



**Jordan University of Science and Technology**  
**Faculty of Engineering**  
**Biomedical Engineering Department**

**BME 460 Medical Imaging Systems**

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**Course Catalog**

3 Credit hours (3 h lectures, Department Elective). This course introduces the physics, instrumentation, the diagnostic methods, signal processing methods, image characteristics and the biological effects in X-ray (projection radiography), X-ray computed tomography, nuclear medicine (SPECT/PET), ultrasound imaging, and magnetic resonance imaging.

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**Textbooks**

Medical imaging: signals and systems. J. L. Prince and J. M. Links, 2<sup>nd</sup> edition, ISBN 0-13-065353-5, Prentice Hall, 2006.

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**References**

**Books**

1. Fundamentals of Medical Imaging, Paul Suetens, Cambridge University Press, 2009, ISBN: 0521519152, 9780521519151.
2. Introduction to biomedical imaging, Andrew Roy Webb, Wiley, 2003. ISBN: 0471237663, 9780471237662.
3. Introduction to Medical Imaging: Physics, Engineering and Clinical Applications, Nadine Barrie Smith, Andrew Webb, Cambridge University Press, 2010. ISBN: 0521190657, 9780521190657.

**Journals**

**Internet links**

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**Instructor**

Instructor **Dr. Areen Al-Bashir**, E-mail: [akbashir@just.edu.jo](mailto:akbashir@just.edu.jo)

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**Prerequisites**

**Prerequisites by topic** Electrical Circuit Lab, Biomedical Signals and Systems.  
**Prerequisites by course** BME 311, BME 321.  
**Co-requisites by course** ---  
**Prerequisite for** ---

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**Topics Covered**

Week	Topics	Chapters in Text
1	Overview of various medical imaging modalities (Ch. 1); Review of signals and systems basic concepts (Ch. 2); Image quality metrics (Ch. 3)	Chapters 1-3& lectures notes
2-3	Physics of radiography	Chapter 4
3-4	Projection radiography	Chapter 5
4-5	Computed tomography (CT): Instrumentation; Image reconstruction (Radon transform, back projection, filtered back-projection); Image quality.	Chapter 6
6	Digital Radiography	Lecture notes
7-8	The Physics of Nuclear Medicine	Chapter 7
8-9	Planar Scintigraphy	Chapter 8
10-11	Emission Computed Tomography	Chapter 9
12-13	Physics of Ultrasound	Chapter 10
14	Ultrasound Imaging,	Chapter 11
15	Physics of Magnetic Resonance	Chapter 12
16	Magnetic Resonance Imaging (MRI) systems: instrumentation, data acquisition, image reconstruction, image quality. Functional MRI	Chapter 13

## Evaluation

Assessment Tool	Expected Due Date	Weight
Quizzes	One week after the problems are assigned	10%
First Exam	According to the department schedule	25 %
Second Exam	According to the department schedule	25 %
Final Exam	According to the University final examination schedule	40 %

### Objectives and Outcomes<sup>1</sup>

Objectives	Outcomes
1. Explain the basic principles of x-ray, CT scan, Ultrasound, Nuclear imaging and MRI as an imaging modality.(a,m). 2. Analyze the above mentioned imaging systems in terms of physical mechanisms, data generation and acquisition, image construction, processing and quality.(a, e, j, k, m) 3. List strengths and weaknesses associated with every imaging system studied. (a, c, f, h, i, j, k) 4. Encourage Long Life Learning, foster team work and enhance students communication skills.	1.1. Understand the general differences between different medical imaging systems. (1, 9) 2.1. Comprehend the generation of different signals from different medical imaging system and its interactions with the human body. (1,9) 2.2. Know the different imaging parameter for each system. The principle behind them, how to control them and how is this can affect the image appearance. (1,9) 2.3. Understand the theory and practical construction of every imaging system discussed. (1, 2, 4, 6, 9). 2.4. Understand the relationship between image parameters for each system and its interaction with human tissues.. 3.1. Know the specific clinical applications of all imaging systems. The student should be able to choose the best imaging system for specific clinical application. (1,2,4,6,7) 4.1. Write technical report and give oral presentation on team work project(1,7)

### Contribution of Course to Meeting the Professional Component

The course contributes to build a comprehensive understanding of the medical imaging systems used in hospital.

#### Relationship to Program Outcomes (%)

1	2	3	4	5	6	7	8	9
35	20		20		10	10		5

#### Relationship to Biomedical Engineering Program Objectives

PEO1	PEO2	PEO3	PEO 4
√		√	√

Prepared by: Dr. Areen Al.Bashir  
 Last Modified: Dec, 2019

<sup>1</sup> Lower-case letters in brackets refer to the Program outcomes