Program SPECIFICATION FOR Master Degree in Medical Biophysics Code: 1712700

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

Program Specification

A- Basic information

1- Program title: Master's degree in medical Biophysics

2- Program type: **single** [√] **double** [ ] **multiple** [ ]

3- Department(s): Medical Biophysics

4- Coordinator: Ass. Prof/ Maisa Elsayed Moustafa

5- External evaluator(s): Prof/ Elsayed Mahmoud Elsayed Solayman

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

B- Professional Information

1- Program aims to

1- Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems

2- Emphasis Tissue engineering theory and principles with cell behavior and morphology, cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs.

3- Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine.

4- Apply theory and measurement of radiation in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations.

5- Apply electrical and computer engineering contributions to biomedical engineering.

6- Discuss biological transport 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).

7- Explain electrical biophysics of nerve and muscle, electrical conduction in excitable tissue, quantitative models for nerve and muscle including the Hodgkin-Huxley equations and bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.

8- Discuss fundamental principles of mechanics applied to the study of biological systems, passive mechanical behaviors of biological materials and measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion

9- Use the physical principals of magnetic resonance imaging and its clinical applications. Also discuss strategies for fast imaging, Clinical MRI techniques and topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient, Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques

10- Compare between 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, single Photon Emission Computed Tomography, Positron Emission Tomography and Nuclear Magnetic Resonance.

11- Recall the biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation

12- Discuss the theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.

13- Illustrate theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of scopes, freeze fracture and image analysis.

14- Use Photographic techniques and some special applications to include energy dispersive spectroscopy (EDS).

15- Apply the therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy, Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography

16- Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.

17- Discuss quantitative analysis of chemical signaling as bioelectronics, electron transport and second messenger production, receptor/Ligand binding and trafficking, signal transduction and Cellular responses such as adhesion and migration.
18- Use systematic approaches to design and conduct scientific research.

2- Intended learning outcomes (ILOS)

a- knowledge and understanding:

a1-Discuss the structure and function for biological macromolecules from a theoretical prospect, intermolecular forces of biomolecular interactions like protein/DNA complexes and energetic of enzymatic reactions.

a2-Discuss tissue engineering theory and principles, different types of stem cells, extracellular matrix biochemistry and cell culture conditions.

a3-Explain the role and bases of mathematical modeling in medicine, bioheat transfer and hyperthermia and artificial neural network modeling and its applications.

a4-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.

a5-Recall basics of biomedical engineering. the principles of electrophysiology.

a6-Discuss the difference between active transport, diffusion and osmosis, mass, and energy transport in biological system.

a7-Discuss the biophysics of nerve and muscle, electrical conduction in excitable tissue and bio-potential mapping.

a8-State the fundamental principles of mechanics applied to the study of biological systems, nonlinear strain in tissues and Arterial flow, motion control mechanisms.

a9-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.

a10-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 .

a11-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.

a12-Discuss hypertension, atherosclerosis, coronary artery, peripheral, and cerebrovascular diseases. in vivo vascular imaging principles and approaches such as flow restriction models.

a13-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.

a14-Explain the working idea for some physical therapy equipment, the artificial kidney and artificial pancreas and the bases of Computerized Tomography, Magnetic Resonance Imaging.

a15-Discuss topics on linear algebra like vectors, matrices, vector spaces, determinants, eigen 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.

a16-Discuss chemical signaling, the quantitative analysis of chemical signaling and receptor/ligand binding and trafficking.

a17-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 different experimental methods used to study properties of biological molecules.

b2- Compare between different tissue engineering processes.

b3- Examine a biomedical system with appropriate mathematical model.

b4- Compare different radio diagnostic and therapeutic modalities.

b5- Evaluate different physical parameters related to image quality and processing.

b6- Compare between the different medical imaging techniques.

b7- Compare the bio-transport mechanisms in living system.

b8- Analyze cardiac electrophysiology.

b9- Calculate both the nonlinear strain in tissues and arterial flow rate.

b10- Analyze different numerical methods in X-Ray Computed Tomography, Nuclear Magnetic Resonance, and positron emission tomography.

b11-Describe the acoustic-wave production and the piezoelectric effects and Laser beam production.

b12-Evaluate the applicability of different vascular imaging techniques based on the anatomical, physiological, and physical parameters.

b13-Compare between column design in transmission and scanning electron microscope and

between different mechanisms of electron beam interaction with specimen.

b14-Examine the functionality of Neural assist devices, Prosthetic joints, Cardiac valves.

b15-Develop mathematical equations to represents a biological system using linear algebra, advanced calculus, ordinary and partial differential equations.

b16-Analyze chemical signaling using bioelectronics.

b17-Differentiate between different methodologies used to carry out scientific research.

b18- Write a thesis protocol using a scientific systemic approach to a research problem.

