Program SPECIFICATION FOR Diploma Degree in Medical Biophysics

Code: 600

University: Alexandria **Faculty:** Medical Research Institute

Program Specification

A- Basic information

1- Program title: Diploma Degree in Medical Biophysics

2- Program type:	single	√	double		multiple	

3- Department(s) : Medical Biophysics

4- Coordinator: Dr/ Abdelhalim Mahmoud Ismail

5- External evaluator(s):

Prof/ Mona Salah- Eldin Talaat

6- Last date of program specification approval: 5/6/2014

B- Professional Information

1- Program aims to provide student knowledge on:

1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given

2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology)

3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance.

4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back - projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance.

5-discuss the electrical and computer engineering contributions to biomedical engineering, with particular emphasis given to related on-going departmental research. Course topics include: Background of general human anatomy and physiology, Background of electrophysiology, Modeling, recording and automated analysis of the electroencephalogram (EEG) and bedside clinical applications.

6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines..

7- explore the different imaging modalities used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.

8- discuss basics of the principles and techniques of electron microscopy. The course is an interactive didactic course. This course covers the following topics: Structure and function of the electron microscope, Tissue preparation for both types of scopes, Freeze fracture, Immunocytochemistry at the EM level, Image analysis, and Photographic techniques and some special applications to include wavelength spectroscopy.Compare between different quantitative analysis techniques of chemical signaling using: Bioelectronics, electron transport and second messenger production. Receptor/Ligand binding and trafficking. Signal transduction and Cellular responses such as adhesion and migration.

9-discuss the basics of theory and measurement of radiation as applied to medicine and the laboratory. Topics include: Production of radioisotopes and radiopharmaceuticals, Convolution and Monte Carlo dose computations, Instrumentation for emission imaging, Gamma Camera, Single Photon Emission Computerized Tomography, Positron Emission Tomography, Radioactive waste issues, radon gas, emergencies, and wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations

10- discuss basics of the electrical and computer engineering contributions to biomedical engineering. Course topics include: Modeling, recording and automated analysis of the electroencephalogram (EEG). Clinical applications, modeling, recording and automated analysis of the electromyogram (EMG). Clinical applications, modeling, recording and automated analysis of the electrocardiogram (EKG). Clinical applications, modeling of neural networks. Clinical applications and Medical imaging techniques (computerized tomography, magnetic resonance imaging and ultrasonic imaging).

11-explore therapeutic medical devices so that they will be able to contribute in hospitals, industry, and research. Pacemakers and defibrillators, Communication aids, Neural assist devices, Physiotherapy equipments, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Intelligent drug delivery, Artificial kidney, Gastrointestinal therapy, Photodynamic therapy, Radiotherapy linear accelerator.

12-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights.

2- Intended learning outcomes (ILOS)

a- knowledge and understanding:

a1-Discuss radiation and its different types, measurements of radiation dose, tissue sensitivity and the factors affecting the biological effects of radiation and protection from radiation hazards

a2-Recall basics of biomedical engineering. the principles of electrophysiology.

a3-Discuss the difference between active transport, diffusion and osmosis, mass and energy transport in biological system.

a4-Discuss the biophysics of nerve and muscle, electrical conduction in excitable tissue and bio-potential mapping.

a5-Discuss the physical principals of magnetic resonance imaging, the T1 &T2 relaxation factors and the Magnetic field gradient, the pulse sequences, Signal-to-noise ratio and spatial resolution

a6-Recall the advanced Physics and mathematics of three-dimensional reconstruction techniques in medical imaging, the slice projection theorem of medical imaging, the different image reconstruction algorithms, different numerical methods and its applications in X-Ray Computed Tomography, positron emission tomography and nuclear magnetic resonance .

a7-Discuss the acoustic-wave production and the piezoelectric effects, Laser beam production, the physical parameters by which laser dose can be calculated, the Laser hazard to be avoid during applications

a8-Discuss hypertension, atherosclerosis, coronary artery, peripheral and cerebrovascular diseases. in vivo vascular imaging principles and approaches such as flow restriction models.

a9-Recall the basic structure and function of transmission electron microscopy, mechanisms of illumination and interaction with biological tissue, the basics of structure and function of scanning electron microscopy, signal detectors of scanning electron microscopy.

a10-Explain the working idea for some physical therapy equipment, the artificial kidney and artificial pancreas and the bases of Computerized Tomography, Magnetic Resonance Imaging.

