

In the Name of God

Section I:

Title: Technology of Radiology/Medical Imaging

Degree: M.Sc.

Introduction

Medical imaging began with radiography after the discovery of X-Rays in 1895 by Wilhelm Röntgen, a German professor of physics. X-Rays were put to diagnostic use very early, before the dangers of ionizing radiation were discovered. In recent years, medical imaging has made very quick advances in medical diagnoses. With the use of different modalities such as spectrography, MR angiography, MRI, spiral CT scan, CT angiography, multislice CT, and EBCT the invasive methods of diagnoses have been significantly reduced.

Education in Technology of Radiology for Bachelor's degree started many years ago in Iran. However, this major does not have a M.Sc. degree in our country; in many European countries and United States universities the degree of M.Sc. in Technology of Radiology is being provided.

Definition

The graduates will be working with advanced modalities on Medical Imaging devices at medical centers with acceptable level of education.

The Aim of the Course

The mission of this program is to train students with acceptable level of knowledge for working in medical centers with advanced imaging modalities in relation to patients.

The vision is to train and educate students and scholars on the bases of international standards in the near future and become an educational polar in the Middle East.

General Competencies

Applicants should have general competencies including communicative, interviewing, educational, writing, reporting, critical thinking, problem solving, and managerial skills as well as advanced fluency in English language.

Admission Requirements

All candidates are expected to have at least a B.Sc. degree (Bachelor of Science) in one of the following disciplines

Technology of Radiology, Radio Imaging Technology, Physics, Medical engineering, Biology, Nuclear engineering

Educational Strategies, Methods and Techniques

- Theoretical
- Practical
- Project

Student Assessment:

- Exam
- Seminar
- Problem solving

Number and Type of Credits and Tables of the Courses (including compulsory and optional [elective] courses):

- Compensation modules 8credits
- Core modules 28 credits
- Project 4 credits
- Total 32 credits

Table A) Compensating Subjects for M.Sc. in Technology of Medical Imaging

Code	Subject	Credits			Hour	
		Theory	Practical	Total	Theory	Practical
01	Medical Informatics Systems	0.5	0.5	1	9	17
02	Mathematics (general)	3	-	3	51	-
03	Biomedical Statistics	2	-	2	34	-
04	MATLAB in Medicine	1	1	2	17	34
Total		8			-	

Table B) Main Subjects in M.Sc. in Technology of Medical Imaging

Code	Subject	Credit				Hour				Pre-Requirement
		Theory	Practical	Hospital training	Total	Theory	Practical	Hospital training	Total	
05	Research Method	2	-	-	2	34	-	-	34	-
06	Sectional Anatomy	1	--	-	1	17	-	-	17	-
07	Medical Image Processing	2	-	-	2	34	-	-	34	-
08	Advance Physics of CT Scan & MRI Systems	3	-	-	3	51	-	-	51	-
09	Advanced Methods of Medical Imaging (CT Scans & MRI)	3	-	-	3	51	-	-	51	08
11	QA of Medical Imaging Systems, CT & MRI	2	1	-	3	68	34	-	34	08
12	SPECT, PETCT, MRS, MRA,	3	-	-	3	51	-	-	51	08

	MRF									
13	Scientific English Language	2	-	-	2	34	-	-	34	
14	CT Scan Hospital Training	-	-	3	3	-		170	170	10
15	MRI Hospital Training	-		3	3	-		170	170	14
16	Seminar	1	-		1	17	-		17	
17	Project	4								
Total		28								

Ethical Issues

The graduates should,

- Observe the Patient's Bill of Rights¹ when working with the patients.
- Strictly observe Biosafety and Patient Safety Rules* concerning the patients, personnel and workplace.
- Observe the Rulebook for Dress Code².
- Strictly observe the Regulations of Working with the Laboratory Animals³.
- Carefully preserve resources and equipment.
- Truly respect faculty members, staff, classmates and other students and work for creating an intimate and respectful atmosphere.
- Observe social and professional ethical considerations in criticism.

1, 2 and 3 are contained in the Enclosures.

