1	**Module Details**	
	Module Name	Medical Imaging Systems
	Nominal duration	It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 to 40 hours.
	Module code	NUE918
	Discipline code	0703230
2	**Module purpose**	This module provides students with an overview of the types of imaging systems used by medical practitioners. Students will gain knowledge of the function, principles of operation and structure of the various types of equipment to block diagram level, as well as the hazards and common faults with in imaging equipment.
3	**Prerequisites**	Electrophysiology (NUE 911)
4	**Relationship to competency standards**	This module provides some of the knowledge and skills underpinning competency in the following standards: National Electrotechnology Industry Standards, Units NES304, NES406, NES504 and the relevant specialisation. Metals & Engineering Industry Standards, Units 18.56A, 18.57A, 18.58A, 18.65A, 18.66A.
5	**Content**	1. Physics of ultrasonic waves. • Characteristic of ultrasonic waves • Generation of ultrasonic waves • Doppler principles • Signal absorption & attenuation • Transmission & reflection of ultrasonic waves 2. Ultrasound equipment • Block diagram of a typical ultrasound. • Function of each block • Principles of operation • Hazards and safety • Imaging techniques 3. Physics of X-rays • Properties of X-rays • Generation of X-rays • Effects of radiation • Radiation adsorption 4. X –ray Tubes • Types of X-ray tubes & their applications • Principles of operation of X-ray tubes • Hazard and Safety 5. X-ray Equipment • Block diagram equipment • Function of each block • Principles of operation • High voltage generation • Image intensification • Digital subtraction

- Contrast Mediums
- Image processing
- Mobile X-ray Equipment
- Hazards and Safety

6. Computerised Axial Tomography -C.T scan
   - Equipment block diagram
   - Principles of operation
   - Imaging systems
   - Data storage
   - Hazards and Safety
7. Magnetic Resonance Imaging – MRI
   - Gradient magnetic fields
   - Relaxation time T1 & T2
   - X,Y & Z imaging
   - Equipment block diagram
   - Principles of operation
   - Common faults
   - Hazards & Safety
   - Localised heating
   - Patient implants
   - Equipment interference
   - Factors effecting image quality
8. Nuclear Medicine
   - Types of Radiation
   - Sources of radiation
   - Half lives of isotopes
   - Clinical applications
   - Hazards and safety
   - Positron Emission Tomography – PET
9. Digital Image Archiving
   - Picture Archiving Communication System – PACS
   - Digital Image Communications System for Medical – DICOM
   - Laser Digitisers
   - Network and computer hardware requirements

6 Assessment strategy

Assessment methods

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Normally learning and assessment will take place in a classroom/laboratory.

7 Learning Outcome Details

Learning Outcome 1

Describe the basic principles of ultrasonic waves.

Assessment criteria

1.1 Describe the properties of ultrasonic waves.

	1.2	Explain how ultrasonic waves are produced.
	1.3	Explain the effect of different materials on the absorption of ultrasonic waves.
	1.4	Describe the effect ultrasonic waves have on tissue.
	1.5	List the safety considerations to be observed when dealing with ultrasonic waves.
	1.6	Define absorption, attenuation and reflection.
Learning Outcome 2	Describe the function, application, hazards, common faults and functional verification of ultrasound equipment.	
Assessment criteria	2.1	Outline the clinical situations which necessitate the use of the various types of ultrasound equipment.
	2.2	Describe the principles of operation of a typical ultrasonic system.
	2.3	Describe the hazards and common faults in operation of ultrasound equipment.
	2.4	List the essential safety and performance parameters which should be tested and documented.
	2.5	List the methods of imaging and image archiving used with ultrasonic systems.
	2.6	List the test equipment necessary to test operational parameters.
	2.7	Describe the procedure for safety and functional testing as per AS3551.
Learning Outcome 3	Describe the basic principles of X-rays.	
Assessment criteria	3.1	Describe the properties of X-rays
	3.2	Explain how X-rays are produced.
	3.3	Define the following terms: • wavelength • absorption • monochromatic • broad band • fluorescence emission.
	3.4	Explain the effect of different materials on the absorption of X-rays
	3.5	Describe the effect X-rays have on tissue.
	3.6	List the safety considerations when dealing with X-rays

