



A POLYTECHNIC INSTITUTION

School of Health Sciences

Program: Medical Radiography

Option:

MRAD 3322**Image Recording, Equipment and Quality Control****Start Date:** January, 2006**End Date:** April, 2006**Total Hours:** 32 **Total Weeks:** 16**Term/Level:** 3 **Course Credits:** 3**Hours/Week:** 2 **Lecture:** **Lab:****Shop:** **Seminar:** **Other:****Prerequisites****MRAD 3322 is a Prerequisite for:****Course No. Course Name****Course No. Course Name**MRAD 2222 Image Recording, Equipment and
Quality Control

None.

Course Description

This course is divided into two parts. **Part A** will explore the fundamental physical principles of mammography, mobile x-ray imaging systems, and outline the essential concepts and procedures of quality assurance/quality control in diagnostic radiology. **Part B** will describe the elements of digital imaging in radiology. Specifically, digital image acquisition technologies such as computed radiography (CR), digital radiography (DR), digital fluoroscopy, and digital mammography, as well as Computed Tomography (CT) will be described. Finally, the course will explain the nature and technology of Picture Archiving and Communications Systems (PACS) and introduce the notion of integrated medical imaging and outline the goals of Integrating the Healthcare Enterprise (IHE).

Detailed Course Description

- To outline the fundamental physical principles and instrumentation concepts of x-ray mammography, mobile imaging systems, and elements of quality assurance/quality control for diagnostic radiology.
- To outline the essential elements of digital image acquisition systems, PACS, and integrated digital imaging in diagnostic radiology.

Evaluation

Laboratory	10%
Project (Article Summary)	10%
Midterm Exam	30%
Final Exam	50%
TOTAL	100%

Comments:

- A grade of 60% is required to pass this course.
- Project requirements will be discussed in the first class
- The final examination is cumulative and is based on the entire course.

Course Learning Outcomes/Competencies

Upon successful completion, the student will be able to:

1. Describe the major features of mobile radiographic and fluoroscopic imaging systems.
2. Outline the characteristics of x-ray mammography imaging systems.
3. Differentiate between the terms quality assurance (QA) and quality control (QC) and list the advantages of a continuous quality improvement (CQI) program in diagnostic radiology.
4. Describe the elements of QC in terms of:
 - a. equipment for QC
 - b. parameters for QC monitoring
 - c. QC test procedures
 - d. image quality standards
 - e. tolerance limits
 - f. error correction
5. Describe the following QC tests for radiographic imaging systems:
 - a. level accuracy, section thickness in conventional tomography
 - b. collimator test
 - c. focal spot assessment
 - d. screen-film contact test
 - e. automatic exposure control (AEC)
 - f. inspection procedures for radiographic equipment
6. Describe each of the following QC tests for fluoroscopic equipment:
 - a. protective apparel
 - b. film illuminators
 - c. fluoroscopic resolution
 - d. maximum exposure rate
 - e. fluoroscopic timer accuracy
 - f. inspection procedures for fluoroscopic procedures
 - g. fluoroscopic timer
7. Outline the essential features of a repeat/reject analysis.
8. Describe the essential characteristics of digital imaging and list the applications of digital imaging in diagnostic radiology.
9. Describe the fundamental principles of each of the following computer-assisted imaging techniques, information, and communication systems:
 - a. computed tomography (CT)
 - b. digital fluoroscopy (DF)
 - c. computed radiography (CR)
 - d. digital radiography (DR), including direct/indirect digital systems
 - e. picture archiving and communication systems (PACS)
 - f. integrated medical imaging, including IHE

CAMRT COMPETENCY PROFILE (Equipment Operation)

On successful completion of these outcomes, students will be prepared to meet the requirements of the following competencies as listed in the CAMRT "Competency Profile" for Radiography.

A2 Prepare the room for radiographic/fluoroscopic imaging procedures.

- A2.5 Obtain accessory imaging equipment.
- A2.6 Select the correct image receptor system (conventional vs digital).

