

The Hashemite University



Deanship of Academic Development  
and International Outreach



الجامعة الهاشمية



عمادة التطوير الأكاديمي والتواصل  
الدولي

## Syllabus

Radiobiology (1905081214)

Second Semester 2021/2022

### COURSE INFORMATION

|  |  |
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| <b>Course Name:</b> Radiobiology   | <b>Course Code:</b> 1905081214                           |
| <b>Semester:</b> Second  | <b>Section:</b> Radiobiology                             |
| <b>Department:</b> Department of Medical Imaging                         | <b>Core Curriculum:</b> Radiological and Medical Imaging |
| <b>Faculty:</b> Applied Medical Sciences                                 |  |
| <b>Day(s) and Time(s):</b> Monday: 14:00-15:30<br>Wednesday: 14:00-15:30 | <b>Credit Hours:</b> 3                                   |
| <b>Classroom:</b> Nursing 202  | <b>Prerequisites:</b>                                    |

### COURSE DESCRIPTION

This course will discuss the effects of ionizing radiation at the molecular, cellular, tissue, and whole organism level understanding how cells, tissues, and the body as a whole respond to ionizing radiation is important for a comprehension of radiation protection and radiotherapy. The effects of repair, re-oxygenation, repopulation, and cell cycle redistribution will be discussed. Normal tissue toxicities including acute and late effects will be detailed in the course. Discussion will include radiation carcinogenesis, radiation Cataractogenesis, low dose effects, the linear non-threshold model for radiation damage.

### DELIVERY METHODS

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

|                          |  |
|--------------------------|--|
| <b>Name</b>              | <i>Dr. Khalid Rabaeh</i>                                 |
| <b>Academic Title:</b>   | <i>Professor</i>   |
| <b>Office Location:</b>  | <i>Medical Imaging Department 3167</i>                   |
| <b>Telephone Number:</b> | 5492   |
| <b>Email Address:</b>    | <a href="mailto:khalidr@hu.edu.jo">khalidr@hu.edu.jo</a> |

**Office Hours:***Sunday: 12:00-13:00**Tuesday: 12:00-13:00**Thursday: 12-13:00**Please send an e-mail ([khalidr@hu.edu.jo](mailto:khalidr@hu.edu.jo)) to meet at any othertime.***REFERENCES AND LEARNING RESOURCES**

**Required Textbook:**

Title Introduction to radiobiology  
Author Maurice Tubiana, Jean Dutreix, Andre Wambersie  
Publisher D.R. Bewley Taylor & Francis Ltd  
Year 1990

## STUDENT LEARNING OUTCOMES MATRIX\*

| Core Curriculum Learning Outcomes  | Program Learning Outcomes   | Course Objectives                          | Course Student Learning Outcomes  | Assessment Method   |
|--|---|--|---|---|
| Think critically and creatively in a variety of methods in order to make | <p>KP1: Develop an understanding of human anatomy and physiology as it relates to health and disease and acquire competency in medical terminology, documentation</p> <p>KP2: Understand the principles and physics of medical imaging technologies such as general X-ray, CT, MRI, ultrasound, fluoroscopy, nuclear medicine, dental radiography, and mammography and relate medical research</p> <p>KP3: Develop and implement protocols for medical imaging procedures, including patient positioning, patient care, proper exposure factor selection,</p> | 1. Explain hereditary effects of radiation | <p>1- Describe the effect of ionizing radiation on DNA</p> <p>2- Describe the effect of ionizing radiation on chromatid</p> <p>3- Describe the effect of ionizing radiation on chromosome</p> | <ul style="list-style-type: none"> <li>• Exams</li> <li>• Quizzes with no marks just to give chance to the students to revise the course.</li> <li>• “On-line” reading assignments</li> </ul> |

appropriate radiation protection measures, demonstrating technical competence, and the use of contrast agents

SP1: Demonstrate depth of knowledge and integrate it of the basic scientific principles of all medical imaging technologies for the implementation of various protocols and techniques and to conduct scientific research in this field

SP2: Use creativity, critical thinking, analysis, and research skills to modify standard procedures to adapt to new circumstances, difficult cases, or unusual situations while maintaining appropriate medical imaging quality.

