



# MEDI12001 Radiation Science

## Term 1 - 2022

Profile information current as at 26/05/2022 09:41 pm

All details in this unit profile for MEDI12001 have been officially approved by CQUniversity and represent a learning partnership between the University and you (our student). The information will not be changed unless absolutely necessary and any change will be clearly indicated by an approved correction included in the profile.

### General Information

#### Overview

This unit prepares you for the safe and effective use of ionising radiation for radiographic imaging in the simulated and clinical environment. The unit covers production and control of the radiation beam, radiation interactions in matter and risk of detriment to the human body from exposure to radiation. Radiation safety and dose minimisation practices are examined in light of current findings on detriment from low level radiation.

#### Details

Career Level: *Undergraduate*

Unit Level: *Level 2*

Credit Points: 6

Student Contribution Band: 8

Fraction of Full-Time Student Load: 0.125

#### Pre-requisites or Co-requisites

Pre-requisites: MEDI11001 Fundamentals of the Imaging Professions MEDI11002 Physics for Health Science ESSC11004 Study and Research Skills for Health Sciences

Important note: Students enrolled in a subsequent unit who failed their pre-requisite unit, should drop the subsequent unit before the census date or within 10 working days of Fail grade notification. Students who do not drop the unit in this timeframe cannot later drop the unit without academic and financial liability. See details in the [Assessment Policy and Procedure \(Higher Education Coursework\)](#).

#### Offerings For Term 1 - 2022

- Mackay
- Online

#### Attendance Requirements

All on-campus students are expected to attend scheduled classes - in some units, these classes are identified as a mandatory (pass/fail) component and attendance is compulsory. International students, on a student visa, must maintain a full time study load and meet both attendance and academic progress requirements in each study period (satisfactory attendance for International students is defined as maintaining at least an 80% attendance record).

#### Website

[This unit has a website, within the Moodle system, which is available two weeks before the start of term. It is important that you visit your Moodle site throughout the term. Please visit Moodle for more information.](#)

## Class and Assessment Overview

### Recommended Student Time Commitment

Each 6-credit Undergraduate unit at CQUniversity requires an overall time commitment of an average of 12.5 hours of study per week, making a total of 150 hours for the unit.

### Class Timetable

#### [Regional Campuses](#)

Bundaberg, Cairns, Emerald, Gladstone, Mackay, Rockhampton, Townsville

#### [Metropolitan Campuses](#)

Adelaide, Brisbane, Melbourne, Perth, Sydney

### Assessment Overview

#### 1. **Online Test**

Weighting: 40%

#### 2. **Online Test**

Weighting: 60%

### Assessment Grading

This is a graded unit: your overall grade will be calculated from the marks or grades for each assessment task, based on the relative weightings shown in the table above. You must obtain an overall mark for the unit of at least 50%, or an overall grade of 'pass' in order to pass the unit. If any 'pass/fail' tasks are shown in the table above they must also be completed successfully ('pass' grade). You must also meet any minimum mark requirements specified for a particular assessment task, as detailed in the 'assessment task' section (note that in some instances, the minimum mark for a task may be greater than 50%). Consult the [University's Grades and Results Policy](#) for more details of interim results and final grades.

## CQUniversity Policies

**All University policies are available on the [CQUniversity Policy site](#).**

You may wish to view these policies:

- Grades and Results Policy
- Assessment Policy and Procedure (Higher Education Coursework)
- Review of Grade Procedure
- Student Academic Integrity Policy and Procedure
- Monitoring Academic Progress (MAP) Policy and Procedure – Domestic Students
- Monitoring Academic Progress (MAP) Policy and Procedure – International Students
- Student Refund and Credit Balance Policy and Procedure
- Student Feedback – Compliments and Complaints Policy and Procedure
- Information and Communications Technology Acceptable Use Policy and Procedure

This list is not an exhaustive list of all University policies. The full list of University policies are available on the [CQUniversity Policy site](#).

## Previous Student Feedback

### Feedback, Recommendations and Responses

Every unit is reviewed for enhancement each year. At the most recent review, the following staff and student feedback items were identified and recommendations were made.

#### Feedback from Unit coordinator self-reflection

**Feedback**

Students appreciated the adaptation of multiple small groups during the tutorials to support their engagement and learning in the unit.

**Recommendation**

Continue utilising the multiple small group approach in the tutorials so that the students have the opportunity to engage, participate, discuss and answer the tutorial questions with other group members.