	3.7	State the imaging licensing requirements for operating and servicing X-ray equipment.
Learning Outcome 4	Describe the function, principles of operation, application, hazards and common faults of X-ray tubes.	
Assessment criteria	4.1	Describe the clinical situations which necessitate the use of different types of X-ray tubes.
	4.2	Describe the principles of operation of X-ray tubes.
	4.3	Define the following terms, line focus principle, focal spot, heel effect and target material.
	4.4	Describe common faults and safety procedures required when working with X-ray tubes.
Learning Outcome 5	Describe the function, principles of operation, application, hazards and common faults of X-ray equipment.	
Assessment criteria	5.1	Outline the clinical situations, which necessitate the use of the different types of equipment.
	5.2	Describe the principle of operation of a typical X-Ray unit.
	5.3	List the possible hazard to a patient caused by X-Ray equipment under the following categories, electrical, mechanical & radiation.
	5.4	Describe the hazards and common faults in operation of X-Ray equipment.
	5.5	List the different methods of generating High Voltage within X-Ray equipment.
	5.6	List the different imaging and image processing techniques used with X-Ray equipment.
	5.7	Explain the effects of parameter settings on image quality.
	5.8	List the common causes of imaging errors.
	5.9	Explain the process of digital subtraction and its effect on the final image.
	5.10	Explain the process of image intensification.
	5.11	Define the following terms as they apply to image intensification, modulation transfer function and conversion factor.
	5.12	List the unique equipment and image processing requirements for mobile X-Ray equipment
	5.13	List the essential safety and performance parameters,

		which should be tested and documented.
Learning Outcome 6	Describe the function, application, hazards, common faults and functional verification of Computerised Tomography (CT) equipment.	
Assessment criteria	6.1	Outline the clinical situation which necessitate the use of CT equipment.
	6.2	Describe the principle of operation of a typical CT system.
	6.3	Describe the hazards and common faults in operation of CT equipment
	6.4	List the essential safety and performance parameters which should be tested and documented
	6.5	List the methods of imaging and image archiving used with CT systems
	6.6	List the test equipment necessary to test operational parameters.
Learning Outcome 7	Describe the function, principles of operation, application, hazards and common faults of MRI equipment.	
Assessment criteria	7.1	Outline the clinical situations, which necessitate the use of MRI.
	7.2	Describe the principle of operation of typical MRI equipment.
	7.3	Describe the heating effects of RF and list the possible hazards to patients caused by MRI where implants are involved.
	7.4	Describe how images are generated using MRI.
	7.5	List common causes of imaging errors.
	7.6	Describe the hazards and common faults in operation of MRI equipment.
	7.7	Define the following terms, processing frequency, gradient fields, T1 & T2 as they relate to MRI.
Learning Outcome 8	Describe the application & hazards of nuclear medicine.	
Assessment criteria	8.1	Outline the clinical situation which necessitate the use of nuclear medicine techniques.
	8.2	List the type of radiation used in nuclear medicine.
	8.3	List the sources of radiation used in nuclear medicine.
	8.4	Define the term half-life.

	8.5 Describe the basic principle behind the application of nuclear medicine. 8.6 Describe the clinical situations in which PET would be used. 8.7 Describe the hazards, safety and documentation requirements.
Learning Outcome 9	Describe the operation and system requirements for an image archival system.
Assessment criteria	9.1 Explain the process of conversion of hardcopy images into a digitised format. 9.2 List the network and computer hardware requirements for a typical image archival system. 9.3 Explain the advantages of a computer based record system over that of a hardcopy based record system. 9.4 Describe the role of DICOM in an image archival system. 9.5 List the interfacing requirements for typical medical imaging systems to an image archival system.

8 Delivery of the module

Delivery strategy	Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective way to achieve this is by the integration of theory and practice where students learn by experimentation and through research and laboratory reports. It is recommended that learning and assessment be facilitated in a holistic manner, which may require a learning outcome sequence other than that indicated in the module.
Resource requirements	Access to the relevant medical equipment for demonstration purposes. Useful references include: Christensen Edward E. An Introduction to Diagnostic Radiology, 2nd Edition, Henry Kimpton Publishers. Useful references include a range of manufacturers operational and maintenance manuals for the relevant medical equipment.
Occupational health and safety requirements	A safe and healthy environment will be provided for students and teachers as well as safety procedures followed with regard to teaching/learning activities.