SP3: Evaluate and criticize all types of medical images

CP1: Access, evaluate, and provide medical imaging requirements

CP2: Recognizing the need to learn from professional

learning, managing learning in the field of medical imaging in an integrated manner, and acquiring continuous learning skills  
 CP3: Demonstrate professional identity and responsibility with patients, colleagues, employers, and society, with ethical and professional behaviors and attitudes in the practice of health care.  
 CP4: Produces high quality, diagnosable medical images by applying positioning skills, selecting technical parameters, and using radiation protection.

2. Identify the effects of radiation

1- Determine the cellular damage by radiation

Exams  
 Quizzes with no marks

|  |  |   |   |  |
|--|--|---|---|--|
|  |  | on cells  | 2- Explain the Bergonié and Tribondeaus law<br><br>3- Compare between the changes of cell metabolism By radiation   | just to give chance to the students to revise the course.<br>. “On-line’ reading Assignments |
|  |  | 3. Describe the Factors affecting cell radiosensitivity | What is the difference Vegetative Cells and Differentiating cells.<br><br>Explain the effect of oxygen on the cell radiosensitivity<br><br>Explain the effect of high LET | . Exams<br>. Quizzes with no marks just to give chance to the students to revise the         |

|  |  |  |   |   |
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|  |  |  | radiation on the cell radiosensitivity  | course.<br>“On-line’ reading assignments  |
|  |  | 4 Describe the effect of ionizing radiation on human cells | 1- Defined Lethal dose<br><br>2- Explain the effect of ionizing radiation on Blood cells<br><br>3- Explain the effect of ionizing radiation on Gastrointestinal<br><br>4- Explain the effect of ionizing radiation on Cerebrovascular | . Exams<br>. Quizzes with no marks just to give chance to the students to revise the course.<br>“On-line’ reading assignments |

## 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

| <b>Assessment</b>        | <b>Grade Weighting</b> | <b>Deadline Assessment</b> |
|--------------------------|------------------------|----------------------------|
| <b>Exam 1</b>            | 20%                    |                            |
| <b>Exam 2</b>            | 20%                    |                            |
| <b>Course assessment</b> | 20%                    |                            |
| <b>Final Exam</b>        | 40%                    |                            |

### **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         |
| 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”*

|                   |  |                  |                   |
|-------------------|--|------------------|-------------------|
| <b>Part One 1</b> | <b>BIOLOGICAL EFFECTS OF IONIZING RADIATION AT MOLECULES AND CELLS</b>   | <b>Week 1-3</b>  | <b>6 lectures</b> |
|                   | 1.1 Interaction of Radiation with Matter<br>1.2 Linear Energy Transfer<br>1.3 The Stage of Action of Ionizing Radiation<br>1.4 Effect of Radiation on Atom and Molecules<br>1.5 Direct and Indirect Action of Ionizing Radiation<br>1.6 Effects of Oxygen on Free Radical Formation<br>1.7 Effects of Ionizing Radiation on DNA<br>1.8 Effects of Ionizing Radiation on Chromosome |                  |                   |
| <b>Part Two:</b>  | <b>EFFECT OF RADIATION ON CELLS</b>  | <b>Week 4-5</b>  | <b>4 lectures</b> |
|                   | 2.1 Types of Cellular Damage<br>2.2 Bergonié and Tribondeaus Law<br>2.3 Radiation Induced Chromosome Damage<br>2.4 Target Theory<br>2.5 Relative Cellular Radiosensitivity<br>2.6 Survival Curves for Mammalian Cells  |                  |                   |
| <b>Part Three</b> | <b>EFFECT OF IONIZING RADIATION ON HUMAN CELLS</b>   | <b>Week 6-7</b>  | <b>4 lectures</b> |
|                   | 3.1 Effect of Radiation on Blood Cells<br>3.2 Effect of Radiation on Muscle Cells<br>3.3 Effect of Radiation on Nervous Cells<br>3.4 Effect of ionizing Radiation on Reproductive Cells<br>3.5 Lethal Dose in Human  |                  |                   |
| <b>Part Four:</b> | <b>EARLY AND LATE EFFECT OF RADIATION</b>  | <b>Week 8-12</b> | <b>4 lectures</b> |