#### Feedback from Have your say Unit coordinator reflection

**Feedback**

Students found the weekly tutorials supported them in reviewing and consolidating the concepts covered in the unit.

**Recommendation**

Continue with the weekly tutorials to support student learning.

#### Feedback from Have your say

**Feedback**

There is an expectation among some students that they can study the unit by reading through the lecture slides only and not watching the pre-recorded lecture videos.

**Recommendation**

Emphasise the importance of watching the lecture video in conjunction with the lecture slides in the future iteration of the unit.

#### Feedback from Have your say Unit coordinator reflection

**Feedback**

Some students found the first four weeks of the unit, which was physics-content heavy, challenging and they struggled with these topics in their first assessment held in Week 5.

**Recommendation**

Investigate the option of having the first assessment in Week 6 instead of Week 5 to give students more time to engage with the content and complete the review and consolidation of the topics in preparation for their assessment.

## Unit Learning Outcomes

**On successful completion of this unit, you will be able to:**

1. Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
2. Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
3. Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk
4. Discuss current scientific understanding of the bioeffects and associated risks of radiation at the levels used in diagnostic radiology to body cells, tissues and systems across the lifespan
5. Discuss radiation safety regulations, legislation and associated best practice standards as they apply to occupational exposure and safe use of ionising radiation in diagnostic imaging.

This unit links to the following Professional Capabilities for Medical Radiation Practitioners as detailed by the Medical Radiation Practice Board of Australia (effective 1 March 2020):

- Domain 1A:1 Perform projection radiography examinations in a range of settings (parts a,d)
- Domain 5:1 Perform and provide safe radiation practice (parts a,b,c,d,f)
- Domain 5:4 Maintain safety of the workplace and associated environments (a,c,d,e,f,g)

## Alignment of Learning Outcomes, Assessment and Graduate Attributes



### Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes				
	1	2	3	4	5
1 - Communication	Introductory	Introductory	Introductory	Introductory	Introductory
2 - Problem Solving		Graduate	Graduate	Graduate	Graduate
3 - Critical Thinking					
4 - Information Literacy					
5 - Team Work					
6 - Information Technology Competence					
7 - Cross Cultural Competence					
8 - Ethical practice					Graduate
9 - Social Innovation					
10 - Aboriginal and Torres Strait Islander Cultures					

### Alignment of Assessment Tasks to Graduate Attributes

Assessment Tasks	Graduate Attributes									
	1	2	3	4	5	6	7	8	9	10
1 - Online Test - 40%	Introductory	Introductory								
2 - Online Test - 60%	Introductory	Introductory						Graduate		

## Textbooks and Resources

### Textbooks

MEDI12001

#### Prescribed

#### Essentials of Radiographic Physics & Imaging

Edition: 3 (2019)

Authors: James Johnston and Terri Fauber

Elsevier

St. Louis , Missouri , USA

ISBN: 9780323566681

Binding: Hardcover

#### Additional Textbook Information

This textbook is required for multiple second year units: MEDI12001 Radiation Science, MEDI12002 Science & Instrumentation 1 and MEDI12005 Science & Instrumentation 2. Students may use either the hard copy or e-book version of this text. The e-book version of the text allows both online (web-based) and offline (downloaded copy) access to the book and has no expiry date. It is usable on both computers and tablets (specifically iPads and Android OS). The hardcopy textbook is available through the University Bookshop here: <http://bookshop.cqu.edu.au> (search on the Unit code). The e-book version of this text can be purchased at the Bookshop as well, just press the "Check for eBook link" in the item.

[View textbooks at the CQUniversity Bookshop](#)

### IT Resources

**You will need access to the following IT resources:**

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)

## Referencing Style

**All submissions for this unit must use the referencing styles below:**

- [Vancouver](#)
- [Harvard \(author-date\)](#)

For further information, see the Assessment Tasks.

