

Department of Medical Imaging Sciences

Faculty of Health Sciences

American University of Beirut

**Course number: MIMG204**

Course name: Medical Imaging Equipment II

Spring semester AY 2019 - 2020

### Course Administration

Primary Instructor: Dr. Charbel Saade (Assistant Professor)

Office: 3<sup>rd</sup> Floor, Van Dyck – Room 329

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Office hours: by appointment

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### Class Time and Location

Monday: 9:30 – 10:45 – Room 103 – Van Dyck

Wednesday: 11:00 – 12.15 – Room 103 – Van Dyck

### Course Description

A detailed study of the equipment design and function in Breast imaging, Nuclear Medicine / PET, Computed Tomography, Ultrasonography and Magnetic Resonance Imaging

### Course Objectives

At the end of this course the student will have detailed understanding of the scheme and instrumentation of imaging equipment used in:

1. Fluoroscopy
  - Understand the scheme of fluoroscopic equipment (analogue and digital)
  - Recognize parameters that affect radiation dose
  - Recognize parameters that affect image quality
  - Recognize dose reduction techniques
2. Control of Scatter
  - Recognize the impact of scatter on patient / staff radiation dose and image / procedure quality
  - Recognize factors that contribute to the creation of scatter
  - Understand technical steps that decrease the amount of scatter created

- Understand procedural steps that decrease the amount of scatter created
3. Breast imaging
    - Understand the scheme of mammographic equipment (analogue and FFDM)
    - Recognize parameters that affect radiation dose
    - Recognize parameters that affect image quality
    - Recognize dose reduction techniques
  4. Nuclear Medicine (NM) / Positron Emission Tomography (PET)
    - Understand the scheme of NM / SPECT / PET equipment
    - Understand the configuration of detectors in NM / SPECT / PET equipment
    - Understand the production of radiopharmaceuticals in in NM / SPECT / PET equipment
    - Understand the role of collimators and imaging parameters on patient radiation dose and image / procedure quality
  5. Ultrasonography (US)
    - Instruct students in the theoretical and practical application of ultrasound physics and instrumentation
    - Describe ultrasound and how it behaves
    - Describe the interaction of ultrasound with matter
    - Describe the construction of a transducer and the function of each part
    - Describe a sound beam and list the factors that affect it
    - Describe the technique used to determine two-dimensional Doppler information
    - Allow students to apply the learned academic knowledge in clinical practice
  6. Computed Tomography (CT)
    - Understand the principles of computed tomography hardware
    - Recognize parameters that affect radiation dose
    - Recognize parameters that affect image quality
    - Recognize parameters that affect contrast media delivery
    - Understand the principles of advanced CT techniques
  7. Magnetic Resonance Imaging (MRI)
    - Understand the principles of magnet hardware
    - Recognize parameters that affect the specific absorption rate (SAR)
    - Recognize parameters that affect image quality
    - Recognize parameters that affect contrast media delivery (gadolinium)

## Required Readings

Notes: All lectures and reading materials and exercises will be uploaded on Moodle / emailed.

1. Mammography:
  - a. Mammography Quality Standards Act (MQSA)  
(<https://www.fda.gov/Radiation-EmittingProducts/MammographyQualityStandardsActandProgram/Regulations/ucm110823.htm>)
  - b. Bushong, S.C. (2009). Radiologic Science for Technologists (9<sup>th</sup> ed.)  
Mosby: Elsevier
2. Nuclear Imaging:
  - a. Bushong, S.C. (2009). Radiologic Science for Technologists (9<sup>th</sup> ed.)  
Mosby: Elsevier
3. Ultrasound:
  - a. Gill R. (2012). The physics and Technology of Diagnostic Ultrasound. A Practitioner's Guide. Sydney, Australia, High Frequency Publishing.
4. Computed Tomography:
  - a. Seeram, E. (2015). Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences
  - b. Romans, L. E. (2010). Computed tomography for technologists: A Comprehensive Text. Lippincott Williams & Wilkins
5. Magnetic Resonance Imaging:
  - a. Westbrook, C., & Roth, C. K. (2011). MRI in Practice. John Wiley & Sons
  - b. Westbrook, C. (2014). Handbook of MRI technique. John Wiley & Sons

## Course Requirements and Student Evaluations

	Assessment	Percent	Linked to objectives
A.	Attendance and Class Contribution	5%	
C.	Test 1	35%	1 - 4
D.	Test 2	20%	5
E.	Test 3	40%	6 - 7

**N.B.: The passing grade for the course is 65/100**

## Credits Allocated

3

## Prerequisites

MIMG 203: Medical Imaging Equipment I

## General Education Knowledge Goals and Skills

### General Education Knowledge Goals

1. Communication: Students will communicate effectively in both speech and writing.
2. Technology: Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
3. Diversity: Students will understand the importance of a global perspective and culturally diverse peoples.
4. Ethical Reasoning and Action: Students will understand ethical issues and situations.