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-Demonstrate cell culture conditions scaffold preparation techniques.

c4-Employ a computer algorithm to formulate a mathematical model for testing.

c5-Apply the radiation dose and the maximum permissible dose of radiation laws in therapy planning.

c6-Demonstrate the use of low dose electromagnetic magnetic field in medical applications.

c7-Demonstrate the ECG and EMG apparatus in the lab.

c8-Employ mathematical equations to calculate mass and energy in bio transport of biological cell.

c9-Evaluate the electrical conduction in excitable tissue of experimental animals.

c10-Use mathematical equations to evaluate some mechanical parameters of biomaterials.

c11-Use computerized methods to calculate MRI physical parameters.

c12-Use computer programming languages to run analytical and iterative reconstruction algorithms

c13-Demonstrate image processing techniques used in clinical X-ray computed tomography.

c14-Demonstrate the different types ultrasound and laser devices.

c15-Practice the ultrasound and laser experimental procedures used in biomedical research.

c16-Apply equations to calculate laser dose.

c17-Apply mathematical equations to calculate the peripheral blood flow rate using different imaging techniques.

c18-Use computational methods for vascular images processing.

c19-Interpret vascular imaging outcomes and judge vessels health.

c20-Practice the preparation of buffers, fixatives, dehydration embedding resins used in specimen preparation for transmission electron microscopy.

c21-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 .

C22-Demonstrate clinical MRI, clinical linear accelerator and kidney dialysis machine.

c23-Use computer programming languages like FORTRAN and C++ to test algorithms and validate mathematical models.

c24-Demonstrate bioelectronics acquisition of chemical signals.

c25-Use computer software to process the chemical signals harvested by bioelectronics.

c26-Demonstrate cell adhesion and migration using light and electron microscope.

c27-Use the appropriate research methodology to conduct research.

c28-Apply statistical methods to analyze experimental data.

c29-Use the principle of scientific writing to avoid literal mistakes and misrepresentations.

c30-Illustrate the ethical issues related to 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	**ILOs of MSc in Medical Biophysics**
A1- Basic facts, theories, of the specialty and related subjects/ fields	A1. Explore the theoretical understanding of biological macromolecules, intermolecular forces, and enzymatic reactions, as well as tissue engineering principles, stem cell types, extracellular matrix biochemistry, and cell culture conditions. A2. Discus the Mathematical modeling in medicine, bioheat transfer, hyperthermia, artificial neural network applications, radiation types, dose measurements, tissue sensitivity, biological effects, and radiation hazards. A3. Examine the biophysics of nerve and muscle, electrical conduction in excitable tissue, bio-potential mapping, and fundamental principles of mechanics applied to biological systems. A4. Recall the physical principles of magnetic resonance imaging, including relaxation factors, magnetic field gradient, pulse sequences, signal-to-noise ratio, and spatial resolution, and its applications in medical imaging.
A2-Mutual relation between professional practice and effects on environment	A5. Cover the acoustic-wave production, laser beam production, dose calculation, and laser hazard avoidance, as well as hypertension, atherosclerosis, coronary artery, peripheral, and cerebrovascular diseases, and in vivo vascular imaging principles.

A3- Main scientific advances in the field of practice	A6. Provide an overview of transmission electron microscopy, scanning electron microscopy, signal detectors, and their applications in physical therapy equipment, artificial kidneys and pancreas, and computerized Tomography and magnetic resonance imaging.
A4- Fundamentals of ethical & legal practice	A8. Examine the standard methods for experimental research design, the fundamentals of scientific writing, basic statistical analysis techniques, ethics of scientific research, publishing, and copyrights.
A5 -Quality standards of the practice	A7. Discus linear algebra, advanced calculus, differential equations, and chemical signaling, as well as topics like receptor/ligand binding and trafficking, and their quantitative analysis.
A6- Basics and ethics of scientific research	A8. Examine the standard methods for experimental research design, the fundamentals of scientific writing, basic statistical analysis techniques, ethics of scientific research, publishing, and copyrights.
B1- Interpret, analyze & evaluate the information to solve problems	B1. Compare the various experimental methods used to study the properties of biological molecules and different tissue engineering processes. B2. Examine a biomedical system using a mathematical model and comparing various radio diagnostic and therapeutic modalities.
B2- Solve some problems that do not conform to classic data (incomplete data)	B3. Asses and compare various physical parameters related to image quality and processing in medical imaging techniques. B4. Discuss bio-transport mechanisms in living systems and analyzes cardiac electrophysiology.
B3- Integrate different information to solve professional problems	B5. Calculate nonlinear strain in tissues and arterial flow rate using X-Ray Computed Tomography, Nuclear Magnetic Resonance, and positron emission tomography. B6. Discuss the production of acoustic waves,