A4 Position the patient.

- A4.10 Collimate to the area of interest only to maximize image quality.

A5 Operate imaging equipment.

- A5.1 Select and use apparatus and accessory equipment safely.
- A5.2 Perform the initial set-up of the equipment.
- A5.3 Select the computer protocol for digital imaging.
- A5.4 Select the source-image distance.
- A5.5 Use radiographic markers.
- A5.6 Select the fastest film/screen/grid combination for optimum image quality appropriate for the examination.
- A5.7 Select appropriate kV, mA and time or automatic exposure control parameters.
- A5.8 Modify exposure factors on the basis of the patient's age, physique and condition.
- A5.9 Take the exposure.

A6 Process images.

- A6.1 Imprint ID information.
- A6.2 Manipulate computer data, if applicable.
- A6.3 Unload the film cassette/magazine and process exposed film.
- A6.4 Reload the cassette/magazine.

A7 Critique images and implement corrective measures.

- A7.8 Manipulate the digital image.

D2 Monitor radiographic/fluoroscopic equipment.

- D2.1 Perform visual inspection of cables and equipment.
- D2.2 Recognize improper functioning of imaging and accessory equipment/devices.
- D2.3 Ensure the proper operation of safety devices.
- D2.4 Record and report equipment malfunctions to the appropriate person.

D3 Perform quality control tasks.

- D3.1 Perform quality control tests on imaging and accessory equipment.
- D3.2 Use test results to initiate corrective action.
- D3.3 Record and maintain records/charts of all tests.
- D3.4 Test lead aprons and shields.
- D3.5 Report test results to appropriate person.
- D3.6 Conduct repeat/reject analysis

Verification

I verify that the content of this course outline is current.

Euclid Seeram
Authoring Instructor

Dec 30 - 05
Date

I verify that this course outline has been reviewed.

M. Filippelli
Program Head/Chief Instructor

December 30 - 05
Date

I verify that this course outline complies with BCIT policy.

Alan Bell
Dean/Associate Dean

21 December, 2005
Date

Note: Should changes be required to the content of this course outline, students will be given reasonable notice.

Instructor(s)

Euclid Seeram, RTR, BSc, MSc,
FCAMRT

Office Location: SW3-4084
Office Hrs.:

Office Phone: 604-432-8231
E-mail Address: euclid_seeram@bcit.ca

Learning Resources

Required:

- Bushong, S. *Radiologic Science for Technologists*. Mosby-Year Book, Inc., Eight Edition. 2004.
- Seeram, E. *Rad. Tech. Guide to Equipment Operation and Maintenance*. Blackwell Science. 2001.

Additional References:

- Gray, J. et al. *Quality Control in Diagnostic Imaging*. Aspen Publishers Inc. 1983.
- *Safety Code 20A: X-ray Equipment in Medical Diagnosis*. Ottawa, 1999.
- Seeram, E. *Computed Tomography*. W.B. Saunders Co. 2001.
- Brennan P, McEntee M, and Seeram E. *Digital Diagnostic Imaging*. Blackwell Publishing Inc., Oxford, In Press

Information for Students

(Information below can be adapted and supplemented as necessary.)

The following statements are in accordance with the BCIT Student Regulations Policy 5002. To review the full policy, please refer to: <http://www.bcit.ca/~presoff/5002.pdf>.

Attendance/Illness:

In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with his/her instructor or Program Head or Chief Instructor, indicating the reason for the absence. Prolonged illness of three or more consecutive days must have a BCIT medical certificate sent to the department. Excessive absence may result in failure or immediate withdrawal from the course or program.

Academic Misconduct:

Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited and will be handled in accordance with the 'Violations of Standards of Conduct' section of Policy 5002.

Attempts:

Students must successfully complete a course within a maximum of three attempts at the course. Students with two attempts in a single course will be allowed to repeat the course only upon special written permission from the Associate Dean. Students who have not successfully completed a course within three attempts will not be eligible to graduate from their respective program.