### General Education Knowledge Skills

1. Written and Oral Communication in English: Students will communicate effectively in speech and writing and demonstrate proficiency in reading.
2. Critical Thinking and Problem-solving: Students will use critical thinking and problem-solving skills in analyzing information.
3. Ethical Decision-Making: Students will recognize, analyze and assess ethical issues and situations.
4. Computer Literacy: Students will use computers to access, analyze or present information, solve problems, and communicate with others.
5. Collaboration and Cooperation: Students will develop the interpersonal skills required for effective performance in group situations.
6. Intra-Cultural and Inter-Cultural Responsibility: Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.

### Detailed Course Outline

Please note this is a tentative schedule. Any changes may be made at the instructor's discretion.

Date	Topic	Reading	Course Objectives
22/01/20	X – Ray generators	Bushong, S.C. (2009). Radiologic Science for Technologists (9 <sup>th</sup> ed.) Mosby: Elsevier	1 and 2
27/1/20	Control of scatter/ Fluoroscopy	PPT presentations and articles posted on Moodle	1 and 2
29/1/20	Fluoroscopy		2
3/2/20	Mammography	Bushong, S.C. (2009). Radiologic Science for Technologists (9 <sup>th</sup> ed.) Mosby: Elsevier PPT presentations and articles posted on Moodle	3
5/2/20	Nuclear Imaging		4
<b>Test 1 - X-ray generators Mammography, Nuclear Imaging</b> 10/2/2020			
12/2/20	Principles of Ultrasound Part 1 - Properties of ultrasound - Parameters describing sound waves Interaction of ultrasound with matter	PPT presentations and exercises will be posted on Moodle	5
12/2/20	Principles of Ultrasound Part 2 - Transducers and their construction		
17/2/20	Principles of Ultrasound Part 3 - Pulse-echo instrumentation - Sound beams - Display modes and 2-D imaging		
19/2/20	Principles of Ultrasound Part 4 - Doppler instrumentation and hemodynamics		
<b>Test 2 - Ultrasound Imaging</b> 24/2/20			

26/2/20	Computed Tomography Part 1 - Principles of CT	1. Seeram, E. (2015). Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences. 2. Romans, L. E. (2010). Computed tomography for technologists: A Comprehensive Text. Lippincott Williams & Wilkins. 3. PPT presentations will be posted on Moodle	6
2/3/20	Computed Tomography Part 1 - Data Acquisition		
4/3/20	Computed Tomography Part 2 - Image Reconstruction		
9/3/20	Computed Tomography Part 2 - Image Display		
11/3/20	Computed Tomography Part 3 - Methods of Data Acquisition		
16/3/20	Computed Tomography Part 3 - Image Quality		
18/3/20	Computed Tomography Part 4 - Image Artefacts: Remedies and Solutions	1. Seeram, E. (2015). Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences. 2. Romans, L. E. (2010). Computed tomography for technologists: A Comprehensive Text. Lippincott Williams & Wilkins. 3. PPT presentations will be posted on Moodle	6
23/3/20	Computed Tomography Part 4 - Cardiovascular CTA applications	1. Seeram, E. (2015). Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences. 2. Romans, L. E. (2010). Computed tomography for technologists: A Comprehensive Text. Lippincott Williams & Wilkins. 3. PPT presentations will be posted on Moodle	6
25/3/20	Computed Tomography Part 4 - Cardiovascular CTA applications		
30/3/20	Computed Tomography Part 4 - Oncology CT applications		
1/4/20	Principles of NMR Part 1 - Nuclear Magnetic Resonance and Instrumentation	1. Westbrook, C., & Roth, C. K. (2011). MRI in Practice. John Wiley & Sons. 2. Westbrook, C. (2014). Handbook of MRI technique. John Wiley & Sons. 3. PPT presentations will be posted on Moodle	7
6/4/20	Principles of NMR Part 1 – MRI Signal and Spatial Encoding in MRI		