a11-Discuss topics on linear algebra like vectors, matrices, vector spaces, determinants, values and linear transformations, topics on advanced calculus such as double and triple integrals, Fourier transforms, infinite series, improper integrals, Gamma and Beta functions and functions of complex variables and topics on ordinary and partial differential equations.

a12-Discuss chemical signaling, the quantitative analysis of chemical signaling and receptor/ligand binding and trafficking.

a13-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights.

b- Intellectual skills:

b1- Compare between different experimental methods used to study properties of biological molecules.
b2- Compare between different radio diagnostic and therapeutic modalities.

b3- Evaluate different physical parameters related to image quality and processing.

b4- Compare between the different medical imaging techniques.

b5- Compare between the bio-transport mechanisms in living system.

b6- Analyze the cardiac electrophysiology.

b7- Calculate both the nonlinear strain in tissues and arterial flow rate.

b8- Analyze different numerical methods in X-Ray Computed Tomography, Nuclear Magnetic Resonance and positron emission tomography .

b9-Describe the acoustic-wave production and the piezoelectric effects and Laser beam production.

b10-Evaluate the applicability of different vascular imaging techniques based on the anatomical, physiological and physical parameters.

b11-Compare between column design in transmission and scanning electron microscope and between different mechanisms of electron beam interaction with specimen valves

b12-Analyze chemical signaling using bioelectronics

b13-Differentiate between different methodologies used to carry out a scientific research.

c- professional and practical skills:

c1-Use methods for separation and concentration calculation of proteins and nucleic acids.

c2-Illustrate cells components and tissue types by light and electron microscope.

c3-Apply the radiation dose and the maximum permissible dose of radiation laws in therapy planning.

c4-Demonstrate the use of low dose electromagnetic magnetic field in medical applications

c5-Demonstrate the ECG and EMG apparatus in the lab.

c6- Employ mathematical equations to calculate mass and energy in bio transport of biological cell.

c7-Evaluate the electrical conduction in excitable tissue of experimental animals.

c8-Demonstrate image processing techniques used in clinical X-ray computed tomography

c9-Demonstrate the different types ultrasound and laser devices.

c10-Practice the ultrasound and laser experimental procedures used in biomedical research.

c11-Apply equations to calculate laser dose.

c12-Apply mathematical equations to calculate the peripheral blood flow rate using different imaging techniques.

c13-Use computational methods for vascular images processing.

c14-Interpret vascular imaging outcomes and judge vessels health.

c15-Practice the preparation of buffers, fixatives, dehydration embedding resins used in specimen preparation for transmission electron microscopy.

c16-Demonstrate the cutting sectioning and staining of samples, the preparation of support films and negative staining, the ultrastructure and cell components under the screen of electron microscopy .

c17-Demonstrate clinical MRI, clinical linear accelerator and kidney dialysis machine

c18-Demonstrate cell adhesion and migration using light and electron microscope

c19-Use the appropriate research methodology to conduct a research .

c20-Apply statistical methods to analyze experimental data .

c21-Use the principal of scientific writing to avoid literal mistakes and misrepresentations.

c22-Illustrate the ethical issues related to the scientific research

d- General and transferable skills:

d1 Develop skills in reading

d2- Develop team work.

d3- Use information technology.

d4- Increase written and oral skills.

3- Academic standards

3a External references for standards (Benchmarks)

Generic Academic Reference Standards if the National Authority for Quality Assurance and Accreditation of Education (NAQAAE)

Adopted at MRI council 12/2/2014 and re-adopted at 15/1/2023

Last date of Academic Reference standards (ARS) approval by institute 15/1/2023 Council

