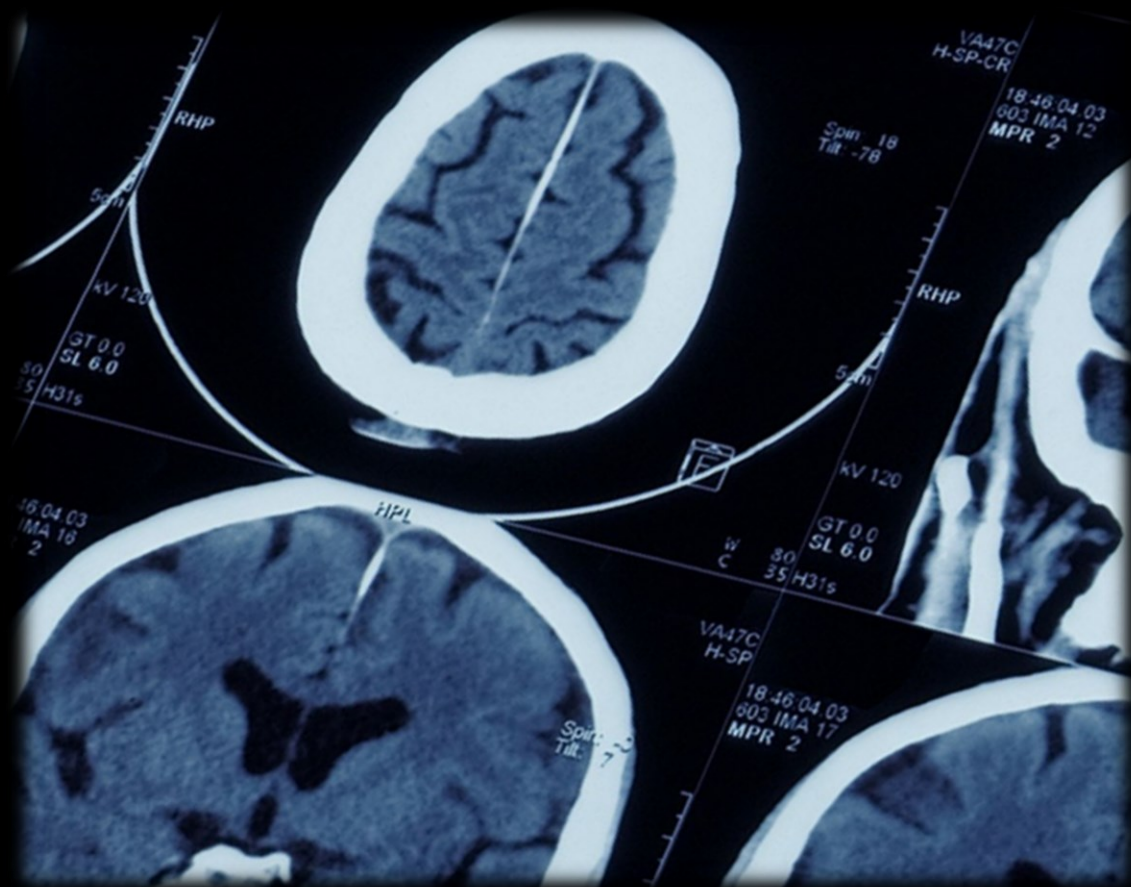




University of Glasgow | School of Physics & Astronomy



# PHYS4013 Medical Imaging

*Course Information Guide 2023-24*

## 1 Course Details

<b>Lecturers:</b>	<a href="#">Dr Maria Chiara Braidotti</a> (co-ordinator)	<b>Schedule:</b>	18 lectures, Mon 11am, Fri 10am; labs – Mon pm
<b>SCQF Credits:</b>	10	<b>ECTS Credits:</b>	5
<b>Assessment:</b>	Practical work (40%) Problem Sheets (35%) Literature Review (25%)	<b>Co-requisites</b>	None
<b>Level:</b>	Honours		
<b>Typically Offered:</b>	Semester 2	<b>Prerequisites:</b>	(Physics 2 preferred)

## 2 Course Aims

This course is an elective for third year Single Hons. Physics, Theoretical Physics and designated degree programmes in the School of Physics & Astronomy. It is also available in fourth and fifth year students, including those on Physics with Astrophysics programmes, and also to students on some degree programmes offered in other schools. The course aims to provide students with an opportunity to develop their knowledge and understanding of the key principles and applications of medical imaging, and their relevance to current developments in physics. In particular, it will provide a working knowledge of:

- An introduction to imaging in medicine;
- Imaging principles;
- Ultrasound;
- Magnetic Resonance Imaging;
- Radiology;
- Nuclear Medicine;
- Tomographic Techniques.



## 3 Intended Learning Outcomes

By the end of the course students will be able to:

- Demonstrate knowledge and a broad understanding of medical imaging;
- Describe qualitatively and quantitatively process, relationships and techniques relevant to the topics included in the course outline, and apply these techniques to solve general classes of problems;
- Write down and, where appropriate, either prove or explain the underlying basis of physical laws relevant to the course topics, discussing their applications and appreciating their relation to the topics to the topics of other courses taken.

## 4 Course Outline

**Introduction:** The uses of imaging in medicine: disease detection and diagnosis, monitoring of clinical procedures, monitoring response to therapy. Composition of the human body; elementary features of anatomy; tissue types, roles and properties. Tissue properties that can be used to provide imaging information useful for clinical applications. Examples of the more important imaging techniques.

**Imaging Principles:** Basic imaging concepts, pixelation, linearity and stationarity. The sampling theorem and its implication for imaging. Resolution, point spread function and modulation transfer function. Image noise, stochastic and deterministic noise types, first and second order noise statistics. Image signal to noise ratio and its dependence on dose. Imaging tests, sensitivity, specificity and accuracy.

**Ultrasound:** Principles of ultrasound imaging. Longitudinal waves in solids and liquids; wave velocity, impedance, reflection and transmission at interfaces. Interaction of ultrasound with tissues; signal absorption. Ultrasound production and transducers; image generation. Doppler techniques. Clinical uses of ultrasound.

**Magnetic Resonance Imaging:** Physical principles of nuclear magnetic resonance (NMR). Generation of NMR signals; spin relaxation, saturation recovery. NMR signals in tissues; longitudinal (spin-lattice) relaxation, transverse (spin-spin) relaxation. NMR signal generating sequences; saturation recovery sequence, spin-echo sequence. Principles of magnetic resonance imaging (MRI); frequency encoding, phase encoding, spin-warp imaging. Magnetic field production for MRI. Clinical MRI systems and applications.

**Radiology:** Principles of diagnostic x-ray image production. Passage of x-rays through matter, absorption and scattering, energy dependence, tissue properties. Image formation techniques, photographic film, intensifier screens, image intensifiers. Digital x-ray imaging. Image resolution. Use of contrast agents. Radiation safety.

**Nuclear Medicine:** Principles of investigative techniques in nuclear medicine. Choice of radioisotopes, isotope production and availability. Activity of a generator system. Gamma radiation detection techniques and the clinical gamma camera. Need for collimation and types of collimator. Quality assurance. Dynamics of nuclear imaging. Typical clinical investigations in nuclear medicine.

**Tomographic Techniques:** Tomographic image reconstruction and its computational principles. X-ray computed tomographic imaging (CTI). Positron emission tomography and single-photon emission tomography. Clinical applications and practical clinical systems.

## 5 Further Information

Further information can be found on the course Moodle page and also using the links below:

- [Course specification](#)
- [Reading list](#)