* Biosafety and Patient Safety Rules will be set out by the Educational Departments and will be available to the students.

Section II

Medical Informatics Systems

Code of the Course: 01

Number of Credits: 01

Type of the Course: Theoretical and practical

Prerequisite: -

Principal Objective(s) of the Course:

At the end of the course students should be:

- Familiar with personal computer and working with it;
- Familiar with a variety of software and working with them;
- Able to work with university library services;
- Able to work with internet; and
- Able to build an email account and use it

Course Description:

Knowledge about PC and working with it, working with Windows system, introduction to a variety of information sources and knowing how to use them, such as Medline, Embase, Biological Abstract, etc. and knowledge about internet and search engines.

Main Topics: 26 hours

Theoretical: 0.5 units (9 hours)

Practical: 0.5 units (9 hours)

Principal Reference(s):

- Kiley R. Medical Information on the Internet, *A Guide for Health Professionals*, Edinburg, Scotland, Churchill Livingstone, Last edition.

Student Assessment Practices:

Exam (practical and written) at the end of the course, Seminar, and being active during the course.

Mathematics (general)

Code of the Course: 02

Number of Credits: 03

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

At the end of the course, students should have general knowledge about mathematics.

Course Description:

Knowledge about main bases of mathematics, differential and integrals.

Main Topics: 51 hours

Theoretical: 03 Units (51 hours)

Practical: - units (- hours)

Principal Reference(s): The books about general knowledge about mathematics, differential and integrals.

Student Assessment Practices: Exam (practical and written) at the end of the course, Seminar, and active presence during the course.

Biomedical Statistics

Code of the Course: 03

Number of Credits: 02

Type of the Course: Theoretical and practical

Prerequisite: -

Principal Objective(s) of the Course:

At the end of the course students should have general knowledge about main bases of the statistics, statistics methods, tests, different methods of analysis, handling data and findings, as well as the ability to display them.

Course Description:

Knowledge about descriptive statistics, different diagrams, histograms, mean, median, mode, standard deviations, variances, normal distributions, sampling, sample size, standard errors, null hypothesis, alternative hypothesis, correlation, regression, probability, student t-tests, chi-square test, etc.

Main Topics: 34 hours

Theoretical: 2 Units (34 hours)

Practical: - units (- hours)

Principal Reference(s):

Dr. Fagihzade Sograt, Use and Descriptive Medical Statistics

Dr. Malekafzali, Hosien, Statistical Methods and Health Indices and different sources of medical statistics books.

Student assessment practices:

Exam (practical and written) at the end of the course, Seminar, and active during the course.

MATLAB in Medicine

Code of the Course: 04

Number of Credits: 02

Type of the Course: Theoretical and practical

Prerequisite: -

Principal Objective(s) of the course:

At the end of course students should:

- Have general knowledge about MATLAB software
- Be able to use MATLAB for solving the mathematical functions
- Have the skill of processing the CT scan images with MATLAB
- Improve quality of images with MATLAB

Course Description: Increase the level of skills and knowledge to use MATLAB software in Technology of Medical Imaging (CT scans).

Main Topics: 51 hours

Theoretical: 1 Unit (17 hours)

Practical: 1 Unit (34 hours)

Principal Reference(s):

- Digital Image Processing Using MATLAB; Rafael C.I Gonzalez, Richard E Woods, Steven L.Eddins, Last edition
- Digital Signal Processing Using MATAALB; Vinavy K. Ingle, John G.Proakis, Last edition, etc

Student Assessment Practices:

Continuous evaluations during the course, and end of the course exam.

Research Method

Code of the Course: 05

Number of Credits: 02

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

Increasing the level of knowledge of students in the field of medical sciences research methods. At the end of this course students should prepare a proposal which includes identify a problem, working on research paper, objectives, etc.

Course Description:

In this course students would get knowledge about different methods of research in the field of medical and health sciences.