3b Comparison of provision to selected external references

Generic Academic Standards	ARS
A1- Basic facts , theories, of the specialty and related subjects/ fields	A1. Discuss radiation types, dose measurements, tissue sensitivity, biological effects, and radiation hazards and relate them with advanced medical imaging techniques, slice projection theorem, image reconstruction algorithms, and applications in X-Ray Computed Tomography, positron emission tomography, and nuclear magnetic resonance.
A2-Mutual relation between professional practice and effects on environment	A2. Recognize biomedical engineering basics, electrophysiology principles, the biophysics of nerve and muscle, electrical conduction in excitable tissue, and bio-potential mapping and relate to quantitative analysis of chemical signaling, specifically its relationship with receptor/ligand binding and trafficking.
A3- Main scientific advances in the field of practice	A3. Explore active transport, diffusion, osmosis, mass and energy transport in biological systems, hypertension, atherosclerosis, coronary artery, peripheral and cerebrovascular diseases, and in vivo vascular imaging principles. A6. Discuss linear algebra, advanced calculus, and differential equations, including vectors, matrices, determinants, values, and linear transformations, as well as functions of complex variables.
A4- Fundamentals of ethical & legal practice	A4. Explain the working idea for Physical therapy equipment, artificial kidneys and pancreas, utilize Computerized Tomography and Magnetic Resonance Imaging, discussing principles, T1 & T2 relaxation factors, magnetic field gradient, pulse sequences, signal-to-noise ratio, and spatial resolution.
A5 -Quality standards of the practice	A5. Recall the basic structure and function of transmission electron microscopy,

	mechanisms of illumination and interaction with biological tissue, the basics of structure and function of scanning electron microscopy, acoustic-wave production, piezoelectric effects, laser beam production, and hazard avoidance during applications.
A6- Basics and ethics of scientific research	A7. Discuss standard experimental research design methods, scientific writing basics, statistical analysis of experimental data, and ethics of scientific research, publishing, and copyrights.
B1- Interpret, analyze & evaluate the information to solve problems	B1. Compare various experimental methods used to study biological molecule properties and analyze chemical signaling using bioelectronics. Analyze the cardiac electrophysiology.
B2- Solve some problems that do not conform to classic data (incomplete data)	B4. Compare between column design in transmission and scanning electron microscope and between different mechanisms of electron beam interaction with specimen valves.
B3- Integrate different information to solve professional problems	B3. Examine various numerical methods in X-Ray Computed Tomography, Nuclear Magnetic Resonance, and positron emission tomography, and evaluates physical parameters related to image quality and processing.
B4- Conduct a scientific research &/Or write scientific systematic approach to a research problem (hypothesis)	B7. Differentiate between different methodologies used to carry out a scientific research.
B5- Evaluate risks imposed during professional practice	B5. Assess the effectiveness of various vascular imaging techniques based on anatomical, physiological, and physical parameters, calculating nonlinear strain in tissues and arterial flow rate.
B6- Plan for professional improvement	B6. Describe the acoustic-wave production and the piezoelectric effects and Laser beam

	production.
B7- Take professional decisions in wide range of professional situations	B2. Compare various radio diagnostic and therapeutic modalities and medical imaging techniques.
C1- Competent in all basic and some of the advanced professional skills (to be determined according to the specialty board/ department)	C1. Utilize separation and concentration calculation methods for proteins and nucleic acids, and demonstrate cell adhesion and migration using light and electron microscopes. C2. Illustrate cells components and tissue types by light and electron microscope, as well as practicing the preparation of buffers, fixatives, and dehydration embedding resins. C3. Apply the radiation dose and the maximum permissible dose of radiation laws in therapy planning and the use of image processing techniques in clinical X-ray computed tomography. C4. Evaluate the electrical conduction in excitable tissue of experimental animals specifically in the lab's ECG and EMG apparatus.
C2- Write and appraise reports	C9. Use the principal of scientific writing to avoid literal mistakes and misrepresentations. C10. Apply statistical methods to analyze experimental data C11. Use the appropriate research methodology to conduct a research and Illustrate the ethical issues related to the scientific research.
C3-Evaluate methods and tools used in specialty	C5. Showcase various ultrasound and laser devices and practice their experimental procedures in biomedical research. Apply equations to calculate laser dose. C6. Demonstrate the application of low dose electromagnetic magnetic field in medical applications, Use computational methods for vascular images processing.

	C7. Apply mathematical equations to calculate the peripheral blood flow rate using different imaging techniques. C8. Interpret vascular imaging outcomes and judge vessels health. Demonstrate clinical MRI, clinical linear accelerator and kidney dialysis machine
D1- Communicate effectively using all methods	D3- Use information technology . D2- Develop team work.
D2- Use information technology to improve his/her professional practice	D1- Develop skills in reading D3- Use information technology.
D3- Practice self appraisal and determines his learning needs	D1- Develop skills in reading
D4- Share in determination of standards for evaluation of others (e.g.: subordinates/ trainees etc.)	D3- Use information technology.
D5-Use different sources of information to obtain data	D4- Increase written and oral skills.
D6-Work in teams	D2- Develop team work.
D7-Manage time effectively	D4- Increase written and oral skills.
D8-Work as team leader in situations comparable to his work level	D2- Develop team work.
D9-Learn independently and seek continuous learning	D1- Develop skills in reading