## Teaching Contacts

**Reshmi Kumar** Unit Coordinator

[r.d.kumar@cqu.edu.au](mailto:r.d.kumar@cqu.edu.au)

## Schedule

### Week 1 - 07 Mar 2022

Module/Topic	Chapter	Events and Submissions/Topic
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**X-ray production: Part 1**

- Review of Physics foundation concepts associated with x-ray production
- Overview of key internal and external structures (anode and cathode) of the x-ray tube involved in the x-ray production process

Essentials of Radiographic Physics & Imaging 3rd edn Chapter 4, Chapter 5 & Chapter 6

- Refer to Moodle for specific pages and any additional readings

**Tutorial 1****Week 2 - 14 Mar 2022****Module/Topic****Chapter****Events and Submissions/Topic****X-ray production: Part 2**

- Heat production at the anode
- Characteristic radiation production
- Bremsstrahlung radiation process

Essentials of Radiographic Physics & Imaging 3rd edn Chapter 4, Chapter 5 & Chapter 6

- Refer to Moodle for specific pages and any additional readings

**Tutorial 2****Week 3 - 21 Mar 2022****Module/Topic****Chapter****Events and Submissions/Topic****X-ray spectrum**Expression of radiation quantity

- Exposure, exposure rate, radioactivity, KERMA, entrance surface dose, dose area product, absorbed dose, equivalent dose, effective dose and tissue weighting

X-ray emission spectrum

- Impact of exposure time, mAs and kVp on beam spectrum

Essentials of Radiographic Physics & Imaging 3rd edn Chapter 6

- Refer to Moodle for specific pages and any additional readings

**Tutorial 3****Week 4 - 28 Mar 2022****Module/Topic****Chapter****Events and Submissions/Topic****Interaction of x-rays with matter**

- Compton scattering
- Photoelectric effect
- Factors affecting probability of interactions of x-ray with matter

Essentials of Radiographic Physics & Imaging 3rd edn Chapter 7

- Refer to Moodle for specific pages and any additional readings

**Tutorial 4****Week 5 - 04 Apr 2022****Module/Topic****Chapter****Events and Submissions/Topic****X-ray beam attenuation**

- Exponential attenuation
- Anode heel effect (self-filtration)
- HVL and compensating filters
- Impact of target material and filtration on beam spectrum

Essentials of Radiographic Physics & Imaging 3rd edn Chapter 6

- Refer to Moodle for specific pages and any additional readings

**Tutorial 5****Vacation Week - 11 Apr 2022****Module/Topic****Chapter****Events and Submissions/Topic**

Break week

**Week 6 - 18 Apr 2022****Module/Topic****Chapter****Events and Submissions/Topic**

Assessment week

No new content taught

**Online Test 1** Due: Week 6 Tuesday (19 Apr 2022) 5:00 pm AEST**Week 7 - 25 Apr 2022****Module/Topic****Chapter****Events and Submissions/Topic**

### **Radiosensitivity and radiation risk**

- Radiosensitivity classification of cell and tissue type
- Physical and biological factors affecting radiation response
- Stochastic versus tissue reactions
- Radiation dose-response relationships
- Epidemiological studies to assess risk of radiation detriment
- Risk models

Refer to the unit Moodle site for assigned readings

**Tutorial 6**

### **Week 8 - 02 May 2022**

<b>Module/Topic</b>	<b>Chapter</b>	<b>Events and Submissions/Topic</b>
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#### **Hereditary effects of radiation**

- Review of meiosis and gamete production
- Radiation effect on different developmental stages of pregnancy
- Target theory
- Models of cell survival
- Cell recovery

Refer to the unit Moodle site for assigned readings

**Tutorial 7**

### **Week 9 - 09 May 2022**

<b>Module/Topic</b>	<b>Chapter</b>	<b>Events and Submissions/Topic</b>
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#### **Radiation effects at cellular level, on the body systems and the body**

- Review of mitosis process
- In-vitro irradiation of macromolecules (main-chain scission, cross-linking and point lesions)
- Effects of radiation on DNA
- Radiolysis of water
- Direct and indirect effects of radiation

Refer to the unit Moodle site for assigned readings

**Tutorial 8**

### **Week 10 - 16 May 2022**

<b>Module/Topic</b>	<b>Chapter</b>	<b>Events and Submissions/Topic</b>
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#### **Radiation protection**

- Cardinal principles of radiation protection
- ALARA principle
- Leakage radiation
- Radiographic features in modern x-ray imaging systems
- Design of primary and secondary radiation barriers

Refer to the unit Moodle site for assigned readings

**Tutorial 9**

### **Week 11 - 23 May 2022**

<b>Module/Topic</b>	<b>Chapter</b>	<b>Events and Submissions/Topic</b>
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#### **Radiation dose management**

- Radiation detection and management
- Occupational versus public radiation exposure
- Managing occupational exposure
- Dose comparisons for imaging procedures and modalities
- Regulation and legislation on radiation protection
- Recent developments in clinical radiation protection practices
- Reducing unnecessary patient dose, including pregnant patients.