Main topics: 34 hours

Theoretical: 2 units (34 hours)

Practical: - unit (- hours)

Principal Reference(s):

- Lumley J. S.P. Benjamin W. *Some Ground Rules* Oxford University Press. Oxford. Last edition
- Abedsaedi Zilla and Amir, Aliakbari Sedeghe, *Research Method in Medical Sciences*, Last edition.
- Asefzadeh Saied, Mallek afzali Hosien. *Ten Steps in Research of the Health and Treatment Systems*, Tehran, Health, treatment and Medical educations Ministry, Last edition

Student Assessment Practices:

Continuous evaluations during the course, and final exam at the end of the course.

Sectional Anatomy

Code of the Course: 06

Number of Credits: 01

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

At the end of course students should know about the anatomy of different body parts in the sagittal, coronal and axial planes, such as head and neck, body and pelvis and abdomen and identify tissue changes in the body parts.

Course Description:

In this course, students would get familiar with anatomy of different body parts in sagittal, coronal and axial planes.

Main topics: 17 hours

Theoretical: 1 Unit (17 hours)

Practical: - units (- hours)

Principal Reference(s):

- *Basuc Atlas of Sectional Anatomy with Correlated Imaging* by Meschan, Wolfman, Kruuueger, Carr, Bowden/Last editiion
- *Pocket Atlas of Anatomy* by Moller/Last edition
- *MR/CT Atlas of Anatomy* by Kupper/Last edition

Student Assessment Practices:

Continuous evaluations during the course, and final exam at the end of the course.

Digital processing of Medical Images

Code of the Course: 07

Number of Credits: 02

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

Increasing the level of knowledge and skills of students in the fields of improving the quality of medical images methods, extract of the image information and characteristics of image for diagnosis and picture archive and communication systems.

Course Description:

In this course students would gain knowledge about:

- The characteristics of different signals in Medical Imaging Technology;
- Harmonic signals, sinusoidal, square, triangle impulses and Delta functions and their characteristics;
- Fourier transform and its characteristics, Fourier series, FFT, display of image in frequency dimensions;
- Convolution and its theory in imaging, matrix algebra, and image filtration;
- Segmentation of image and current methods; and,
- DICOM and PACS

Main Topics: 34 hours

Theoretical: 2 Units (34 hours)

Practical: - units (- hours)

Principal Reference(s):

- Gonzales. R.C. Woods R.E. *Digital Image Processing*. Prentice Hall. Last edition
- Castleman K.R. *Digital Image Processing*. Prentice Hall. Last edition.

Student Assessment Practices:

Continuous evaluations during the course, final course exam, lectures, group discussion, with the use of new auditory and visionary methods.

Advanced Physics of CT Scans and MRI Medical Imaging Systems

Code of the Course: 08

Number of Credits: 03

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

Increasing the knowledge of students about advanced physics of CT scans and MRI systems and basics of working with these modalities and image reconstructions.

Course Description:

Students learn about the advanced physics of CT scan and MRI systems and do the image reconstructions for obtaining better quality images.

Main Topics: 51 hours

Theoretical: 3 Units (54 hours)

Practical: - units (- hours)

Principal Reference(s):

- Bush Burg, *Mri Procedures: Health Effect & Safety* by Fran G Shellok. Last edition
- *Computed Tomography Fundamental, System technology, Image Quality, Application* by William A. Kalender revised edition. Last edition
- *Spiral CT principle, Techniques, Clinical Application* by Elliot. K. fishman, R. brooke Jeffrey JR. Last edition
- *Helical Computed Tomography* by A. Paul M. Silverman. Last edition
- *Computed Tomography Physical Principles, Clinical Application and Quality Control* by Euclid seeram. Last edition
- *Computed Tomography Fundamentals System Technology, Image Quality, application* by Willi A. Kalendar. Last edition
- Dr. Vahid Changizi. *Educational CD of Advance Imaging Method in Medicine*

Student Assessment Practices:

Continuous evaluations during the course, final course exam, lectures, group discussion, with the use of new auditory and visionary methods.

