations
5. Reproducibility testing
   i. Definition
   ii. Testing methods
   iii. Results

6. Linearity testing
   i. Definition
   ii. Testing methods
   iii. Results
T. Kilovoltage (kV)  
   1. Function – kV accuracy  
   2. Reasons for inaccuracy  
   3. Testing methods  
   4. Allowable limits  

U. Automatic Exposure Control (AEC)  
   1. Exposure reproducibility  
   2. Ion chamber sensitivity  
   3. Image receptor (IR) exposure variation control accuracy  
   4. Response capability  
   5. Backup timer verification  

V. Lead apparel  

W. Fluoroscopy systems  
   1. Exposure reproducibility  
   2. Exposure rate  
   3. Field size accuracy and beam alignment  
   4. Source to skin distance limits  
   5. Intensifier viewing system resolution  
   6. Intensifier viewing system contrast  
   7. Image display systems  
   8. Automatic brightness control  

X. Picture Archiving and Communications System (PACS) QC  
   1. Display monitor  
      i. Purpose  
      ii. Testing  
      iii. Frequency  
   2. Monthly/quarterly performance  

Y. PACS continuous quality improvement (CQI)  
   1. Recognition of non-diagnostic images  
   2. System up-time  
   3. System training  

Z. Digital radiography (DR) detector systems / automatic exposure controls (AEC)  
   1. Vendor testing tools  
   2. Purpose  
   3. Tests  

AA. Digital Radiography Plate Reader  
   1. Photostimulable storage phosphor (PSP)  
   2. QC testing  
   3. Frequency  

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)


VI. SUPPLEMENTAL TEXTBOOK(S)


VII. REQUIRED MATERIALS

A. A computer with internet access and basic software to include Word and Power Point (available through Jefferson College labs)

B. Course homepage available through Blackboard

VIII. 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

IX. 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. The student should be aware that proofreading and revision are extremely important when preparing homework. 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)*
- A = 100-92%
- B = 91.9-86%
- C = 85.9-80%
- D = 79.9-70%
- F = 69.9 and below
- I = Incomplete
- W = Excused withdrawal from course

**X. ADA AA STATEMENT**

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

**XI. 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)).
XII. ATTENDANCE STATEMENT

Regular and punctual attendance is expected of all students. Any one of these four options may result in the student being removed from the class and an administrative withdrawal being processed: (1) Student fails to begin class; (2) Student ceases participation for at least two consecutive weeks; (3) Student misses 15 percent or more of the coursework; and/or (4) Student misses 15 percent or more of the course as defined by the instructor. 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.

XIII. OUTSIDE OF CLASS ACADEMICALLY RELATED ACTIVITIES

The U.S. 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.