

**BIOIMG101x**

# INTRODUCTION TO BIOMEDICAL IMAGING

## Course Syllabus

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## 1.0 What is this Biomedical Imaging course about?

Imaging technologies form a significant component of the health budgets of all developed economies, and most people need advanced imaging at some stage during their life. All of us are aware of the misinformation sometimes portrayed in TV dramas, which either exaggerates the benefits or overemphasises the risks. This course will provide an introduction to the physics and engineering of modern imaging modalities. It will introduce some of the key applications in neurological disease, degenerative disease, reproduction and oncology. The course will include modules that will be of interest to the general public, whilst also providing some advanced modules which will contribute to professional development in health, engineering and the IT industry.

## 2.0 Who is the audience for this course?

This course is designed with two audiences in mind.

1. **The basic course:** It is anticipated that this audience will have completed secondary schooling (and particularly science subjects) as some biology, physics and chemistry concepts are involved.
2. **The advanced course:** First tertiary year of applied mathematics or computer science specialising in modelling is recommended. Health professionals wishing to update their knowledge concerning medical imaging post-processing may wish to take this course as part of their continuing professional development program.

## 3.0 What are the expected learning outcomes?

On completion of the **basic course**, you should:

- Recognise that there is a need for different imaging modalities
- Understand the basic principles of each modality
- Understand the terminology of biomedical imaging
- Understand the patient experience and why things happen during the imaging procedure
- Select the most suitable modality for a given clinical case
- Provide basic advice on imaging modalities to your peers

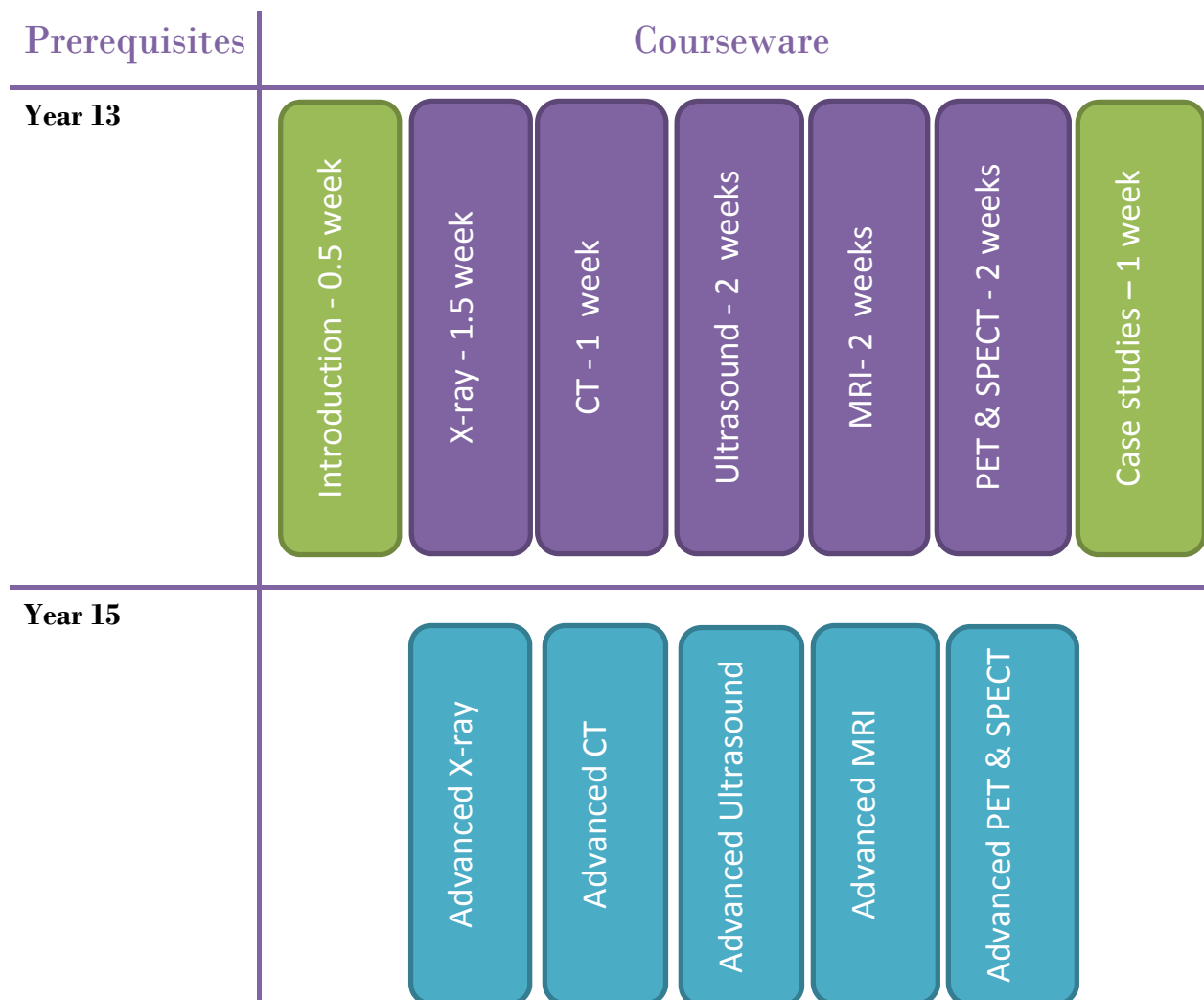
Additionally, the **advanced course** will ensure that you have a:

