BROWARD COLLEGE
COURSE OUTLINE

LAST REVIEW: 2010-2011 **NEXT REVIEW:** 2015-2016 **STATUS:** A

COURSE TITLE: Radiographic Equipment & Quality Assurance

COMMON COURSE NUMBER: RTE 2623

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN

CLOCK HOURS:

Lecture: 48 Lab:

Clinic: Other:

PREREQISITE(S): RTE 2385, RTE 2457, RTE 2457L, RTE 2533, RTE 2834

COREQUISITE(S):

PRE/COREQUISITE(S): RTE 2130, RTE 2130L, RTE 2782, RTE 2844

COURSE DESCRIPTION: A study of the physical basis of operation of radiographic equipment. Emphasis includes x-ray equipment components, x-ray tubes, image intensifiers, TV monitors and video recorders, serial imaging, generators, image subtraction techniques, digital equipment, non-film imaging equipment, accessory equipment, x-ray production and interaction processes, Quality Assurance and CT equipment.

UNIT TITLES

1. X-ray Machine Circuitry & Components
2. X-ray Production & Interaction Processes
3. X-ray Tubes
4. Image Intensification
5. TV & Video Recording Devices
6. Computer Science & Digital Imaging Concepts
7. Non-Film Imaging Equipment
8. Alternate Radiographic Imaging Equipment
9. Quality Assurance
10. CT Equipment & Operation

EVALUATION: Assessment includes assignments, comprehensive unit exams, comprehensive final exam.

Common Course Number: RTE 2623

UNITS

Unit 1 X-Ray Machine Circuitry & Components

General Outcome:

1.0 The student shall be able to accurately describe the circuitry, components and basic operation of an x-ray machine.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

1.1 Identify the individual components of an x-ray machine and describe their location.

1.2 Describe the functioning of each separate x-ray machine circuit component.

1.3 Differentiate between single and three phase x-ray circuits.

1.4 Describe rectification and discuss its importance to the production of radiation for diagnostic exposures.

1.5 Work problems related to x-ray equipment operation; including transformers, rectifiers, power production and loss and generator efficiency.

1.6 Diagram applied and tube current wave forms for half-wave, full-wave and three phase equipment.

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UNITS

Unit 2 X-Ray Production & Interaction Processes

General Outcome:

2.0 The student shall be able to accurately describe radiation production and interaction with matter.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

2.1 Describe, in detail, Bremsstrahlung and Characteristic type x-ray production.

2.2 Differentiate between Bremsstrahlung and Characteristic type x-ray production processes.

2.3 Identify the factors affecting x-ray production and discuss properties of radiation, including wavelength and frequency.

2.4 Describe how changes in anode material, kVp setting and filtration affect the beam average energy.

2.5 Discuss the impact of filament heating on the production of x-rays.

2.6 Identify the factors effecting minimum and maximum wavelength photon production.

2.7 Identify the factors impacting x-ray beam heterogeneity.

2.8 Describe radiation and matter interaction sequences in detail.

2.9 Explain why each different interaction type occurs, and the parameters of its occurrence.

2.10 Discuss the consequences of each interaction type with regard to the patient and the technologist.

2.11 Identify the energy range over which each interaction type predominates.

2.12 Discuss the imaging significance of each interaction type.

2.13 Employ the formulas: $C = \nu\lambda$, $kV = 12.4/\lambda$ and $\lambda = 12.4/kV$.

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UNITS

Unit 3 X-Ray Tubes

General Outcome:

3.0 The student shall be able to accurately describe the construction and operation of a modern x-ray tube.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

3.1 Identify all components of an x-ray tube.

3.2 Describe the function of each part of an x-ray tube.

3.3 Explain the differences in x-ray tube designs.

3.4 Describe the line focus principle for x-ray tubes.

3.5 Discuss the effect of changing anode angle, filament size, anode disc diameter anode rotational speed and anode material composition on focal spot size and heat loading capacity.

3.6 Calculate anode heat units for single and three phase units.

3.7 Determine safe exposure limits by employing anode rating charts.

3.8 Accurately employ anode cooling charts in solving heat loading problems.

3.9 Discuss advances in x-ray tube design.

3.10 Discuss the advantages and disadvantages of *small anode angle* rotating anode x-ray tubes.

3.11 Explain how modern small anode angle tubes achieve high heat loading capacity.

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UNITS

Unit 4 Image Intensification

General Outcome:

4.0 The student shall be able to accurately describe the construction and operation of image intensification systems.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

4.1 Identify and describe the function of each component of a modern image intensifier.

4.2 Calculate minification, flux, and total brightness gain of an image intensifier.

4.3 Identify and accurately describe the factors affecting image intensifier brightness gain, quantum mottle and output image resolution.