Refer to the unit Moodle site for assigned readings

**Tutorial 10**



## Week 12 - 30 May 2022

Module/Topic	Chapter	Events and Submissions/Topic
Consolidation and revision		<b>Tutorial 11</b>

## Review/Exam Week - 06 Jun 2022

Module/Topic	Chapter	Events and Submissions/Topic
		<b>Online Test 2</b> Due: Review/Exam Week Wednesday (8 June 2022) 12:00 pm AEST

## Term Specific Information

You are expected to spend on average 10 -12 hours of time each week in your study activities for this unit. A suggested budget for weekly study is:

- 2 hours for watching lecture recordings and taking notes
- 1.5 - 2 hours for completing assigned readings
- 0.5 - 1 hour for completing other posted learning activities
- 2-2.5 hours for creating study notes to meet weekly learning goals using lectures and readings
- 1-1.5 hours for working on posted tutorial questions in preparation for tutorial
- 1 hour for participation in tutorial
- 1-2 hours for preparation and/or revision for online tests

Tutorials are interactive sessions where your participation enables you to check your understanding of and your ability to apply the week's concepts and for you to build your skills in responding to test questions. Your regular and active participation strongly supports your success in the unit.

## Assessment Tasks

### 1 Online Test 1

#### Assessment Type

Online Test

#### Task Description

You will complete an online test on **Tuesday 19 April 2022 in Week 6**. This test will be available from 3:20pm to 5:00pm AEST. The test is a timed test that will begin once you've opened it, and will be for a duration of 90 minutes, closing automatically when the 90 minutes is up. The aim of the test is for you to demonstrate your ability to apply concepts and terminology from Weeks 1-5 of the unit. All questions will be based on the posted weekly learning goals. The question tasks will be of similar type to those discussed in weekly tutorials and will require you to apply your knowledge and understanding to a given scenario. These tasks may include analysis of diagrams and photographs to explain and discuss concepts. There will be a mixture of problem solving and application of concepts type questions.

**This is an open book test.** It means that during the test you may access your study notes, textbook, the unit Moodle site and/or any website. **The standards of academic integrity still apply.** All responses must be your own work. Colluding with other students on non-group work is considered academic misconduct. Just as for written assignments, you must acknowledge intellectual content in your answers that is not your own work. Basic statements of facts are considered 'common knowledge' in the context of this unit so they do not need to be cited. *However, if you copy any explanation content word-for-word from ANY source, you must put that content in quotation marks and formally cite your source.* Although this is an open book test, the expectation is that you will be familiar with the unit content and concepts. You should not assume you will have time to look up the answer to every question.

As per the assessment Procedures, this test must be written at the timetabled date and time. **There is no opportunity to apply a late penalty. In the absence of an approved extension, you cannot complete this assessment at a later time and you will receive a mark of zero for the assessment if you have not submitted it by the scheduled date and time.** *If you start the test late, you will still be required to submit at the stated closing time.*

#### Assessment Due Date

Week 6 Tuesday (19 Apr 2022) 5:00 pm AEST

## Return Date to Students

Week 8 Tuesday (3 May 2022)

## Weighting

40%

## Assessment Criteria

Question responses will be scored on the following criteria:

- correct use of terminology
- correct selection and application of core concepts to the specific content of the question
- clarity, correctness, relevance and completeness of the response in addressing the question that was asked
- critical thinking

The number of marks for each question are allocated based on the depth and breadth of the required response, and will be indicated on the online test.

## Referencing Style

- [Vancouver](#)
- [Harvard \(author-date\)](#)

## Submission

Online

## Learning Outcomes Assessed

- Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
- Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
- Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk

## Graduate Attributes

- Communication
- Problem Solving

## 2 Online Test 2

### Assessment Type

Online Test

### Task Description

You will complete an online test on **Wednesday 8th June 2022 in Week 13 (Review/Exam week)** to demonstrate your ability to apply concepts and terminology learned in the unit. This test will be available from 9:50am to 12:00pm AEST. The test is a timed test that will begin once you've opened it, and will be for a duration of 120 minutes, closing automatically when the 120 minutes is up. All questions will be based on the posted weekly learning goals. The question tasks will be the same types that you will practice in the weekly tutorials. These tasks may include analysis of diagrams and photographs to explain and discuss concepts. There will be a mixture of problem solving and application of concepts type questions.

