BROWARD COLLEGE
COURSE OUTLINE

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

COURSE TITLE: Imaging I

COMMON COURSE NUMBER: RTE 1418

CREDIT HOURS: 2

CONTACT HOUR BREAKDOWN

CLOCK HOURS:

Lecture: 32 Lab:

Clinic: Other:

PREREQISITE(S): RTE 1000, RTE 1111, RTE 1503, RTE 1503L, RTE 1804

COREQUISITE(S):

PRE/COREQUISITE(S): RTE 1418L, RTE 1513, RTE 1513L, RTE 1613, RTE 1814

COURSE DESCRIPTION: A study of the production and properties of x-radiation, primary exposure factors as they relate to the formulation of radiographic technique, the properties and characteristics of imaging media and the primary factors of radiographic quality.

UNIT TITLES

1. X-ray Tube & X-ray Production
2. X-ray Emission and Exposure
3. Radiographic Image Receptors
4. X-ray Attenuation and Filters
5. Beam Restriction and Grids
6. Photographic Characteristics of Imaging Media & Sensitometry
7. The Radiographic Image
8. Geometry of Image Formation

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

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Unit 1 X-ray Tube & X-ray Production

General Outcome:

1.0 The student shall be able to identify and describe the components of an x-ray tube and explain their function, and describe the process of x-ray production.

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

1.1 Describe the design of the modern x-ray tube.

1.2 Identify, on a drawing, picture or actual tube, each of the x-ray tube components.

1.3 Identify the properties of each of the x-ray tube and housing components.

1.4 Describe tube/anode warm-up procedure and discuss its importance.

1.5 Discuss filament and tube current and differentiate between them.

1.6 Describe the line-focus principle and give applications of its use.

1.7 Identify the common tube anode angle used in the modern x-ray tube anode.

1.8 Discuss heel effect and identify its importance in radiography along with methods for minimizing its effect in x-ray imaging.

1.9 Differentiate between useful radiation, remnant radiation, stem radiation and leakage radiation and describe how each where each originates.

1.10 Identify common causes of x-ray tube failure.

1.11 Describe the operation of an induction, stator equipped, rotating anode assembly.

1.12 State the purpose of the tube housing.

1.13 Define thermionic emission.

1.14 Describe the methods for making an x-ray exposure with a two-position exposure switch.

1.15 Determine safe/unsafe exposures, using x-ray tube anode rating charts.

1.16 Describe the function of each of the following x-ray tube components: stator, rotor, stem, envelope, housing, focusing cup, filament, & tube window.

1.17 Discuss methods of heat dissipation from the x-ray anode.

1.18 Identify the materials commonly used to construct the x-ray tube anode and the tube filaments.

1.19 Identify the Z number and chemical symbol of tungsten, molybdenum, and rhenium.

1.20 Describe the difference in anode heating among single phase, three phase and high frequency x-ray machines using the same technical settings.

1.21 Define ionization and suggest methods of producing it.

1.22 Describe the Bremsstrahlung process of x-ray production.

1.23 Describe the Characteristic process of x-ray production.

1.24 Differentiate between polyenergetic and discrete x-ray production processes.

1.25 Describe the properties of an x-ray beam produced by Bremsstrahlung.

1.26 Define wavelength, frequency and amplitude.

1.27 Identify the properties of x-radiation.

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Unit 2 X-ray Emission and Exposure

General Outcome:

2.0 The student shall be able to identify and describe the factors that control x-ray emission and exposure, and relate ways of minimizing exposure and maximizing image quality.

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

2.1 Explain the relationship between mA and time as they relate to mAs.

2.2 Explain the Reciprocity Law; state it mathematically and solve problems utilizing it.

2.3 Explain the relationship between x-ray intensity and SID.

2.4 Explain the Inverse Square Law; state it mathematically and solve problems utilizing it.

2.5 Explain the relationship between mAs and SID.

2.6 State the mAs-distance relationship (Squared Law) mathematically and solve problems utilizing it.

2.7 List the factors that affect the intensity (exposure rate) of the x-ray beam and describe the results of changing each factor.

2.8 Explain how the energy of x-rays is related to the voltage applied across the x-ray tube electrodes at the time of production.