- Basic understanding how an image is reconstructed / visualised. OR
- You understand the principles of image post-processing

## 4.0 What is the learning pathway for the course?

The following diagram shows how the course is designed. It is recommended that if you are doing the **basic course** then you work through the introduction, the basic modules (coloured blue) and then complete the case studies in the final module.

If you intend to do the **advanced course**, you are welcome to complete the basic course and then complete the advanced sections. Alternatively, you can complete just the assessment pieces from the basic course to test your understanding of the topics, and then complete the related advanced modules.



## 5.0 How is the course content organised?

This course incorporates a **Case Study** which is introduced at the start of each section (an outline of the sections and sub-sections is shown in the table below). This case study follows a hypothetical patient required to undergo various imaging modalities for a medical condition.

Following the case study, each section has information relevant to that modality divided into sub-section topics such as basic scientific principles, hardware and technology and clinical applications. These early sub-sections form the basic course. Each sub-section has one or several short quiz/zes. These quizzes do not contribute to your final grade, but let you know if you have understood the key points. The final sub-section for each section of the basic course is a marked quiz on that topic.

The advanced sub-section is then presented just after the assessment item, for each section.

Finally, a discussion forum has been integrated at the end of each section.

This table provides a summary of the course sections and sub-sections.

Week	Section	Sub-sections
1.	Introduction to biomedical imaging	<ul style="list-style-type: none"> <li>• Welcome to the course</li> <li>• Survey</li> <li>• How to use this course</li> <li>• Myth busting</li> <li>• Can you guess what is imaged?</li> <li>• The need of Multimodality</li> <li>• Case study – Meet our unlucky patient</li> </ul> Introductory Discussion
1 and 2	Episode 1: X-rays	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Basic scientific principles</li> <li>• Technology</li> <li>• Contrast</li> <li>• Clinical applications</li> <li>• <b>Assessment 1 (18%)</b></li> </ul> Advanced: <ul style="list-style-type: none"> <li>• Advanced course - x-rays</li> </ul> Discussion
3.	Episode 2: Computerised Tomography (CT)	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Basic scientific principles</li> <li>• Technology</li> <li>• Contrast</li> <li>• Clinical applications</li> </ul>

