# Syllabus

# Fundamentals of Medical Imaging

# (140508111)Second Semester 2021 /2022

| COURSE INFORMATION | |
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| **Course Name:** Fundamentals of Medical Imaging<br>**Semester:** Second<br>**Department:** Department of Medical Imaging<br>**Faculty:** Applied Medical Sciences | **Course Code:** 140508111<br>**Section:**<br>Introduction in Medical Imaging Applications<br>**Core Curriculum**:<br>Radiological and Medical Imaging |
| **Day(s) and Time(s):** Sunday: 11:00-12:00<br>Tuesday: 11:00-12:00<br>Thursday (online): 11:00-12:00<br>**Classroom:** Nursing 202 | **Credit Hours:** 3<br>**Prerequisites**: |

## COURSE DESCRIPTION

A comprehensive introduction to the major aspects of standard medical imaging systems used today. The necessity and emerge of medical imaging science is introduced. The course starts with introducing the basics of radiation science and the main radiation interactions with matter. Later, the fundamental physics underlying each imaging modality are reviewed. This includes X-Ray Imaging Systems, X-Ray Computed Tomography CT, Nuclear Medicine Imaging, Magnetic Resonance Imaging MRI, and Ultrasound Imaging. Brief advantages and disadvantages of each one of those imaging modalities are put in plain words. As a focus, this course provides details on the design of the X-Ray tube and X-Ray generation in order to help the forthcoming courses in the department.

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The course will be delivered through a combination of active learning strategies. These will include:

- PowerPoint lectures and active classroom based discussion.
- Collaborative learning through small groups acting in an interdisciplinary context.
- Relevant films and documentaries.
- Video lectures.
- E-learning resources: e-reading assignments and practice quizzes through Model and Microsoft Team.

## FACULTY INFORMATION

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| **Name** | *Ammar Anwar Khaled Oglat* |
| **Academic Title:** | *Assistant Professor* |
| **Office Location:** | *Applied Medical Sciences /Chairman Office of Medical Imaging Department* 3158 |
| **Telephone Number:** | *5354* |
| **Email Address:** | *ammar.oglat@yahoo.com*<br>*ammara@hu.edu.jo* |
| **Office Hours:** | *Sunday: 11:00-12:00*<br>*Tuesday: 11:00-12:00*<br>*Thursday (online): 11:00-12:00*<br><br>*Please send an e-mail (ammar.oglat@yahoo.com) to meet at any other time*. |

## REFERENCES AND LEARNING RESOURCES

**Required Textbook:**

There is no required textbook for purchase.

All compulsory weekly readings are available electronically on Microsoft Teams and Teaching files”on Facebook group.

**Suggested textbook for reading:**

Fundamentals of Medical Imaging Book.

The Essential Physics of Medical Imaging, 2nd edition, Bushberg, Seibert, Leidholdt and Boone. Published By: Lippincott Williams & Wilkins, 2012.

The Physics of Medical Imaging, S. Webb, Institute of Physics Publishing, 1988.

## STUDENT LEARNING OUTCOMES MATRIX*

| Core Curriculum Learning Outcomes | Program Learning Outcomes | Course Objectives | Course Student Learning Outcomes | Assessment Method |
|---|---|---|---|---|
| . Definition of radiation.<br><br>. Radiation types and interactions.<br><br>. Basic principle work and function of medical imaging modalities.<br>. | Apply critical thinking and demonstrate problem-solving skills in more than three major fields of medical Imaging. | 1. Comprehend basics of radiation science as used in Medical Imaging Systems. | 1. Know the basic principle and the interactions of radiations.<br>2. Know the main hardware components of the medical imaging modalities.<br>3. Understand the safety issues related to the radiation environment | • Exams<br>• Quizzes with no marks just to give chance to the students to revise the course.<br>• "On-line' reading assignments |
| | | 2. Realize the basics interaction between radiation and matter. | . Explain all medical imaging modalities in brief (X-Ray Imaging Systems, X-Ray Computed<br>. Tomography CT, Nuclear Medicine Imaging, Magnetic Resonance Imaging MRI, and Ultrasound Imaging).<br><br>. Know the attenuation and enetration phenomena.<br><br>. Explain the attenuation of ifferent densities. | . Exams<br>. Quizzes with no marks just to give chance to the students to revise the course.<br>. "On-line' reading assignments<br>. |
| | | 3. Appreciate the various common Medical Imaging modalities and identify major headlines involved in formation of medical images. | | . Exams<br>. Quizzes with no marks just to give chance to the students to revise the course.<br>. "On-line' reading assignments |