8/4/20	Principles of NMR Part 2 - Image Formation - Pulse Sequences		
13/4/20	Principles of NMR Part 3 Fat, Water and Gadolinium		
15/4/20	Principles of NMR Part 4 - Image Quality and Artefacts - Parallel Imaging		
20/4/20	Clinical Lecture Series (Saturday) – 6 hours Brain Tumor MRI Lecture Shoulder MRI Knee MRI Breast Prostate		
22/4/20	MRI Safety		
27/4/20	Liver MRI Extremity Oncology MRI		
<b>Test 3 - Computed Tomography and Magnetic Resonance Imaging</b> 29/4/20			

### Bibliography / References

- Bushong, S.C. (2009). Radiologic Science for Technologists (9<sup>th</sup> ed.) Mosby: Elsevier
- Gill R. (2012). The physics and Technology of Diagnostic Ultrasound. A Practitioner's Guide. Sydney, Australia, High Frequency Publishing.
- Mammography Quality Standards Act (MQSA) (<https://www.fda.gov/Radiation-EmittingProducts/MammographyQualityStandardsActandProgram/Regulations/ucm110823.htm>)
- Romans, L. E. (2010). Computed tomography for technologists: A Comprehensive Text. Lippincott Williams & Wilkins
- Seeram, E. (2015). Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences  
Website: <http://www.mdct.com.au/web/>
- Westbrook, C. (2014). Handbook of MRI technique. John Wiley & Sons
- Westbrook, C., & Roth, C. K. (2011). MRI in Practice. John Wiley & Sons

### Course Policy

- Attendance:** Attendance is mandatory, and attendance will be taken in each lecture. You are expected to attend all classes and participate in classroom activities. If you miss a class, it is your responsibility to make up for the material missed and inquire

about any announcements made. As per AUB General Regulations, students who miss more than one-fifth of the sessions of any course in the first ten weeks of the semester (five weeks in the case of the summer term) are dropped from the course.

- 2. Academic integrity:** Education is demanding, and time management is essential. Do not hesitate to use the resources around you but do not cut corners. Cheating and plagiarism will not be tolerated. Please review the Student Code of Conduct in your handbook available on the following web page:  
<https://www.aub.edu.lb/sao/Documents/Student%20Handbook%202016-2017.pdf>  
and familiarize yourself with definitions and penalties (p. 33).

If you're in doubt about what constitutes plagiarism, ask your instructor because it is your responsibility to know. The American University of Beirut has a strict anti-cheating and anti-plagiarism policy. Penalties include failing marks on the assignment in question, suspension or expulsion from University and a permanent mention of the disciplinary action in the student's records.

- 3. Missed tests:** All tests must be completed within the time period specified; zero points will be given for an exam if the student does not adhere to the time guidelines. The only delays for the final exam that will be considered by the instructor are for documented illness, death in the family, and personal/family emergency.
- 4. Students with Disabilities:** AUB strives to make learning experiences accessible for all. If you anticipate or experience academic barriers due to a disability (such as ADHD, learning difficulties, mental health conditions, chronic or temporary medical conditions), please do not hesitate to inform the Accessible Education Office. In order to ensure that you receive the support you need and to facilitate a smooth accommodations process, you must register with the Accessible Education Office (AEO) as soon as possible: [accessibility@aub.edu.lb](mailto:accessibility@aub.edu.lb); [+961-1-350000](tel:+961-1-350000), x3246; West Hall, 314.
- 5. Non-Discrimination – Title IX – AUB:** AUB is committed to facilitating a campus free of all forms of discrimination including sex/gender-based harassment prohibited by Title IX. The University's non-discrimination policy applies to, and protects, all students, faculty, and staff. If you think you have experienced discrimination or harassment, including sexual misconduct, we encourage you to tell someone promptly. If you speak to a faculty or staff member about an issue such as harassment, sexual violence, or discrimination, the information will be kept as private as possible, however, faculty and designated staff are required to bring it to the attention of the University's Title IX Coordinator. Faculty can refer you to fully confidential resources, and you can find information and contacts at [www.aub.edu.lb/titleix](http://www.aub.edu.lb/titleix). **To report an incident**, contact the University's Title IX Coordinator Trudi Hodges at 01-350000 ext. 2514, or [titleix@aub.edu.lb](mailto:titleix@aub.edu.lb). An anonymous report may be submitted online via EthicsPoint at [www.aub.ethicspoint.com](http://www.aub.ethicspoint.com).