**This is an open book test.** It means that during the test you may access your study notes, textbook, the unit Moodle site and/or any website. **The standards of academic integrity still apply.** All responses must be your own work. Colluding with other students on non-group work is considered academic misconduct. Just as for written assignments, you must acknowledge intellectual content in your answers that is not your own work. Basic statements of facts are considered 'common knowledge' in the context of this unit so they do not need to be cited. *However, if you copy any explanation content word-for-word from ANY source, you must put that content in quotation marks and formally cite your source.* Although this is an open book test, the expectation is that you will be familiar with the unit content and concepts. You should not assume you will have time to look up the answer to every question.

As per the assessment Procedures, this test must be written at the timetabled date and time. **There is no opportunity to apply a late penalty. In the absence of an approved extension, you cannot complete this assessment at a later time and you will receive a mark of zero for the assessment if you have not submitted it by the scheduled date and time.** *If you start the test late, you will still be required to submit at the stated closing time.*

### Assessment Due Date

Review/Exam Week Wednesday (8 June 2022) 12:00 pm AEST

**Return Date to Students**

Two weeks after the final test.

**Weighting**

60%

**Minimum mark or grade**

50%

**Assessment Criteria**

Question responses will be scored on the following criteria:

- correct use of terminology
- correct selection and application of core concepts to the specific content of the question
- clarity, correctness, relevance and completeness of the response in addressing the question that was asked
- critical thinking

The number of marks for each question are allocated based on the depth and breadth of the required response, and will be indicated on the online test.

**Referencing Style**

- [Vancouver](#)
- [Harvard \(author-date\)](#)

**Submission**

Online

**Learning Outcomes Assessed**

- Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
- Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
- Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk
- Discuss current scientific understanding of the bioeffects and associated risks of radiation at the levels used in diagnostic radiology to body cells, tissues and systems across the lifespan
- Discuss radiation safety regulations, legislation and associated best practice standards as they apply to occupational exposure and safe use of ionising radiation in diagnostic imaging.

**Graduate Attributes**

- Communication
- Problem Solving
- Ethical practice

## Academic Integrity Statement

As a CQUniversity student you are expected to act honestly in all aspects of your academic work.

Any assessable work undertaken or submitted for review or assessment must be your own work. Assessable work is any type of work you do to meet the assessment requirements in the unit, including draft work submitted for review and feedback and final work to be assessed.

When you use the ideas, words or data of others in your assessment, you must thoroughly and clearly acknowledge the source of this information by using the correct referencing style for your unit. Using others' work without proper acknowledgement may be considered a form of intellectual dishonesty.

Participating honestly, respectfully, responsibly, and fairly in your university study ensures the CQUniversity qualification you earn will be valued as a true indication of your individual academic achievement and will continue to receive the respect and recognition it deserves.

As a student, you are responsible for reading and following CQUniversity's policies, including the [Student Academic Integrity Policy and Procedure](#). This policy sets out CQUniversity's expectations of you to act with integrity, examples of academic integrity breaches to avoid, the processes used to address alleged breaches of academic integrity, and potential penalties.

### What is a breach of academic integrity?

A breach of academic integrity includes but is not limited to plagiarism, self-plagiarism, collusion, cheating, contract cheating, and academic misconduct. The Student Academic Integrity Policy and Procedure defines what these terms mean and gives examples.

### Why is academic integrity important?

A breach of academic integrity may result in one or more penalties, including suspension or even expulsion from the University. It can also have negative implications for student visas and future enrolment at CQUniversity or elsewhere. Students who engage in contract cheating also risk being blackmailed by contract cheating services.

### Where can I get assistance?

For academic advice and guidance, the [Academic Learning Centre \(ALC\)](#) can support you in becoming confident in completing assessments with integrity and of high standard.

### What can you do to act with integrity?



#### Be Honest

If your assessment task is done by someone else, it would be dishonest of you to claim it as your own



#### Seek Help

If you are not sure about how to cite or reference in essays, reports etc, then seek help from your lecturer, the library or the Academic Learning Centre (ALC)



#### Produce Original Work

Originality comes from your ability to read widely, think critically, and apply your gained knowledge to address a question or problem