- 4.1 Early Somatic Effects
- 4.2 Acute Radiation Syndrome
- 4.3 Hematopoietic syndrome
- 4.4 Gastrointestinal syndrome
- 4.5 Cerebrovascular syndrome

|                   |   |                              |                       |
|-------------------|---|------------------------------|-----------------------|
| <b>Part Five:</b> | <b>LATE EFFECT OF RADIATION</b>   | <b>Week 13-15</b>            | <b>6 lectures</b>     |
|                   | <ul style="list-style-type: none"> <li>5.1 Radiation Dose-Response</li> <li>5.2 Non-threshold</li> <li>5.3 Factors Effecting the Dose Models and Theories</li> <li>5.4 Long Term Effects</li> <li>5.5 Cytogenetic damage</li> <li>5.6 Cataractogenesis</li> <li>5.7 Radiation Effects On Fetal Development</li> <li>5.8 Radiation protection</li> </ul> |                              |                       |
| <b>Exams</b>      |   | <b>Review and University</b> | <b><u>Week 16</u></b> |

| <b>Classroom Participation: Assessment Criteria</b>                                    |  |  |   |   |              |
|--|--|--|---|---|--------------|
| <b>Criteria</b>  | <b>Quality</b>   |  |   |   | <b>Score</b> |
|  | <b>Excellent(5 points)</b>   | <b>Good (4 points)</b>   | <b>Satisfactory(3 points)</b>   | <b>Needs Improvement( 2 points)</b>   |              |
| <b>Degree to which student integrates course readings into classroom participation</b> | often cites from readings; uses readings to support points; - often articulates "fit" of readings with topic at hand.                        | -occasionally cites from readings; - sometimes uses readings to support points; -occasionally articulates "fit" of readings with topic at hand .   | -rarely able to cite from readings; - rarely uses readings to support points; -rarely articulates "fit" of readings with topic at hand                                | -unable to cite from readings; -cannot use readings to support points; cannot articulates "fit" of readings with topic at hand .                              |              |
| <b>Interaction/ participation inclassroom discussions</b>                              | -always a willing participant, responds frequently to questions; - routinely volunteers point of view .                                      | -often a willing participant, - responds occasionally to questions; -occasionally volunteers point of view .                                       | -rarely a willing participant, - rarely able to respond to questions; - rarely volunteers point of view .   | -never a willing participant. , - never able to respond to questions; - never volunteers point of view .  |              |
| <b>Interaction/par ticipation in classroom learning activities</b>                     | -always a willing participant; -acts appropriately during all role plays; - responds frequently to questions; -routinely volunteers point of | -often a willing participant; -acts appropriately during role plays; - responds occasionally to questions; -occasionally volunteers point of view. | -rarely a willing participant. -occasionally acts inappropriately during role plays; - rarely able to respond to direct questions; -rarely volunteers point of view . | -never a willing participant - often acts in appropriately during role plays;, - never able to respond to direct questions; - never volunteers point of view. |              |

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|  | view.   |  |   |  |  |
| <b>Demonstration of professional attitude and demeanor</b> | <ul style="list-style-type: none"> <li>-always demonstrates commitment through thorough preparation;</li> <li>- always arrives on time;</li> <li>-often solicits instructors' perspective outside class.</li> </ul> | <ul style="list-style-type: none"> <li>rarely unprepared;</li> <li>rarely arrives late;</li> <li>- occasionally solicits instructors' perspective outside class .</li> </ul> | <ul style="list-style-type: none"> <li>-often unprepared; occasionally arrives late;</li> <li>- rarely solicits instructors' perspective outside class .</li> </ul> | <ul style="list-style-type: none"> <li>-rarely prepared;</li> <li>- often arrives late;</li> <li>-never solicits instructors' perspective outside class</li> </ul> |  |

