MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Medical Equipment I**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☒ **Practical** ☐ **Seminar**	
Module Code	**MDER316**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		**Semester of Delivery**	5	
Administering Department	Biomedical engineering		**College**	College of Engineering	
Module Leader	Dr basem		**e-mail**		
Module Leader's Acad. Title	Assistant Lecturer		**Module Leader's Qualification**	M.SC	
Module Tutor	Muntadher Hasan Naeemah		**e-mail**	Phd.muntdher@gmail.com	
Peer Reviewer Name			**e-mail**	Hasnaa.Mohamad.edu.iq	
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module		**Semester**	
Co-requisites module		**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims

أهداف المادة الدراسية

The course Medical Equipment I aims to provide students with a comprehensive understanding of the principles, components, and applications of diagnostic imaging systems. Students will begin by exploring the history of radiology, learning about the major discoveries and scientific milestones that led to the development of X-rays and modern imaging technologies. Emphasis will be placed on recognizing the contributions of key scientists and understanding how innovation transformed medical diagnostics.

The course then focuses on the X-ray tube, its components, and its operational principles. Students will study the structure and function of different parts of the tube, including the cathode, anode, and focusing cup, and will distinguish between the types of anodes and their influence on image quality and tube performance. Understanding the main X-ray circuit is also essential, as it explains how electric power is generated, controlled, and rectified to produce a consistent X-ray output. The concept of rectification will be discussed in detail to highlight its importance in ensuring stable and efficient operation of X-ray machines.

In addition, the course introduces the fundamentals of image detection, explaining how X-ray photons are converted into visible or digital images using various detection systems such as film, computed radiography (CR), and digital radiography (DR). Students will also gain knowledge about contrast media, including their physical and chemical properties, classifications, and the way they enhance visualization of anatomical structures during diagnostic procedures. Proper understanding of radiography terminology will enable students to communicate effectively using professional medical imaging vocabulary.
The second part of the course covers the principles and mechanisms of computed tomography (CT). Students will learn how CT technology works to produce detailed cross-sectional images, focusing on the processes of image reconstruction and attenuation. The generations of CT scanners will be studied to understand the evolution of CT design and performance from the first to the current advanced systems. Furthermore, the course explores spiral (helical) CT, describing how continuous rotation of the X-ray tube and synchronized patient movement enhance image quality, speed, and diagnostic accuracy. Finally, students will examine different types of CT detectors, including gas and solid-state detectors, comparing their efficiency, response, and role in producing high-quality images.
By the end of the course, students are expected to have a solid foundation in the technical and operational aspects of X-ray and CT imaging systems, preparing them to apply this knowledge in clinical and biomedical engineering contexts.

Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Knowledge	A2	A2-1: Recognize the historical development and fundamental principles of X-ray and computed tomography (CT) systems, including tube components, types of anodes, image detection, and rectification processes. A2-2: Explain the principles, mechanisms, and clinical applications of radiographic imaging, contrast media examinations, and the evolution of CT technologies such as spiral (helical) scanning and detector types. A2-3: Apply technical knowledge to understand, maintain, and analyze the performance of medical imaging devices, ensuring accurate diagnostic output and safe operation in clinical environments.
		A3	A3-1: Measure physiological signals and parameters using major medical instruments and laboratory devices, ensuring accurate operation, calibration, and maintenance in accordance with technical standards. A3-2: Analyze measurement results, device performance, and theoretical principles, integrating them with practical clinical applications while maintaining safety procedures.
	Skills	B1	B1.1 Function efficiently as an individual B1.2 Function as a member of multidisciplinary and multicultural teams
		B2	B2.1 Communicate effectively – graphically with a range of audiences using contemporary tools. B2.2 Communicate verbally and in writing with a range of audiences using contemporary tools.
	Ethics	C2	C1-1: Commit to quality standards. C1-2: Adhere to deadlines. C1-3: Strive for continuous improvement.

Indicative Contents

المحتويات الإرشادية

A: General Introduction

Overview of medical imaging systems, introduction to diagnostic X-ray and computed tomography (CT), and the role of radiologic equipment in modern healthcare.

[5 hrs]

B: History of Radiology

Study of the discovery of X-rays, major historical milestones, and the evolution of imaging technologies leading to the development of CT.

[5 hrs]

C: X-Ray Tube and Components

Detailed explanation of the structure and function of the X-ray tube, including cathode, anode, focusing cup, and cooling systems; comparison between stationary and rotating anodes.

