COURSE INFORMATON					
Course Title	***Code***	***Semester***	***L+P Hour***	***Credits***	***ECTS***
Medical Imaging Reconstruction	**BME512**		(3+0+0)	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Technical Elective
Course Coordinator	Prof. Dr. Ali Ümit Keskin
Instructors	Assist. Prof. Andaç Hamamcı
Assistants	
Goals	To provide students knowledge on reconstruction methods used in medical imaging, which provide images in the clinical setting following the data acquisition.
Content	In this course, magnetic resonance, PET, CT, and X-ray data acquisition and reconstruction methods, and the artifacts that might result during data reconstruction and their remedies will be discussed. The laboratory sessions will aim to teach the students how to program the data reconstruction methods. X-ray image reconstruction, CT backprojection, CT fan beam reconstruction, PET 3D filtered back projection, cartesian and non-cartesian MR reconstruction (EPI, spiral, rosette imaging), convolution regridding, density weighting, off-resonance correction algorithms, data reduction and half-Fourier techniques (direct reconstruction, keyhole imaging, homodyne reconstruction, conjugate synthesis, POCS), data reduction in time (UNFOLD, k-t Blast, k-t SENSE), multi-coil reconstructions, parallel imaging techniques (SENSE, SMASH, GRAPPA, GROG), compressed sensing.

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Basics of medical image data acquisition and reconstruction methods.	1,2,3,4,5,7,11	1,2,3	A,C,D
2) Programming the data reconstruction methods.	1,2,3,4,5,7,11	1,2,3	A,C,D
3) Understanding the correction techniques for the reconstruction artifacts.	1,2,3,4,5,7,11	1,2,3	A,C,D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project presentation

COURSE CONTENT

Week	Topics	Study Materials
1	Review of Python programming	Lecture notes, articles
2	Basics of medical image reconstruction	Lecture notes, articles
3	Radon Transform and Projection Slice Theorem	Lecture notes, articles
4	X-ray image reconstruction, CT backprojection	Lecture notes, articles
5	CT fan beam reconstruction	Lecture notes, articles
6	PET 3D filtered back projection	Lecture notes, articles
7	MID-TERM EXAM	Lecture notes, articles
8	Cartesian and non-cartesian MR reconstruction (EPI, spiral, rosette imaging)	Lecture notes, articles
9	Convolution regridding, density weighting, off-resonance correction algorithms	Lecture notes, articles
10	Data reduction and half-Fourier techniques (direct reconstruction, keyhole imaging, homodyne reconstruction, conjugate synthesis, POCS)	Lecture notes, articles
11	Data reduction in time (UNFOLD, k-t Blast, k-t SENSE)	Lecture notes, articles
12	Multi-coil reconstructions, parallel imaging techniques (SENSE, SMASH, GRAPPA, GROG)	Lecture notes, articles
13	Compressed sensing	Lecture notes, articles
14	Presentations	Lecture notes, articles

RECOMMENDED SOURCES

Textbook	
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	50
Homework	10	20
Presentation	1	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	**Program Learning Outcomes**	**Contribution**					
		0	**1**	**2**	**3**	**4**	**5**
1	Ability to reach wide and deep knowledge through scientific research in the field of Biomedical Engineering, evaluate, interpret and apply.					**X**	
2	Ability to use scientific methods to cover and apply limited or missing knowledge, and to integrate the knowledge of different disciplines to identify, define, formulate solutions to complex engineering problems.					**X**	
3	Ability to construct Biomedical Engineering problems, develop methods to solve the problems and use innovative methods in the solution.					**X**	
4	Ability to develop new and/or original ideas, tools and algorithms; develop innovative solutions in the design of system, component or process.					**X**	
5	Ability to have extensive knowledge about current techniques and methods applied in Biomedical Engineering and their constraints.						**X**
6	Ability to design and implement analytical modeling and experimental research, solve and interpret complex situations encountered in the process.		**X**				

7	Ability to use a foreign language (English) at least at the level of European Language Portfolio B2 in verbal and written communication.					X	
8	Ability to lead in multidisciplinary teams, develop solutions to complex situations and take responsibility.			X			
9	Ability to pass process and the results in Biomedical Engineering field, in national and international area in or outside of the field, systematically and clearly in written or oral form.		X				
10	Awareness of the social, legal, ethical and moral values and environmental dimensions. The ability to conduct research and implementation work within the framework of these values.				X		
11	Awareness of the new and emerging applications in Biomedical Engineering field, and the ability to examine them and learn if necessary.					X	
12	Ability to read, understand, present, critise research work and conduct original theoretical or applied research.				X		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	**Quantity**	**Duration (Hour)**	**Total Workload (Hour)**
Course Duration (Excluding the exam weeks: 12x Total course hours)	12	3	36
Hours for off-the-classroom study (Pre-study, practice)	14	5	70
Midterm examination	2	3	6
Homework	5	6	30
Presentation	1	20	20
Final examination	1	3	3
Total Work Load			240
Total Work Load / 25 (h)			9.6
ECTS Credit of the Course			**10**