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| | | 4. Understand the design of X-Ray tube and how the X-Ray photons are generated. | | . Exams<br>. Quizzes with no marks just to give chance to the students to revise the course.<br>. "On-line' reading assignments<br>. |
| | | 5. Realize the basic image features differences between various common Medical Imaging modalities. | | • Exams<br>• Quizzes with no marks just to give chance to the students to revise the course.<br>• "On-line' reading assignments |

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| | | | Spatial resolution, and Temporal resolution. | |

## ACADEMIC SUPPORT

It is The Hashemite University policy to provide educational opportunities that ensure fair, appropriate and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their Instructor to ensure that their individual needs are met. The University through its Special Need section will exert all efforts to accommodate for individual's needs.

## COURSE REGULATIONS

### *Participation*

Class participation and attendance are important elements of every student's learning experience at The Hashemite University, and the student is expected to attend all classes. A student should not miss more than 15% of the classes during a semester. *Those exceeding this limit of 15% will receive a failing grade regardless of their performance*. It is a student's responsibility to monitor the frequency of their own absences. **Attendance record begins on the first day of class irrespective of the period allotted to drop/add and late registration. It is a student's responsibility to sign-in; failure to do so will result in a non-attendance being recorded.**

In exceptional cases, the student, with the instructor's prior permission, could be exempted from attending a class provided that the number of such occasions does not exceed the limit allowed by the University. The instructor will determine the acceptability of an absence for being absent. A student who misses more than 25% of classes and has a valid excuse for being absent will be allowed to withdraw from the course.

***Plagiarism***

Plagiarism is considered a serious academic offence and can result in your work losing marks or being failed. HU expects its students to adopt and abide by the highest standards of conduct in their interaction with their professors, peers, and the wider University community. As such, a student is expected not to engage in behaviors that compromise his/her own integrity as well as that of the Hashemite University.

Plagiarism includes the following examples and it applies to all student assignments or submitted work:

- **Use of the work, ideas, images or words of someone else without his/her permission or reference to them.**
- **Use of someone else's wording, name, phrase, sentence, paragraph or essay without using quotation marks.**
- **Misrepresentation of the sources that were used.**

**The instructor has the right to fail the coursework or deduct marks where plagiarism is detected**

### *Late or Missed Assignments*

In all cases of assessment, students who fails to attend an exam, class project or deliver a presentation on the scheduled date without prior permission, and/or are unable to provide a medical note, will automatically receive a fail grade for this part of the assessment.

- Submitting a term paper on time is a key part of the assessment process. Students who fail to submit their work by the deadline specified will automatically receive a 10% penalty. Assignments handed in more than 24 hours late will receive a further 10% penalty. Each subsequent 24 hours will result in a further 10% penalty.

- In cases where a student misses an assessment on account of a medical reason or with prior permission; in line with University regulations an incomplete grade for the specific assessment will be awarded and an alternative assessment or extension can be arranged.

***Student Complaints Policy***

Students at The Hashemite University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the students' handbook.

## COURSE ASSESSMENT

### *Course Calendar and Assessment*

Students will be graded through the following means of assessment and their final grade will be calculated from the forms of assessment as listed below with their grade weighting taken into account. The criteria for grading are listed at the end of the syllabus

| Assessment | Grade Weighting | Deadline Assessment |
|---|---|---|
| **Exam 1** | 30% | 10/4/2022 12:00-1:00 |
| **Exam 2** | 30% | 15/5/2022 12:00-1:00 |
| **Final Exam** | 40% | To be arranged by the registration office |

### Description of Exams

Test questions will predominately come from material presented in the lectures. Semester exams will be conducted during the regularly scheduled lecture period. Exam will consist of a combination of multiple choice, short answer, match, true and false and/or descriptive questions.