Advanced Methods of the Medical Imaging (CT scans and MRI)

Code of the course: 09

Number of Credits: 03

Type of the course: Theory

Prerequisite: Advanced Physics of CT Scans and MRI Systems

Principal Objective(s) of the Course:

Increasing the knowledge of students about working with different methods of tomography imaging modalities.

Course Description:

Students should get familiar with the advanced methods of tomography imaging of different body parts and different techniques of imaging on the base of the kinds of sickness and need.

Main topics: 51 hours

Theoretical: 3 Units (51 hours)

Practical: - units (- hours)

Principal Reference(s):

- *Practical Differential Diagnosis* in CT and MRI/thieme. Last edition.
- *Computed Tomography Fundamental, System, Technology, Image Quality, Application* by William A.Kalender revised edition Last edition.
- *Spiral CT principle, Techniques, Clinical application* by Elliot K.l fshman, R. brooke Jeffrey JR. Last edition.
- *Helical (spiral) Commuted Tomography*, Paul M. Silverm, Lippincott Williams & wilkins. Last edition
- *Multislice, CT, Principles And Protocols*, Friedrich knollmann, Fergus v. coakley . Saunders, Elsevier. Last editon.
- *Helical Computed Tomography* by A Paul M. Silverman, Last edition.

Student Assessment Practices:

Continuous evaluations during the course, and final exam at the end of the course.

Specialized Interpretation and Evaluations of Medical Tomography Images

Code of the Course: 10

Number of Credits: 02

Type of the Course: Theory

Prerequisite: Advanced Methods of the Medical Imaging (CT scans and MRI)

Principal Objective(s) of the Course:

Increasing the knowledge of students about advanced methods of correct interpret and evaluations of the images in medical tomography imaging systems (CT scans and MRI)

Course Description:

In this course, students learn how to interpret and evaluate medical tomography images of different sections of body.

Main topics: 34 hours

Theoretical: 2 Units (34 hours)

Practical: - units (- hours)

Principal Reference(s):

- *Practical Differential Diagnosis in CT and MRI/thif.* Last edition.
- *Computed Tomography Fundamental, System Technology, Image Quality, Application* by William A. Kalender. Revised edition. Last edition.
- *Spiral Ct Principle, Techniques, Clinical Application* by Elliot K. Fishman, R. Brooke Jeffrey JR. Last edition.
- *Helical Computed Tomography* by A. Paul M. Silverman. Last edition

Student Assessment Practices:

Continuous evaluations during the course, and final exam at the end of the course.

QA of Advanced Medical Imaging Systems, CT & MRI

Code of the Course: 11

Number of Credits: 03

Type of the Course: Theory: 02, practical: 01

Prerequisite: Advanced Physics of CT Scans and MRI Medical Imaging Systems

Principal Objective(s) of the Course:

Increasing the knowledge of students about QA of advanced medical tomography imaging systems (CT scans and MRI).

Course Description:

In this course students gain knowledge about basics of the QA of medical tomography imaging systems and equipment.

Main Topics: 68 hours

Theoretical: 2 Units (34 hours)

Practical: 1 Unit (34 hours)

Principal Reference(s):

- *Computed Tomography Physical Principles, Clinical Application and Quality Control* by Euclid seeram, Last edition.
- *Computed Tomography Fundamentals System Technology, Image Quality, and Application* by Willi A.Kalendar, Last edition.
- *Basic Physics, Instrumentation and Quality Control* by William Faulkner, Last edition.

Student Assessment Practices:

Continuous evaluations during the course and final exam, being active in classroom and doing at least one practical project and handing in a report.

PET/MRI-MRA, MRF, MRS, SPECT/CT, PET/CT

Code of the Course: 12

Number of Credits: 03

Type of the Course: Theory: 02

Prerequisite: Advanced Physics of CT scans and MRI Medical Imaging systems

Principal objective(s) of the course:

Increase the knowledge of students about PET/MRI-MRA, MRF, MRS, SPECT/CT, PET/CT systems

Course Description:

In this course, students would get familiar with physics, QA, and structures of different imaging modality such as; SPECT, PET, SPECT/CT and PET/CT.

