

Course Description					
Name	Code	Semester	T+A Hour	Credit	ECTS
MEDICAL IMAGING	EEE4234060	Spring Semester	3+0	3	6
Prerequisites Courses	LİNEER CEBİR VE DİFERANSİYEL DENKLEMLER; SİNYALLER VE SİSTEMLER; DİFERANSİYEL DENKLEMLER				
Recommended Elective Courses	MATLAB				
Language of Instruction	English				
Course Level	First Cycle (Bachelor's Degree)				
Course Type	Elective				
Course Coordinator	Assist.Prof. Kevser Banu KÖSE				
Name of Lecturer(s)	Assist.Prof. Kevser Banu KÖSE, Assoc.Prof. Muhammed Fatih TOY				
Assistant(s)					
Aim	The goal is to convey the fundamental terminology and the underlying physics principles of medical imaging techniques, accompanied by the necessary theoretical knowledge in the field of engineering related to device hardware. This aims to comprehend clinical engineering applications for treatment using image data from the devices.				
Course Content	This course contains; Atomic structure, radioactivity, Rayleigh Scattering, Compton Scattering and Photoelectric Effect,X-Rays, X-ray Tube, X-Ray Devices, Fluoroscopy and Angiography,Computed Tomography Devices and Basic Working Principles,Sound Wave and Physics, Reflection, Refraction, Scattering and Attenuation,Piezoelectric Effect, Transducer, Ultrasonography, Ultrasound Modes and Acquisition,Proton, Spin, Magnetic Moment, Electromagnetism, Magnetic Field and Radio Frequency,Magnetic Resonance Imaging Devices, Image Formation in Magnetic Resonance Devices,Functional Magnetic Resonance device and BOLD technique,Diffusion Tensor Magnetic Resonance Device,Nuclear Medicine Imaging Devices,Positron Emission Tomography and Principles,Digital Twins with 3D Dimensional Reconstruction Tools,Image analysis with MATLAB,Medical Image Reconstruction with MATLAB.				
Course Learning Outcomes				Teaching Methods	Assessment Methods
Classify the techniques of medical imaging				10, 16, 6, 9	
Express the working principles of medical imaging				10, 16, 37, 6, 9	
Evaluate the working principles and equipments of medical imaging devices				10, 11, 3, 6, 9	
Analyze the advantages, disadvantages of the medical imaging devices				10, 19, 21, 9	A
Perform the image generation on MATLAB.				6, 9	A, E, G
Teaching Methods	10: Discussion Method, 11: Demonstration Method, 16: Question - Answer Technique, 19: Brainstorming Technique, 21: Simulation Technique, 3: Problem Based Learning Model, 37: Computer-Internet Supported Instruction, 6: Experiential Learning, 9: Lecture Method				
Assessment Methods	A: Traditional Written Exam, E: Homework, G: Quiz				
Lecture Schedule					
Sequence	Topics	Preliminary Preparation			
1	Atomic structure, radioactivity, Rayleigh Scattering, Compton Scattering and Photoelectric Effect	Research and create a summary document that explains the fundamental concepts of atomic structure, radioactivity, Rayleigh Scattering, Compton Scattering, and the Photoelectric Effect. Include real-life examples and applications where possible.			
2	X-Rays, X-ray Tube, X-Ray Devices, Fluoroscopy and Angiography	Watch educational videos or read articles about X-rays, X-ray tubes, and their applications in fluoroscopy and angiography. Try to understand how these imaging techniques work and their significance in medical diagnostics.			
3	Computed Tomography Devices and Basic Working Principles	Study the basic principles of computed tomography and how CT scanners produce cross-sectional images. Explore how different tissue types are distinguished in CT scans and research any recent advancements in CT technology.			
4	Sound Wave and Physics, Reflection, Refraction, Scattering and Attenuation	Learn about the physics of sound waves, including concepts of reflection, refraction, scattering, and attenuation. Explore how these principles apply to medical ultrasound and its diagnostic capabilities.			
5	Piezoelectric Effect, Transducer, Ultrasonography, Ultrasound Modes and Acquisition	Research the piezoelectric effect and how it is employed in ultrasound transducers. Familiarize yourself with different ultrasound modes and understand the process of image acquisition in ultrasound imaging.			
6	Proton, Spin, Magnetic Moment, Electromagnetism, Magnetic Field and Radio Frequency	Study the fundamental concepts of proton spin, magnetic moments, and their application in magnetic resonance imaging (MRI). Understand the role of electromagnetic fields and radio frequencies in MRI.			
7	Magnetic Resonance Imaging Devices, Image Formation in Magnetic Resonance Devices	Explore how magnetic resonance imaging devices work and how images are formed in MRI. Understand the role of magnetic fields, gradients, and radiofrequency pulses in MRI image generation.			
8	Functional Magnetic Resonance device and BOLD technique	Learn about functional magnetic resonance imaging (fMRI) and the blood-oxygen-level-dependent (BOLD) technique. Investigate how fMRI is used to study brain activity and functional connectivity.			
9	Diffusion Tensor Magnetic Resonance Device	Research diffusion tensor imaging (DTI) and its application in understanding the brain's white matter connectivity. Explore how DTI data is acquired and analyzed.			
10	Nuclear Medicine Imaging Devices	: Learn about nuclear medicine imaging techniques, including the use of radioactive tracers. Understand how these techniques provide valuable diagnostic information.			
11	Positron Emission Tomography and Principles	Explore the principles of positron emission tomography (PET) and its role in detecting and visualizing metabolic processes in the body. Research the radiotracers used in PET imaging.			
12	Digital Twins with 3D Dimensional Reconstruction Tools	Study the principles and applications of medical image segmentation			
13	Image analysis with MATLAB	Install MATLAB on your computer if not already done. Familiarize yourself with basic MATLAB operations, and practice loading and manipulating images using MATLAB functions.			

MEDICAL IMAGING**Syllabus**

Lecture Schedule		
Sequence	Topics	Preliminary Preparation
14	Medical Image Reconstruction with MATLAB	Study the basics of medical image reconstruction using MATLAB. Learn about techniques for image enhancement and reconstruction, and try reconstructing sample medical images.
Evaluation Methods		Weight(%)
Midterm Exam		30
General Exam		70

Resources
1) Medical Imaging Technology, Victor I. Mikla and Victor V. Mikla, Elsevier 2) Fundamentals of Medical Imaging, Paul Suetens, CambridgeSunumlara ait PDF dosyaları. Derse ve örnek uygulamalara ait podcast dijital medya dosyaları.