4- Curriculum structure and contents

4. a program duration: minimum of three semesters to 3 years

4.b program structure :

4. b.i- No. of hours per week in each year/semester: from 12 to 14 hours per week in each semester

Semester	**Number of hours**

First semester	9 credit hours
Second semester	6 credit hours
Third semester	9 credit hours
Forth semester	6 credit hours

4.b.ii- No. of credit hours	Lectures	19	Practical	11	Total	30
	Compulsory	24	Elective	6	Optional	0

4.b.v- No. of credit hours of specialized courses	No.	24	%	80
4.b.vi- No. of credit hours of other courses(e.g. statistics, computer)	No.	6	%	20
4.b.vii- Practical/Field Training	Yes	-	No	√

4.b.viii- Program levels (in credit-hours system) NA

5- Program Courses

5.1- Compulsory (24)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1712601	Medical Imaging Biophysics	3	2	2
1712602	Principals of Magnetic Resonance Imaging	3	2	2
1712603	Principals of 3-D Reconstruction in Medical Imaging	3	2	2
1712604	Fundamentals of Radiological Biophysics and Dosimetry - I	3	2	2
1712605	Introduction to Biomedical Engineering – I	3	2	2
1712606	Principals of Ultrasound and Laser Biophysics	3	2	2
1712607	Introduction to Vascular Imaging Techniques	3	2	2
1712608	Basics of Electron Microscopy	3	2	2
Total		24	16	16

5.2- Elective (6)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1712609	Fundamentals of Radiological Biophysics and Dosimetry - II	**2**	**1**	**2**
1712610	Introduction to Biomedical Engineering – II	**2**	**1**	**2**
1712611	Basics of Therapeutic Medical Devices	**2**	**1**	**2**
1709620	Histochemistry and Cell Biology	**1**	**1**	**0**
1721620	Medical Statistics	**1**	**1**	**0**

5.3- Optional – (none)

6- Program admission requirements

Graduate students with a degree of science, education, engineering, applied medical science, medicine, dentistry, pharmacy, nursing, veterinary medicine, physiotherapy, or any degree relevant to medical biophysics and recognized by the council of the medical biophysics department

7- Teaching and learning methods

1. Lectures
2. Practical sessions
3. Seminars
4. group discussion
5. self-learning
6. brain storming

8- Regulations for progression and program completion

For the progression and completion of the program to obtain the degree of Diploma in medical biophysics, the student must complete 30 credit hours with CGPA of at least C.

9- Evaluation of program intended learning outcomes

Evaluator	**Tool**	**Sample**
1- Senior students	Questionnaire	at least 50%
2- Alumni	Questionnaire	representative sample
3- Stakeholders (Employers)	Meeting	representative sample
4- External Evaluator(S) External Examiner (s)	Report	**Prof/ Mona Salah- Eldin Talaat**
5- Other	NA	NA

Program coordinator:

Name: Dr/ Abdelhalim Mahmoud Ismail

Signature: A. Ismail

Department head:

Name: Prof.Dr. Heba Said Ramadan

Signature: Heba Said

Date: 29/8/20

Program Aims vs Graduate Attribute matrix

Generic Graduate Attributes of NAQAAE	Graduate Attributes	aims
Apply specialized knowledge related to professional skills in the field of specification.	Apply knowledge on different imaging modalities, radiation therapy and medical devices	1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given 2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology) 3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance. 4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics

		and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance. 5-discuss the electrical and computer engineering contributions to biomedical engineering, with particular emphasis given to related on-going departmental research. Course topics include: Background of general human anatomy and physiology, Background of electrophysiology, Modeling, recording and automated analysis of the electroencephalogram (EEG) and bedside clinical applications. 7- explore the different imaging modalities used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease. 9-discuss the basics of theory and measurement of radiation as applied to medicine and the laboratory. Topics include: Production of radioisotopes and radiopharmaceuticals, Convolution and Monte Carlo dose computations, Instrumentation for emission imaging, Gamma Camera, Single Photon Emission Computerized Tomography, Positron Emission Tomography, Radioactive waste issues, radon gas, emergencies, and wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations 10- discuss basics of the electrical and computer engineering contributions to biomedical engineering. Course topics include: Modeling, recording and automated analysis of the electroencephalogram (EEG). Clinical applications, modeling, recording and automated analysis of the electromyogram (EMG). Clinical applications, modeling, recording and automated analysis of the electrocardiogram (EKG). Clinical applications, modeling of neural networks. Clinical applications and Medical imaging techniques (computerized tomography, magnetic resonance imaging and ultrasonic imaging). 11-explore therapeutic medical devices so that they will be able to contribute in hospitals, industry, and research. Pacemakers and defibrillators, Communication aids, Neural assist devices, Physiotherapy equipments, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Intelligent