2.9 Differentiate between Quality and Quantity of the x-ray beam; state which factors control each.

2.10 Describe the relationship between x-ray wavelength and frequency.

2.11 Describe the relationship between x-ray photon velocity and wavelength and frequency.

2.12 Differentiate between minimum and maximum wavelength in the useful beam and identify the factors that control each.

2.13 Discuss the effect of anode target material on x-ray beam wavelengths and frequencies.

2.14 Discuss the effects of altering mA, kVp or filtration on beam average energy and intensity.

2.15 Describe the Bremsstrahlung and Characteristic x-ray production spectra.

2.16 Discuss the effect on emission spectra of altering: tube current, tube voltage, added filtration, target material or voltage waveform.

2.17 Identity the four prime factors of x-ray exposure.

2.18 Discuss mA and kVp in terms of x-ray beam quality and quality.

2.19 Identify the methods of describing beam quality.

2.20 Discuss the reciprocity law, square law, and inverse square law as they relate to altering beam quantity or quality.

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Unit 3 Radiographic Image Receptors

General Outcome:

3.0 The student shall be able to describe in detail the use of radiographic intensifying screens, CR plates and DR receptors employed as modern image receptors.

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

3.1 Describe the component layers of a typical rare earth screen.

3.2 Explain the reason for using intensifying screens.

3.3 Define luminescence, fluorescence and phosphorescence and after glow.

3.4 Identify factors that affect intensifying screen speed.

3.5 Compare screen absorption and conversion efficiency.

3.6 Define image noise and discuss the factors that affect it.

3.7 Discuss image resolution as it relates to screen speed.

3.8 Discuss image density and contrast as they relate to screen speed.

3.9 Define spectrum matching as it relates to screen and film use.

3.10 Explain screen contact artifact production and the test used to evaluate it.

3.11 Describe how changes in screen speed or type affect patient exposure.

3.12 Describe the composition of a CR plate.

3.13 Describe the image recording and processing steps used in CR radiography.

3.14 Differentiate between CR imaging and DR imaging.

3.15 Differentiate between direct and indirect image capture type DR.

3.16 Identify advantages and disadvantages of CR, direct DR, and indirect DR.

3.17 Discuss the image formation process used for screen-film and for digital x-ray imaging.

3.18 Compare Screen-film, CR, & DR imaging with regard to spatial and contrast resolution.

3.19 Discuss exposure latitude and patient dose comparison among the various imaging systems.

3.20 Compare the effects of scatter on screen-film and digital recording systems.

3.21 Identify common LP/mm averages for screen-film and for digital imagining.

3.22 Identify common terms associated with image evaluation with screen-film and digital images.

3.23 Discuss image storage concerns related to screen-film and digital recording systems.

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Unit 4 X-ray Attenuation and Filters

General Outcome:

4.0 The student shall be able to describe the process of attenuation of x-radiation and relate the effect of filters on beam spectra.

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

4.1 Define attenuation, absorption, scatter and transmission.

4.2 Differentiate between monochromatic and polychromatic radiation beams.

4.3 Discuss Half-Value Layer (HVL) as it relates to beam quality specification.

4.4 Describe the factors affecting attenuation.

4.5 Compare the average energy of a polychromatic x-ray beam to the peak energy of the beam.

4.6 Describe the physical characteristics (effective atomic number, density, electrons per gram and electrons per cubic centimeter) of air, fat, water and bone.

4.7 Identify the most common type of filter material used in diagnostic radiology equipment.

4.8 Differentiate between inherent, added and total filtration.

4.9 Describe a compound filter and identify its use.

4.10 Identify types of compensating filters, and describe where each type is used.

4.11 Identify the effect of filtration on beam quantity and quality.

4.12 Identify the recommended minimum total filtration levels for x-ray equipment operating: below 50 kVp, between 50 – 70 kVp, and above 70 kVp.

4.13 Identify the type of material often used as a filter in dedicated mammography units.

4.14 State the purpose of filtration and its effect on patient dose.

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Unit 5 Beam Restriction and Grids

General Outcome:

5.0 The student shall be able to describe the characteristics and use of beam restriction devices and grids.

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

5.1 Discuss the factors that affect the amount of scatter radiation produced, including kVp, field size, material irradiated and part thickness.

5.2 Discuss methods used by radiographers to control the amount of scatter reaching the film.

5.3 Describe the construction of the three common types of beam restricting devices: cones, diaphragms and collimators.

5.4 Compare the effectiveness of the three types beam restricting devices.

5.5 Identify the parts of a modern collimator assembly.

5.6 Differentiate between penumbra and umbra.

5.7 Determine the field size produced with a given aperture size at a fixed SID.

5.8 Describe the use of a PBL device.

5.9 Discuss the use of ancillary devices such as lead masks or blockers as beam restrictors.

5.10 Identify the amount of lead material required for lead shield placed IN the primary beam.

5.11 Identify exams where beam restriction is especially important.

5.12 Describer the effect of beam restriction on patient dose and beam intensity at the film surface.

5.13 Describe the effect of beam restriction on image brightness/ density and contrast.

5.14 Given radiograph images taken with and without beam restriction identify the image made with adequate beam restriction.