### Homework:

Will be given for each chapter, while the chapter in progress you are supposed to work on them continuously and submit in next lecture when I finish the chapter.

You are also expected to work on in-chapter examples, self-tests and representative number of end of chapter problems. The answers of self-tests and end of chapter exercises are given at the end of the book.

### Quizzes:

Unannounced quizzes will be given during or/and at the end of each chapter based upon the previous lectures. It will enforce that you come prepared to the class.

No make-up exams, homework or quizzes will be given. Only documented absences will be considered as per HU guidelines.

Grades are not negotiable and are awarded according to the following criteria*:

| Letter Grade | Description | Grade Points |
|---|---|---|
| A+ | Excellent | 4.00 |
| A | | 3.75 |
| A- | | 3.50 |
| B+ | Very Good | 3.25 |
| B | | 3.00 |
| B- | | 2.75 |
| C+ | Good | 2.50 |
| C | | 2.25 |
| C- | | 2.00 |

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| D+ | Pass | 1.75 |
| D | Pass | 1.50 |
| F | Fail | 0.00 |
| I | Incomplete | - |

## WEEKLY LECTURE SCHEDULE AND CONTENT DISTRIBUTION

***"Lecture hours and weeks are approximate and may change as needed"***

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| **Part One 1** | **BASIC RADIATION PHYSICS** | **Week 1- 6** | **18 lecture hours** |
| 1.1 | Introduction | | |
| 1.2 | Structure of the atom | | |
| 1.3 | Radiation types | | |
| 1.4 | Electromagnetic spectrum | | |
| 1.5 | Radioactivity and isotopes | | |
| **Part Two:** | **INTERACTIONS OF RADIATION WITH MATTER**<br>**12 lecture hours** | | **Week 7-10** |
| 2.1 | Basic Interactions of Particle Radiation with Matter | | |
| 2.2 | Basic Interactions of Electromagnetic radiation with matter | | |
| 2.3 | Radiation Linear Transfer Energy | | |
| **Part Three** | **X-RAY TUBE and X-RAY PRODUCTION** | **Week 11-14** | **12 lecture hours** |
| 3.1 | Internal Component of Diagnostic X-Ray Tubes | | |
| 3.2 | Principle of Line Focus | | |
| 3.3 | Anode Heel Effect | | |
| 3.4 | Tube Rating Charts | | |
| 3.5 | X- Ray Tube Shield | | |
| ***Part Four:*** | ***MEDICAL IMAGING MODALITIES*** | ***Week 15*** | |
| *4.1* | *Introduction to X-Ray Imaging* | | |
| *4.2* | *Introduction to Magnetic Resonance Imaging (MRI)* | | |
| *4.3* | *Introduction to Nuclear Medicine Imaging* | | |
| *4.4* | *Introduction to Ultrasound Imaging* | | |
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| **Review and University Exams** | | ***Week 16*** | |
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| Classroom Participation: Assessment Criteria | | | | | |
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| **Criteria** | **Quality** | | | | **Score** |
| | **Excellent (5 points)** | **Good (4 points)** | **Satisfactory (3 points)** | **Needs Improvement (2 points)** | |
| **Degree to which student integrates course readings into classroom participation** | often cites from readings;<br>uses readings to support points;<br>- often articulates "fit" of readings with topic at hand. | -occasionally cites from readings;<br>- sometimes uses readings to support points;<br>-occasionally articulates "fit" of readings with topic at hand . | -rarely able to cite from readings;<br>- rarely uses readings to support points;<br>- rarely articulates "fit" of readings with topic at hand | -unable to cite from readings;<br>-cannot use readings to support points;<br>cannot articulates "fit" of readings with topic at hand . | |
| **Interaction/ participation in classroom discussions** | -always a willing participant, responds frequently to questions;<br>- routinely volunteers point of view . | -often a willing participant,<br>- responds occasionally to questions;<br>- occasionally volunteers point of view . | -rarely a willing participant,<br>- rarely able to respond to questions;<br>- rarely volunteers point of view . | -never a willing participant.,<br>- never able to respond to questions;<br>- never volunteers point of view . | |
| **Interaction/participation in classroom learning activities** | -always a willing participant;<br>-acts appropriately during all role plays;<br>- responds frequently to questions;<br>- routinely volunteers point of view. | -often a willing participant;<br>-acts appropriately during role plays;<br>- responds occasionally to questions;<br>-occasionally volunteers point of view. | -rarely a willing participant.<br>-occasionally acts inappropriately during role plays;<br>- rarely able to respond to direct questions;<br>-rarely volunteers point of view . | -never a willing participant<br>- often acts inappropriately during role plays;,<br>- never able to respond to direct questions;<br>- never volunteers point of view. | |
| **Demonstration of professional attitude and demeanor** | -always demonstrates commitment through thorough preparation;<br>- always arrives on time;<br>- often solicits instructors' perspective outside class. | rarely unprepared;<br>rarely arrives late;<br>- occasionally solicits instructors' perspective outside class . | -often unprepared;<br>occasionally arrives late;<br>- rarely solicits instructors' perspective outside class . | -rarely prepared;<br>- often arrives late;<br>-never solicits instructors' perspective outside class | |