		drug delivery, Artificial kidney, Gastrointestinal therapy, Photodynamic therapy, Radiotherapy linear accelerator.
Identify professional problems in the field of specification and propose solutions to them.	Identify problems with artefacts and RT treatment plan propose solutions to them.	1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given 2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology) 3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance. 4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction

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Master professional skills in the field of specification.	master judging and enhancing images quality and RT treatment planning, various mathematical and computational methods	1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given 2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology)

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Use appropriate technology means in his/her professional practice of the	use MS office, reference management software,	12-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights

field of specification.	programming and statistical package software	
Communicate and lead work teams in a systematic, professional manner.	Communicate and lead work teams in presenting research advances on different course topics	12-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights
Take professional decisions in case of available information.	Take professional decisions on how to enhance images and RT data quality, how to choose suitable laser for specific medical application	1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given 2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology) 3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance. 4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy.

		Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance. 6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines.. 7- explore the different imaging modalities used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease. 9-discuss the basics of theory and measurement of radiation as applied to medicine and the laboratory. Topics include: Production of radioisotopes and radiopharmaceuticals, Convolution and Monte Carlo dose computations, Instrumentation for emission imaging, Gamma Camera, Single Photon Emission Computerized Tomography, Positron Emission Tomography, Radioactive waste issues, radon gas, emergencies, and wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations
Use available resources efficiently.	use lab resources in wise and shared way	6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines..

		8- discuss basics of the principles and techniques of electron microscopy. The course is an interactive didactic course. This course covers the following topics: Structure and function of the electron microscope, Tissue preparation for both types of scopes, Freeze fracture, Immunocytochemistry at the EM level, Image analysis, and Photographic techniques and some special applications to include wavelength spectroscopy.Compare between different quantitative analysis techniques of chemical signaling using: Bioelectronics, electron transport and second messenger production. Receptor/Ligand binding and trafficking. Signal transduction and Cellular responses such as adhesion and migration.
Relate his/her studies to community development and environmental preservation.	learn how to contain radiation and bio-waste hazards	4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance 6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines.. 8- discuss basics of the principles and techniques of electron microscopy. The course is an interactive didactic course. This course covers the following topics: Structure and function of the electron microscope, Tissue preparation for both types of scopes, Freeze fracture, Immunocytochemistry at the EM level, Image analysis, and Photographic techniques and some special applications to include wavelength spectroscopy.Compare between different quantitative analysis techniques of chemical

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Act in a manner that reflects a commitment to integrity, credibility, professionality, and accountability.	deliver assignments and participation in class individually or in groups	12-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights
Realize the need for self-development and engaging in continuous learning.	presenting advances and future perspectives in taught topics	12-Discuss the standard methods of preparing experimental research design, the basics of scientific writing, the elementary statistical analysis methods of experimental data and ethics of scientific research, publishing and copyrights

Program Aims vs ILO's Matrix

ILOS Aims	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13
1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given	√												
2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology)		√											
3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance.			√										
4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance.				√									
5-discuss the electrical and computer engineering contributions to biomedical engineering, with particular emphasis given to related on-going departmental research. Course topics include: Background of general human anatomy and physiology, Background of electrophysiology, Modeling, recording and automated analysis of the electroencephalogram (EEG) and bedside clinical applications.					√								

6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines..						√							
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11-explore therapeutic medical devices so that they will be able to contribute in hospitals, industry, and research. Pacemakers and defibrillators, Communication aids, Neural assist devices, Physiotherapy equipments, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Intelligent drug delivery, Artificial kidney, Gastrointestinal therapy, Photodynamic therapy, Radiotherapy linear accelerator.											√		