4.4 Describe the use of multi-field size image intensifiers.

4.5 Discuss rod vs. cone vision as it relates to image intensifier use.

4.6 Discuss the advantages and disadvantages of varying the input field size with a multi-field image intensifier.

4.7 Discuss Automatic brightness gain as it applies to image resolution and patient dose.

4.8 Compare direct digital fluoroscopy with conventional image intensification fluoroscopy.

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Unit 5 TV and Video Recording Devices

General Outcome:

5.0 The student shall be able to describe the construction and operation of video cameras, CCDs, TV monitors, and video recording devices.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

5.1 Accurately identify all the components of a video camera, TV monitor and a video recording device.

5.2 Describe the operation of a video camera, CCD, TV monitor and video recording device.

5.3 Compare black and white and color video imaging systems.

5.4 Differentiate between Vidicon and Plumbicon type video camera tubes.

5.5 Differentiate between interlaced and non-interlaced raster pattern TV monitors.

5.6 Explain how band width and lines/frame impacts image resolution.

5.7 Identify the factors primarily responsible for vertical and horizontal resolution.

5.8 Identify the common parameters of operation for video devices in the US, including CCD and video tube type devices.

5.9 Identify advantages of LCD type displays over CRT type displays.

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Unit 6 Computer Science and Digital Imaging Concepts

General Outcome:

6.0 The student shall be able to describe the construction and operation of digital imaging devices and computer equipment.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

6.1 Define or describe each of the following as they relate to computer use: CPU, control unit, arithmetic unit, memory unit, RAM, ROM, Hard drive, input-output devices, VDT, CRTs, LCD, storage devices, modems and PACs.

6.2 Discuss binary and hexadecimal number systems as they relate to computer use.

6.3 Describe how computers are impacting the radiology department.

6.4 Differentiate between analog and digital image processing.

6.5 Identify the primary components of a digital x-ray unit.

6.6 Discuss the use of computers in digital processing of image data.

6.7 Describe the advantages of digital x-ray imaging over analog x-ray imaging.

6.8 Discuss *window width* and *level* as they relate to digital image manipulation.

6.9 Compare digital and analog fluoroscopy equipment.

6.10 Describe the two primary methods of digital image subtraction.

6.11 Identify advantages of each digital image subtraction method.

6.12 Compare digital image subtraction with conventional film subtraction.

6.13 Describe the basic components of a computer and discuss the function of each component.

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UNITS

Unit 7 Non-Film Imaging

General Outcome:

7.0 The student shall be able to describe the construction and operation of non-film imaging systems and compare them with film type imaging systems.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

7.1 Compare non-film imaging methods with film type imaging.

7.2 Describe the primary advantages related to non-film imaging technique.

7.3 Discuss limitation of non-film imaging systems .

7.4 Compare photostimulated phosphor (PSP) radiography with direct digital radiography (DDR).

7.5 Describe patient exposure with digital and PSP radiography and compare each with conventional (analog) radiography.

7.6 Describe scanned projection radiography (SPR).

7.7 Describe Computed Radiography (CR) and compare it with DR.

7.8 Differentiate between direct and indirect image capture techniques used in DR imaging, including the components employed in each system.

7.9 Describe the image formation process involved with: Phosphor Plate Radiography - Computed Radiography (CR), Indirect Digital Radiography (DR), Direct Digital radiography (DR), Digital Fluoroscopy (DF) and Scan Projection Radiography (SPR).

7.10 Describe the advantages and disadvantages of each of the digital imaging techniques identified in Outcome 7.9.

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UNITS

Unit 8 Alternate Radiographic Imaging Equipment

General Outcome:

8.0 The student shall be able to describe the construction and operation of accessory radiographic equipment, including: contrast media injectors, film copiers & duplicators, tomography equipment and x-ray exposure monitoring equipment.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

8.1 Describe the operation of each of the radiographic alternate imaging devices.

8.2 Identify the specific uses for each alternate imaging device.

8.3 Select the appropriate alternate imaging device for any given radiologic task.

8.4 Identify the advantages and disadvantages of each alternate imaging device.

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UNITS

Unit 9 Quality Assurance

General Outcome:

9.0 The student shall be able to describe the processes involved in Quality Management in the radiology department, including QA processes and QC procedures, with either screen-film based or digital based imaging.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

9.1 Differentiate between QA and QC and give examples of each.

9.2 Define and calculate Accuracy, Sensitivity and Specificity as they relate to QM.

9.3 Identify, and briefly describe the, equipment testing that is routinely employed for QC of an R/F radiography room in screen-film and digital imaging systems.

9.4 Identify the acceptance limits for the commonly performed QC tests, including collimator coincidence and CR accuracy, kVp, exposure timer and focal spot size accuracy, linearity and reproducibility variance and fluoroscopy exposure rate limitations for fixed and mobile units.

9.5 Discuss QC testing frequency and reasons for different time frames for different tests.

9.6 Identify the NCRP report that deals specifically with QA.

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UNITS

Unit 10 CT Equipment & Operation

General Outcome:

10.0 The student shall be able to describe the construction and operation of CT equipment, including: different generations of equipment, advantages and disadvantages of different generations of equipment, common operating parameters and exposure concerns.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

10.1 Describe the operation of each of the different generations of CT equipment.

10.2 Identify the imaging parameters influencing spatial and contrast resolution, noise, linearity and uniformity with CT.

10.3 Identify advantages and disadvantages of each different types of CT scanning units, including spiral and non spiral CT.

10.4 Discuss considerations of patient dose Vs image quality with the different CT modes.

10.5 Define terms commonly used to describe CT digital imaging equipment, including; pixel, voxel, image matrix, Hounsfield unit, etc.

10.6 Discuss considerations of patient dose Vs image quality with the different CT modes.

10.7 Discuss image reconstruction via back projection and interpolation.

10.8 Discuss considerations of patient dose Vs image quality with the different CT modes.

10.9 Explain spiral imaging relations among pitch, index, dose profile and patient dose.

10.10 Describe multislice spiral CT and discuss its' advantages and limitations.