Accommodation:

Any student who may require accommodation from BCIT because of a physical or mental disability should refer to BCIT's Policy on Accommodation for Students with Disabilities (Policy #4501), and contact BCIT's Disability Resource Centre (SW1-2300, 604-451-6963) at the earliest possible time. Requests for accommodation must be made to the Disability Resource Centre, and should not be made to a course instructor or Program area.

Any student who needs special assistance in the event of a medical emergency or building evacuation (either because of a disability or for any other reason) should also promptly inform their course instructor(s) and the Disability Resource Centre of their personal circumstances.

Assignment Details

There are two assignments in this course:

1. **Laboratory:** Conduct and write a brief report on ONE QC test (to be discussed in detail during lectures).
2. **Article Summary:** To be discussed in class during the course outline discussion.

Schedule

Week	Outcome/Material Covered	Reference/Reading
TERM 3A		
1 Jan 4-6	COURSE OUTLINE REVIEW <ul style="list-style-type: none"> • Goals • Description • Evaluation • Outlines/CAMRT Competencies • Learning Resources 	Euclid Seeram
	FLUOROSCOPY (Continued from MRAD 2222) <ul style="list-style-type: none"> • Performance Characteristics of the Image Intensifier Tube • Television Monitoring • Charge Coupled Device • Image Recording • Introduction to Digital Fluoroscopy 	Seeram, Chapter 8 Bushong, Chapter 24
2 Jan 9-13	MAMMOGRAPHY IMAGING <ul style="list-style-type: none"> • Definition of Mammography • Type of Mammography <ul style="list-style-type: none"> – Screening – Diagnostic • Basic Principles of Imaging • Equipment <ul style="list-style-type: none"> – X-Ray Tube – Filtration – Compression – Grids – AEC • Screen-Film Mammography • Digital Mammography–An Overview 	Bushong, Chapter 22

Week	Outcome/Material Covered	Reference/Reading
3 Jan 16-20	MOBILE IMAGING SYSTEMS <ul style="list-style-type: none"> • Radiographic Systems <ul style="list-style-type: none"> – Generators and Power Supply – Advantages/Disadvantages • Fluoroscopic Systems <ul style="list-style-type: none"> – Mobile C-Arms – Mini C-Arms QUALITY MANAGEMENT IN RADIOLOGY <ul style="list-style-type: none"> • Purpose of a QM Program • JCAHO Model • QA/QC Definitions • QC and Levels of Testing • Continuous Quality Improvement • Tools for QC Monitoring • Measurement and Control Charts • Benefits of QM 	Seeram, Chapter 9 Seeram, Chapter 10 Bushong, Chapter 31
4-6 Jan 23-Feb 10	RADIOGRAPHIC QUALITY CONTROL <ul style="list-style-type: none"> • Parameters for QC Monitoring • Elements of a QC Test • QC Tests <ul style="list-style-type: none"> – Review Test done by Jennifer <ul style="list-style-type: none"> ◆ Exposure Reproducibility ◆ Exposure Linearity ◆ Output vs kVp ◆ kVp Accuracy ◆ HVL Assessment – Inspection Procedures – Collimation – Film/Screen Contact – Automatic Exposure Control – Focal Spot Assessment – Tomographic Tests <ul style="list-style-type: none"> ◆ Level Accuracy ◆ Section Thickness 	Seeram, Chapter 10 Bushong, Chapter 31
7 Feb 13-17	FLUOROSCOPIC QUALITY CONTROL <ul style="list-style-type: none"> • Inspection Procedures • Maximum Exposure Rate • Fluoro Timer Accuracy • Fluoroscopic Resolution Test • Protective Apparel 	Seeram, Chapter 10 Bushong, Chapter 31