ILOS Aims	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13
1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given	√												
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ILOS Aims	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17	c18	c19	c20	c21	c22
1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given			√					√														
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ILOS Aims	d1	d2	d3	d4
1-discuss different medical imaging modalities, including: X-rays, Digital Subtraction Angiography, Dual-energy X-ray Absorptiometry, Electron Microscopy, Nuclear Medicine, Clinical Ultrasound, Computed Tomography, Magnetic Resonance Imaging, and Gamma Camera. The physical and mathematical principles involved in the formation of medical images will be presented, along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will	√	√	√	√

be given				
2-discuss the physical and mathematical principals of magnetic resonance imaging. Topics include: Atoms and protons, Longitudinal relaxation forces, Angular momentum and precession, Nuclear Magnetic Resonance, Radio waves and magnetic fields, Transverse relaxation, Spatial localization, Body Tissues, Field Strength, Repetition time and contrast, Flip angle, MRI Spectroscopy, Frequency encoding, Phase encoding, K-space trajectories, Echo-planer imaging, Basic pulse sequence annotation Single slice acquisitions, 2-D multislice acquisitions, 3-D multislice acquisitions.Examine the biological transport mechanism of cell biology include: Convection laws, Diffusion, Active transport, Osmosis, mass and energy which applied in cellular and organ level (e.g. respiratory system and renal physiology)	√	√	√	√
3- discuss the Physics and mathematics of three-dimensional reconstruction techniques in medical imaging: Projection slice theorem, Back-projection techniques, Analytical and iterative reconstruction algorithms, and Numerical methods; applications in X-Ray Computed Tomography and Nuclear Magnetic Resonance.	√	√	√	√
4-dscuss the theory and measurement of radiation as applied to medicine and the laboratory. It covers ionizing sources as used in biology, diagnostic radiology, nuclear medicine, and radiation therapy. Topics include: ICRU definitions of radiation quantities, Radioactivity, Attenuation and scattering of photons and electrons, Interactions with tissue, Radiation equilibrium, and Practical radiation dosimeters, including: ion chambers, diodes, TLD, film, and chemical dosimeters.Recognize Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. Projection slice theorem. Back -projection techniques. Analytical and iterative reconstruction algorithms. Numerical methods. Applications in X-Ray Computed Tomography. Single Photon Emission Computed Tomography, Positron Emission Tomography, Nuclear Magnetic Resonance.	√	√	√	√
5-discuss the electrical and computer engineering contributions to biomedical engineering, with particular emphasis given to related on-going departmental research. Course topics include: Background of general human anatomy and physiology, Background of electrophysiology, Modeling, recording and automated analysis of the electroencephalogram (EEG) and bedside clinical applications.	√	√	√	√
6- discuss the Acoustic-wave propagation in biological materials, Examples of practical medical instrumentation resulting from ultrasound interactions with biological structures, and Ultrasound	√	√	√	√

laboratory equipments. Basics of different types of lasers and their medical use, Differences in their use, Important energy and delivery system concepts for applying these lasers to tissues, Clinical safety precautions, outlined in the ANSI standards for safe use of lasers in health care facilities, are discussed along with recommended medical credentialing guidelines..				
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9-discuss the basics of theory and measurement of radiation as applied to medicine and the laboratory. Topics include: Production of radioisotopes and radiopharmaceuticals, Convolution and Monte Carlo dose computations, Instrumentation for emission imaging, Gamma Camera, Single Photon Emission Computerized Tomography, Positron Emission Tomography, Radioactive waste issues, radon gas, emergencies, and wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations	√	√	√	√
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Program Courses vs Program ILO's Matrix

Course code	ILOS / Courses	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13
1712601	Medical Imaging Biophysics	√												
1712602	Principals of Magnetic Resonance Imaging		√											
1712603	Principals of 3-D Reconstruction in Medical Imaging			√										
1712604	Fundamentals of Radiological Biophysics and Dosimetry - I				√									
1712605	Introduction to Biomedical Engineering – I					√								
1712606	Principals of Ultrasound and Laser Biophysics						√							
1712607	Introduction to Vascular Imaging Techniques							√						
1712608	Basics of Electron Microscopy								√					
1712609	Fundamentals of Radiological Biophysics and Dosimetry - II									√				
1712610	Introduction to Biomedical Engineering – II										√			
1712611	Basics of Therapeutic Medical Devices											√		