5.15 Differentiate between stationary and moving type grids.

5.16 Describe grid construction and define grid ratio, grid focus, grid radius and grid frequency.

5.17 Explain what is meant by focal range of a grid.

5.18 Identify parallel, focused, and cross hatch type grids.

5.19 Explain how grids affect radiographic quality.

5.20 Identify the conversion factors required for technique correction when changing grid ratio.

5.21 Given the height and distance between grid lines, determine the grid ratio.

5.22 Describer the materials generally used to construct grids.

5.23 Describe the principle function of a grid.

5.24 Identify the Contrast improvement factor range found with most grids.

5.25 Identify the common grid ratios used in the radiology department.

5.26 Use the Bucky factor formula to determine changes in patient dose when a grid is used.

5.27 Identify the Bucky Factor for the commonly employed grids.

5.28 Define grid selectivity.

5.29 Define grid cutoff and describe how it is produced.

5.30 Describe methods of minimizing grid cutoff.

5.31 Discuss advantages and disadvantages of each grid type, and grid ratio.

5.32 Identify common grid problems.

5.33 Discuss patient exposure dose as it relates to grid selection and use.

5.34 Discuss specific problems relating to grid us in CR imaging.

5.35 Describe the air-gap technique and describe where is might be used.

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Unit 6 Photographic Characteristics of Imaging Media & Sensitometry

General Outcome:

6.0 The student shall be able to describe the characteristics and sensitometric properties of imaging media.

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

6.1 Define photographic density.

6.2 Write the formula for photographic, i.e., optical density (OD).

6.3 Define opacity and transmittance as they relate to film density readings.

6.4 Discuss the characteristic (H & D, sensitometric, or D log E) curve of screen type film exposed to x-ray, and digital media.

6.5 Identify and describe a penetrometer and a densitometer.

6.6 Describe the primary characteristics of imaging media, i.e., resolution, speed, contrast and latitude.

6.7 Identify the factors affecting imaging media resolution, speed, contrast and latitude.

6.8 Discuss shape of the characteristic curve as it relates to contrast, d-max, base + fog, and latitude.

6.9 Define film gamma and average gradient and compare them.

6.10 Identify the toe, shoulder and linear portion of a film based H & D curve.

6.11 Compare film and digital exposure Vs response graphs.

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Unit 7 The Radiographic Image

General Outcome:

7.0 The student shall be able to identify the factors affecting image clarity and understand how to measure and control the image contrast, resolution and quality.

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

7.1 Define radiographic contrast.

7.2 Define subject contrast, and compare it to image contrast.

7.3 Identify the affect on image (radiographic) contrast when atomic number of the irradiated part changes.

7.4 Discuss alterations in image contrast resulting from changes in kVp.

7.5 Describe the effect of fog on image contrast.

7.6 Describe the following types of mottle: screen; structure & quantum, graininess.

7.7 Describe the relationship between screen system speed and image noise.

7.8 Describe methods of increasing speed with no change in image noise.

7.9 Describe methods of increasing speed with increased image noise.

7.10 Define sharpness, geometric unsharpness, absorption unsharpness, screen unsharpness and parallax unsharpness.

7.11 Compare and contrast spatial and contrast resolution of the various imaging processes.

7.12 Identify methods of measuring image resolution.

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Unit 8 Geometry of Image Formation

General Outcome:

8.0 The student shall be able to identify the geometric factors affecting image quality and methods of minimizing loss of quality through appropriate use of those factors.

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

8.1 Solve imaging problems using similar triangles.

8.2 Define magnification and use the appropriate formula to solve problems relating to magnification.

8.3 Identify factors that control image magnification.

8.4 Define image distortion and describe factors that contribute to it.

8.5 Identify methods of minimizing image distortion.

8.6 Describe how geometric variables alter the size of the penumbra.

8.7 Describe the impact of focal spot size on image unsharpness.

8.8 Explain motion unsharpness and identify means of minimizing it.

8.9 Explain how changes in mA and kVp affect the focal spot size (Blooming of focal spot).

8.10 Describe how screen construction can produce geometric loss of quality (resolution).