		<ul style="list-style-type: none"> <li>• <b>Assessment 2 (18%)</b></li> </ul> <b>Advanced:</b> <ul style="list-style-type: none"> <li>• Advanced course – CT</li> </ul> <b>Discussion</b>
4 and 5	Episode 3: Ultrasound (U/S)	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Basic scientific principles</li> <li>• Technology</li> <li>• Clinical applications</li> <li>• <b>Assessment 3 (18%)</b></li> </ul> <b>Advanced:</b> <ul style="list-style-type: none"> <li>• Advanced course – U/S</li> </ul> <b>Discussion</b>
6 and 7	Episode 4: Magnetic Resonance Imaging (MRI)	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Basic principles – Nuclear Spin</li> <li>• Basic principles – the MR Signal</li> <li>• Basic principles – Relaxation</li> <li>• Basic principles – Spatial encoding</li> <li>• Basic principles – Contrast</li> <li>• MR Technology</li> <li>• Clinical applications</li> <li>• <b>Assessment 4 (18%)</b></li> </ul> <b>Advanced:</b> <ul style="list-style-type: none"> <li>• Advanced course – MRI</li> </ul> <b>Discussion</b>
8 and 9	Episode 5: PET and SPECT	<b>Basic:</b> <ul style="list-style-type: none"> <li>• Case study</li> <li>• Basic principles</li> <li>• SPECT</li> <li>• PET</li> <li>• Quality control</li> <li>• <b>Assessment 5 (18%)</b></li> </ul> <b>Advanced:</b> <ul style="list-style-type: none"> <li>• Advanced course – CT</li> </ul> <b>Discussion</b>
10.	Assessment Scenarios (2)	<ul style="list-style-type: none"> <li>• <b>Final assessment (10%)</b></li> </ul>

Note! To complete the basic course you must also complete the final section (Week 10 – Assessment Scenarios) which involves reviewing 2 case studies/scenarios and answering questions related to imaging modalities of relevance.

## 6.0 Approximately how long will it take to complete the course?

As you can see from the table, some of the topics run across more than 1 week. For the basic course, one week of work involves approximately 2 -3 hours of work. Therefore, for the ultrasound topic, for example, you will need to allow 4 – 6 hours to complete.

If you are doing the advanced course, estimates for how long this will take will depend on whether or not you also complete the basic course content.

## 7.0 How do I navigate through the course?

When you first go to the course you will land in **Course Info** area, where you will see announcements, course updates etc. This area also contains links to the syllabus (this document) and general information about doing edX courses. There are several other tabs across the top of the page:

**Progress:** This tab shows your progress and grades for all completed sections of the course.

**Courseware:** This area holds the course content – videos, lectures, assessments etc. You should generally work through the course in the order in which it is presented. The sections are listed in the left-hand navigation bar and when you click on one of these then the sub-sections will be displayed as shown here for the x-ray section.

The screenshot shows the edX Courseware interface. At the top, there are navigation tabs: Courseware (selected), Course Info, Discussion, Wiki, Progress, and Syllabus. The left sidebar contains a list of course sections under 'Introduction to Biomedical Imaging': Episode 1: X-rays (expanded), Episode 2: Computerised Tomography (CT), Episode 3: Ultrasound, Episode 4: Magnetic Resonance Imaging (MRI), Episode 5: Diagnostic Nuclear Medicine, and Episode 6: Assessment Scenarios. The main content area displays a video player for 'X-RAY TUBES' by Graham Galloway. The video player has a progress bar at 0:00 / 2:57, a speed control set to 1.0x, and various playback controls. To the right of the video player, there is a text overlay describing the X-ray tube system.

Once you click into a sub-section then each of these will consist of a varying number of units (between 1 and 10). These are displayed in the horizontal bar across the top of the screen.

**Tip!** It can be easy to miss some of the content if your previous experience of learning platforms uses navigation from the sidebar. In the edX environment you need to navigate using **both** the left side bar and the bar at the top of the page.

There is a video tutorial demonstrating how to use the edX platform in the section called *Introduction to Biomedical Imaging*. If you need additional help, the [edX Demo](#) course goes into more depth on how to use the platform.

## 8.0 What are the assessment and completion requirements for this course?

**Basic course:**

**Please note that only the basic course is evaluated, as follows**

- 5 quizzes (one for each episode) worth 18% each.
- 2 assessment scenarios at the end of the course (in week 10) worth 5% each.

The pass mark is 50%. In order to receive a certificate, all assignments have to be completed within 3 weeks of the end of the course. The due-by-dates are displayed under the Assessment sub-section titles on the left navigation pane.