Course code	ILOS / Courses	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13
1712601	Medical Imaging Biophysics	√												
1712602	Principals of Magnetic Resonance Imaging		√											
1712603	Principals of 3-D Reconstruction in Medical Imaging			√										
1712604	Fundamentals of Radiological Biophysics and Dosimetry - I				√									

1712605	Introduction to Biomedical Engineering – I					√								
1712606	Principals of Ultrasound and Laser Biophysics						√							
1712607	Introduction to Vascular Imaging Techniques							√						
1712608	Basics of Electron Microscopy								√					
1712609	Fundamentals of Radiological Biophysics and Dosimetry - II									√				
1712610	Introduction to Biomedical Engineering – II										√			
1712611	Basics of Therapeutic Medical Devices											√		

Course code	**ILOS** **Courses**	**c1**	**c2**	**c3**	**c4**	**c5**	**c6**	**c7**	**c8**	**c9**	**c10**	**c11**	**c12**	**c13**	**c14**	**c15**	**c16**	**c17**	**c18**	**c19**	**c20**	**c21**	**c22**
1712601	Medical Imaging Biophysics					√		√	√				√										
1712602	Principals of Magnetic Resonance Imaging																	√					
1712603	Principals of 3-D Reconstruction in Medical Imaging								√														
1712604	Fundamentals of Radiological Biophysics and Dosimetry - I			√																			
1712605	Introduction to Biomedical Engineering – I				√																		
1712606	Principals of Ultrasound and Laser Biophysics									√	√	√											
1712607	Introduction to Vascular Imaging Techniques													√	√								
1712608	Basics of Electron Microscopy		√													√	√		√				
1712609	Fundamentals of Radiological Biophysics and Dosimetry - II			√																			

1712610	Introduction to Biomedical Engineering – II							√															
1712611	Basics of Therapeutic Medical Devices								√														

Course code	**ILOS** **Courses**	**d1**	**d2**	**d3**	**d4**
1712601	Medical Imaging Biophysics	√	√	√	√
1712602	Principals of Magnetic Resonance Imaging	√	√	√	√
1712603	Principals of 3-D Reconstruction in Medical Imaging	√	√	√	√
1712604	Fundamentals of Radiological Biophysics and Dosimetry - I	√	√	√	√
1712605	Introduction to Biomedical Engineering – I	√	√	√	√
1712606	Principals of Ultrasound and Laser Biophysics	√	√	√	√
1712607	Introduction to Vascular Imaging Techniques	√	√	√	√
1712608	Basics of Electron Microscopy	√	√	√	√
1712609	Fundamentals of Radiological Biophysics and Dosimetry - II	√	√	√	√
1712610	Introduction to Biomedical Engineering – II	√	√	√	√
1712611	Basics of Therapeutic Medical Devices	√	√	√	√

ARS vs ILOs Matrix

ILOS / ARS	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13
A1.	√	√											
A.2			√	√									
A3.					√	√							
A4.							√	√					
A5.									√	√			
A6.											√	√	
A7.													√

ILOS / ARS	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13
B1.	√	√											
B2.			√	√									
B3.					√	√							
B4.							√	√					
B5.									√	√			

B6.											√	√	
B7													√

ILOS ARS	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17	c18	c19	c20	c21	c22
C1.	√	√																				
C2.			√	√																		
C3.					√	√																
C4.							√	√														
C5.									√	√												
C6.											√	√										
C7.													√	√								
C8.															√	√						
C9.																	√	√				
C10.																			√	√		
C11.																					√	√

ARS / ILOS	d1	d2	d3	d4
D1 Develop skills in reading	√			
D2- Develop team work.		√		
D3- Use information technology.			√	
D4- Increase written and oral skills.				√

Teaching and Learning Methods Vs Courses Matrix (Degree: Diploma) Code: 1712600

	1709601	*1709602*	*1709603*	*1709604*	*0709605*	*1709606*	*1709607*	*1709608*	*1709609*	*1709610*	*1709611*	1709620	1709620
Lectures	√	√	√	√	√	√	√	√	√	√	√	√	√
Practical sessions	√	√	√	√	√	√	√	√	√	√	√	√	√
Seminars	√	√	√	√	√	√	√	√	√	√	√	√	√
Group discussion	√	√	√	√	√	√	√	√	√	√	√	√	√
Self-learning	√	√	√	√	√	√	√	√	√	√	√	√	√
Brain storming	√	√	√	√	√	√	√	√	√	√	√	√	√