## ASSESSMENT RUBRICS

| *Classroom Participation: Oral Presentation* | | | | | | | | | | |
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| **Element** | **Excellent** | | | **Satisfactory** | | | **Needs Improvement** | | | **Points** |
| | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| **Organization** | ▪ There is a logical sequence of information.<br>▪ Title slide and closing slide are included appropriately. | | | ▪ There is some logical sequence of information.<br>▪ Title slide and closing slides are included. | | | ▪ There is little or no logical sequence of information.<br>▪ Title slide and/ or closing slides are not included. | | | |
| **Slide Design** (text, colors, background, illustrations, size, titles, subtitles) | ▪ Presentation is attractive and appealing to viewers. | | | ▪ Presentation is somewhat appealing to viewers. | | | ▪ Little to no attempt has been made to make presentation appealing to viewers. | | | |
| **Content** | ▪ Presentation covers topic completely and in depth.<br>▪ Information is clear, appropriate, and accurate. | | | ▪ Presentation includes some essential information.<br>▪ Some information is somewhat confusing, incorrect, or flawed. | | | ▪ Presentation includes little essential information.<br>▪ Information is confusing, inaccurate, or flawed. | | | |
| **Language** | ▪ Spelling, grammar, usage, and punctuation are accurate<br>▪ Fluent and effective | | | ▪ There are minor problems in spelling, grammar, usage, and/or punctuation. | | | ▪ There are persistent errors in spelling, grammar, usage, and/or punctuation.<br>▪ Less or not fluent and effective. | | | |
| **Delivery** | ▪ Ideas were communicated with enthusiasm, proper voice projection and clear delivery.<br>▪ There was sufficient eye contact with audience.<br>▪ There were sufficient use of other non-verbal communication skills.<br>▪ Appropriate delivery pace was used. | | | ▪ There was some difficulty communicating ideas due to voice projection, lack of preparation, incomplete work, and/or insufficient eye contact.<br>▪ Insufficient use of non-verbal communication skills.<br>▪ Delivery pace is somewhat appropriate. | | | ▪ There was great difficulty communicating ideas due to poor voice projection, lack of preparation, incomplete work, and/or little or no eye contact.<br>▪ No use of non verbal communication skills.<br>▪ Inappropriate delivery pace was used. | | | |
| **Interaction with Audience** | ▪ Answers to questions are coherent and complete. | | | ▪ Most answers to questions are coherent and complete. | | | ▪ Answers to questions are neither coherent nor complete. | | | |

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| | ▪ Answers demonstrate confidence and extensive knowledge. | ▪ Answers somehow demonstrate confidence and extensive knowledge. | ▪ Is tentative or unclear in responses. | |