	[8 hrs] **D: Main X-Ray Circuit and Rectification** Principles of electrical circuits used in X-ray systems, power supply, step-up and step-down transformers, rectifiers, and the process of current conversion for stable X-ray production. **[7 hrs]** **E: Image Detection Systems** Study of different image receptors (film, computed radiography, digital radiography), conversion of X-ray photons to digital data, and principles of image formation. **[6 hrs]** **F: Contrast Media and Radiography Terminology** Classification of contrast agents (iodinated, barium-based, etc.), their chemical and physical properties, applications in diagnostic imaging, and essential radiographic terminology. **[6 hrs]** **G: Principles and Mechanism of Computed Tomography (CT)** Basic working mechanism of CT imaging, data acquisition, image reconstruction algorithms, and factors affecting image resolution and quality. **[8 hrs]** **H: Generations of CT Scanners** Study of the development of CT technology from first to multi-slice systems; comparison of design, rotation methods, and scanning time across generations. **[6 hrs]** **I: Spiral (Helical) CT and Detector Types** Explanation of spiral/helical CT operation with continuous tube rotation and patient movement, advantages over conventional CT, and classification of detectors (gas-filled and solid-state). **[7 hrs]** **J: Comprehensive Review and Practical Overview** Integration and revision of all course topics including X-ray systems, image detection, CT principles, and contrast applications; emphasis on safety, calibration, and clinical relevance. **[6 hrs]**

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Lectures Brainstorming strategy Practical demonstrations Research projects Rapid tests Interactive learning strategy Indirect learning strategy.

Student Workload (SWL) الحمل الدراسي للطالب (15 اسبوع)			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	93	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	57	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.8
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	A2
	Attendance		%10(10)		
	Projects / seminar	1	15% (10)	Continuous	A2,A3
	Lab.		10% (10)		A2,A3,B1, B2, C1
Summative assessment	**Midterm Exam**	1 hr	10% (10)	7	A2,A3
	Final Exam	3hr	50% (50)	16	A2,A3
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري		
	Material Covered	LOs
Week 1	History	A2-1, B1.1, C1-1
Week 2	Introduction	A2-1, B2.1, C1-3
Week 3	X-ray tube Components	A2-1, A3-1, C1-1
Week 4	Types of anodes	A2-1, A3-1
Week 5	Mid Exam I	A2
Week 6	Main X-Ray Circuit	A2-1, A2-3, A3-1, B2.2
Week 7	Rectification	A2-1, A3-1, C1-2
Week 8	Image Detection	A2-1, A2-3, A3-2
Week 9	Contrast Media Examinations	A2-2, B2.2, C1-3
Week 10	Radiography Terminology	A2-2, B2.1, C1-1
Week 11	Mid exam II	A2,A3
Week 12	Principle and Mechanism of CT	A2-1, A2-3, A3-2, B1.2, C1-3
Week 13	Generations of CT	A2-2, A3-2, B1.1
Week 14	Spiral/helical CT	A2-2, A3-2, C1-2
Week 15	Detectors' types	A2-2, A3-1, B2.1, C1-3
Week 16	**Preparatory week before the final Exam**	**A2,A3**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر		
	Material Covered	LOs
Week 1	History	A3
Week 2	Introduction	A3
Week 3	X-ray tube Components	A3
Week 4	Types of anodes	A3
Week 5	Mid Exam I	A3
Week 6	Main X-Ray Circuit	A3
Week 7	Rectification	A3

Week 8	Image Detection	A3
Week 9	Contrast Media Examinations	A3
Week 10	Radiography Terminology	A3
Week 11	Mid exam II	A3
Week 12	Principle and Mechanism of CT	A3
Week 13	Generations of CT	A3
Week 14	Spiral/helical CT	A3
Week 15	Detectors' types	A3

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Biomedical Technology and Devices Handbook, By James Moore, George Zouridakis	yes
Recommended Texts	1. The Biomedical Engineering Handbo By Josef D. Bronzino. 2. Biomedical Technology and Devic Handbook, By James Moore, Geor Zouridakis. 3- Medical Imaging Physics, By William Hendee, E. Russell Ritenour 4- Medical Imaging Physics, By William Hendee, E. Russell Ritenour	No
Websites	https://eng.alayen.edu.iq//colleges/e/42	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.