Week	Outcome/Material Covered	Reference/Reading
	<ul style="list-style-type: none"> Film Illuminators 	
7 Mid Term (Feb 16-Thursday)	END OF TERM 3A EXAMINATIONS A set of multiple choice questions on all topics covered in Term 3A	Euclid
TERM 3B		
8 Feb 20-Feb24	REPEAT/REJECT FILM ANALYSIS <ul style="list-style-type: none"> What is a Repeat/Reject Analysis? Why Conduct an Analysis? Definitions Ways to Conduct an Analysis Repeat/Reject Analysis Program 	Seeram, Chapter 10 Bushong, Chapter
9 Feb 27-Mar3	COMPUTED RADIOGRAPHY (CR) <ul style="list-style-type: none"> What is CR? Brief History Physical Principles Technology <ul style="list-style-type: none"> Components Imaging Plates/Cassettes Laser Scanning and Detection of CR Latent Image Processing the Digitized Image <ul style="list-style-type: none"> Pre-acquisition Processing Post-acquisition Processing Control of Exposure of Exposure Factor Selection Artifacts 	Bushong, Chapter 27 Additional Notes by Euclid Seeram
10 Mar 6-10	DIGITAL RADIOGRAPHY (DR) <ul style="list-style-type: none"> CR Limitations Indirect Digital Radiography <ul style="list-style-type: none"> CCD-based Systems Large Area Flat Panel Detectors Direct Digital Radiography <ul style="list-style-type: none"> Detection Technology Principles of Operation Comparing Technologies <ul style="list-style-type: none"> Image Quality Detective Quantum Efficiency (DQE) Benefits Digital Mammography 	Bushong, Chapter 27

Week	Outcome/Material Covered	Reference/Reading
<p>10 Mar 7-11</p>	<p>DIGITAL FLUOROSCOPY (DF)</p> <ul style="list-style-type: none"> • What is Digital Fluoroscopy? • System Components <ul style="list-style-type: none"> – X-Ray Source – Image Receptor – Video Camera and Optics – Digital Chain • Digital Subtraction Angiography <ul style="list-style-type: none"> – Principles – Technology 	<p>Bushong, Chapter 28</p> <p>Additional Notes by Euclid Seeram</p>
<p>11</p>	<p>SPRING BREAK - SPRING BREAK - SPRING BREAK</p>	<p>March 13-17</p>
<p>12, 13,14,15 Mar 20-April 14</p>	<p>COMPUTED TOMOGRAPHY</p> <ul style="list-style-type: none"> • Limitations of Radiography • Brief History <ul style="list-style-type: none"> – Hounsfield – Cormack – Kalender • Basic Physics <ul style="list-style-type: none"> – Attenuation • Image Reconstruction • Equipment Configuration • Image Manipulation • Single-Slice Volume CT - Principles and Instrumentation • Multi-Slice Volume CT – Principles and Instrumentation • Applications of MSCT <ul style="list-style-type: none"> – CT Fluoroscopy – CT Angiography – 3-D Imaging – Virtual Reality Imaging 	<p>March 14-Good Friday</p> <p>March 17-Easter Monday</p> <p>Bushong, Chapter 29 and some aspects of Chapter 30</p> <p>Additional Notes by Euclid Seeram</p>

Week	Outcome/Material Covered	Reference/Reading
15 April 10-14	PICTURE ARCHIVING AND COMMUNICATION SYSTEMS (PACS) <ul style="list-style-type: none"> • Definition • Image Acquisition • PACS Components <ul style="list-style-type: none"> – Network Infrastructure – Image Management – Display of Images – Image Storage 	Bushong, Chapter 28 Additional Notes by Euclid Seeram
15 April 10-14	INTEGRATED DIGITAL IMAGING <ul style="list-style-type: none"> • Integrated Imaging <ul style="list-style-type: none"> – Enterprise-wide Image Distribution – Integrating the Healthcare Enterprise (IHE) 	Notes by Euclid Seeram
16 April 17-21	FINAL EXAMINATION	
	The final examination will be based on all materials covered in Term B – Multiple Choice Questions.	