Students also learn how to correct the scatter radiation in these systems, the physics' base of preparing MRA, MRF and MRS images and analyzing them.

Main Topics: 51 hours

Theoretical: 3 Units (51 hours)

Practical: - unit (- hours)

Principal Reference(s):

- *Nuclear Medicine and pet-CT*, Paul E. Christian M. Waterstram-Rich. Last edition
- *Practical Nuclear Medicine*. P.E. Sharp, H.G. Germmel & F.W. Smith.Last edition.
- *MRI the Basic* by Ray H.hashemi, wiiliam G. bradey, JR, christopher J. lisanti/Last edition.
- *The MRI Manual* by roberT B.lufkin. Last edition.
- *The Essential Physics of Medical Imaging*. Jerrold T. Bushberg, J. Anathony Seibert, Edwin M. Boone. Last edition.
- Dr. Vahid Changizi. *Educational CD of Advance Imaging Method in Medicine*

Student Assessment Practices:

Continuous evaluations during the course, and final exam.

Scientific English languages

Code of the Course: 13

Number of Credits: 02

Type of the Course: Theory: 02

Prerequisite: -

Principal Objective(s) of the Course:

Increasing familiarity with reading, writing, comprehension of scientific writings especially in the field of the medical imaging technology.

Course Description:

In this course, students would get familiar with scientific English writing, comprehension and reading papers, books, etc. in the field of medical imaging.

Main topics: 34 hours

Theoretical: 2 Units (34 hours)

Practical: - unit (- hours)

Principal Reference(s):

- English scientific writing, books, journals, etc. in the field of radiology and medical imaging

Student Assessment Practices:

Continuous evaluations during the course, mid-term exam ad final exam, and seminars.

Hospital Training (CT Scan)

Code of the Course: 14

Number of Credits: 03

Type of the Course: Training Course

Prerequisite: Specialized Interpretation and Evaluations of Medical Tomography Images

Principal Objective(s) of the Course:

Increasing the knowledge and practical skills of students in the field of CT scan imaging modality.

Course Description:

In this training course, students would learn the methods of imaging with CT scan imaging modality and increase their practical skills in preparing better quality images of head and neck, trunk and different body parts.

Main topics: 03 Units (170 hours)

Theoretical: -

Practical: - unit (- hours)

Principal Reference(s): -

Student Assessment Practices:

Continuous evaluations during the course, and final exam.

Hospital Training (MRI)

Code of the Course: 15

Number of Credits: 03

Type of the Course: Training course

Prerequisite: Hospital training (CT scan)

Principal Objective(s) of the Course:

Increasing the knowledge and practical skills of students in the field of MRI modality.

Course Description:

In this training course, students would learn methods of imaging with MRI modality and increase their practical skills about preparing better quality images. As well as practical education of MRA, MRF, MRS

Main topics: 3 units (170 hours)

Theoretical: -

Practical: - unit (- hours)

Principal Reference(s):

Student Assessment Practices:

Continuous evaluations during the course, and final exam at the end of the course.

Seminar

Code of the Course: 16

Number of Credits: 01

Type of the Course: Theory

Prerequisite: -

Principal Objective(s) of the Course:

Increasing the skills of students about preparing and providing contents of the scientific papers, books and delivering lectures in the field of their projects.

Course Description:

In this course, students would learn how to collect and prepare their lecture and deliver it.

Main topics: 51 hours

Theoretical: 03 units (51 hours)

Practical: - unit (- hours)

Principal reference(s):

Student Assessment Practices:

To provide a scientific lecture or seminar at the end of course.

Thesis

Code of the Course: 17

Number of Credits: 04

Type of the Course: -

Prerequisite: -

Principal Objective(s) of the Course:

To gain experience in the field of dedicated methods in MRI or CT scans.

Course Description:

To do practical applications of MRI or CT scans in the field, such as MR angiography, MR functional, MR spectroscopy, CT scans, CT angiography, etc. and to hand in a report

Main topics: -

Theoretical: -

Practical: -

Principal Reference(s): -

Student Assessment Practices:

Handing in a report.