**ASSESSMENT RUBRICS**

*Classroom Participation: Oral Presentation*

| Element   | Excellent  |   |   | Satisfactory   |   |   | Needs Improvement   |   |   | Points |
|---|--|---|---|--|---|---|---|---|---|--------|
|   | 8  | 7 | 6 | 5  | 4 | 3 | 2   | 1 | 0 |        |
| <b>Organization</b>   | <ul style="list-style-type: none"> <li>There is a logical sequence of information.</li> <li>Title slide and closing slide are included appropriately.</li> </ul> |   |   | <ul style="list-style-type: none"> <li>There is some logical sequence of information.</li> <li>Title slide and closing slides are included.</li> </ul>                     |   |   | <ul style="list-style-type: none"> <li>There is little or no logical sequence of information.</li> <li>Title slide and/or closing slides are not included.</li> </ul>     |   |   |        |
| <b>Slide Design</b><br>(text, colors, background, illustrations, size, titles, subtitles) | <ul style="list-style-type: none"> <li>Presentation is attractive and appealing to viewers.</li> </ul>   |   |   | <ul style="list-style-type: none"> <li>Presentation is somewhat appealing to viewers.</li> </ul>   |   |   | <ul style="list-style-type: none"> <li>Little to no attempt has been made to make presentation appealing to viewers.</li> </ul>   |   |   |        |
| <b>Content</b>  | <ul style="list-style-type: none"> <li>Presentation covers topic completely and in depth.</li> <li>Information is clear, appropriate, and accurate.</li> </ul>   |   |   | <ul style="list-style-type: none"> <li>Presentation includes some essential information.</li> <li>Some information is somewhat confusing, incorrect, or flawed.</li> </ul> |   |   | <ul style="list-style-type: none"> <li>Presentation includes little essential information.</li> <li>Information is confusing, inaccurate, or flawed.</li> </ul>           |   |   |        |
| <b>Language</b>   | <ul style="list-style-type: none"> <li>Spelling, grammar, usage, and punctuation are accurate</li> <li>Fluent and effective</li> </ul>                           |   |   | <ul style="list-style-type: none"> <li>There are minor problems in spelling, grammar, usage, and/or punctuation.</li> </ul>  |   |   | <ul style="list-style-type: none"> <li>There are persistent errors in spelling, grammar, usage, and/or punctuation.</li> <li>Less or not fluent and effective.</li> </ul> |   |   |        |

|                                  |   |   |  |  |
|----------------------------------|---|---|--|--|
| <b>Delivery</b>                  | <ul style="list-style-type: none"> <li>▪ Ideas were communicated with enthusiasm, proper voice projection and clear delivery.</li> <li>▪ There was sufficient eye contact with audience.</li> <li>▪ There were sufficient use of other non-verbal communication skills.</li> <li>▪ Appropriate delivery pace was used.</li> </ul> | <ul style="list-style-type: none"> <li>▪ There was some difficulty communicating ideas due to voice projection, lack of preparation, incomplete work, and/or insufficient eye contact.</li> <li>▪ Insufficient use of non-verbal communication skills.</li> <li>▪ Delivery pace is somewhat appropriate.</li> </ul> | <ul style="list-style-type: none"> <li>▪ There was great difficulty communicating ideas due to poor voice projection, lack of preparation, incomplete work, and/or little or no eye contact.</li> <li>▪ No use of non verbal communication skills.</li> <li>▪ Inappropriate delivery pace was used.</li> </ul> |  |
| <b>Interaction with Audience</b> | <ul style="list-style-type: none"> <li>▪ Answers to questions are coherent and complete.</li> </ul>   | <ul style="list-style-type: none"> <li>▪ Most answers to questions are coherent and complete.</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Answers to questions are neither coherent nor complete.</li> </ul>  |  |



|  |   |   |   |  |
|--|---|---|---|--|
|  | <ul style="list-style-type: none"><li>▪ Answers demonstrate confidence and extensive knowledge.</li></ul> | <ul style="list-style-type: none"><li>▪ Answers somehow demonstrate confidence and extensive knowledge.</li></ul> | <ul style="list-style-type: none"><li>▪ Is tentative or unclear in responses.</li></ul> |  |
|--|---|---|---|--|