	piezoelectric effects, and laser beams, and evaluates the effectiveness of various vascular imaging techniques based on anatomical, physiological, and physical parameters.
B4- Conduct a scientific research &/Or write scientific systematic approach to a research problem (hypothesis)	B9. Outline the importance of distinguishing between various scientific research methodologies and developing a thesis protocol using a scientific systemic approach to address a research problem.
B5- Evaluate risks imposed during professional practice	B7. Examine column design in transmission and scanning electron microscopes and electron beam interaction mechanisms with specimens, and examines the functionality of neural assist devices, prosthetic joints, and cardiac valves.
B6- Plan for professional improvement	B8. Create mathematical equations to represent biological systems using linear algebra, advanced calculus, and differential equations, and analyzing chemical signaling using bioelectronics.
B7- Take professional decisions in wide range of professional situations	B9. Outline the importance of distinguishing between various scientific research methodologies and developing a thesis protocol using a scientific systemic approach to address a research problem.
C1- Competent in all basic and some of the advanced professional skills (to be determined according to the specialty board/ department)	C1. Examine methods for calculating protein and nucleic acid concentration, illustrating cell components and tissue types using light and electron microscopes, and demonstrating cell culture conditions and scaffold preparation techniques. C2. Utilize computer algorithms for testing mathematical models, apply radiation dose laws for therapy planning, and demonstrate low dose electromagnetic magnetic field use in medical applications. C3. Demonstrate ECG and EMG apparatus in lab, calculate mass and energy in biological cell biotransport, and evaluate electrical conduction in excitable tissue of experimental

	animals.
C2- Write and appraise reports	C4. Utilize mathematical equations to assess biomaterial mechanical parameters, computerized methods to calculate MRI physical parameters, and computer programming languages for analytical and iterative reconstruction algorithms. C5. Demonstrate image processing techniques in clinical X-ray computed tomography, demonstrate ultrasound and laser devices, and practice experimental procedures in biomedical research. C6. Create mathematical equations to calculate laser dose, peripheral blood flow rate, and use computational methods for processing vascular images. C7. Interpret vascular imaging outcomes, judge vessel health, prepare buffers, fixatives, and resins for transmission electron microscopy specimens, and demonstrate cutting sectioning, staining, support films, and negative staining.
C3-Evaluate methods and tools used in specialty	C8. Demonstrate clinical MRI, linear accelerator, kidney dialysis machine, use programming languages like FORTRAN and C++ for algorithm testing, and demonstrate bioelectronics acquisition of chemical signals. C9. Utilize computer software to process bioelectronics chemical signals, observe cell adhesion and migration using light and electron microscopes, and employ the appropriate research methodology. C10. Emphasize the importance of using statistical methods for experimental data analysis, adhering to scientific writing principles to avoid errors, and discussing ethical issues in scientific research.
D1- Communicate effectively using all methods	D1. Develop skills in reading.

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	D4. Increase written and oral skills.
D4- Share in determination of standards for evaluation of others (e.g.: subordinates/ trainees etc.)	D1. Develop skills in reading. D4. Increase written and oral skills.
D5-Use different sources of information to obtain data	D3. Use information technology.
D6-Work in teams	D2. Develop team work.
D7-Manage time effectively	D3. Use information technology.
D8-Work as team leader in situations comparable to his work level	D1. Develop skills in reading . 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: 2-5 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
Thesis	8 credit hours after finishing 12 credit hours at least

4.b.ii- No. of credit hours	**Lectures**	**20**	**Practical**	**10**	**thesis**	**8**	**Total**		**38**
	Compulsory	**24**	**Elective**	**6**	**Optional**				**0**

4.b.iii- No. of credit hours of specialized courses **No.** **24** **%** **80**

4.b.v- No. of credit hours of other courses **No.** **6** **%** **20**

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

Student is required to pass at least 12 credit hours with CGPA not less than C+ before submitting a thesis proposal.

5- Program Courses

5.1- Compulsory (24)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1712701	Biophysics of proteins and nucleic acids-I	**3**	**2**	**2**
1712702	Fundamentals of tissue engineering -I	**3**	**2**	**2**
1712703	Introduction to mathematical modeling in medical biophysics-I	**3**	**2**	**2**
1712704	Advances in radiological biophysics and dosimetry-I	**3**	**2**	**2**
1712705	Advances in biomedical engineering -I	**3**	**2**	**2**
1712706	Biotransport -I	**3**	**2**	**2**
1712707	Bioelectricity	**3**	**2**	**2**
1712708	Biomechanics	**3**	**2**	**2**
		24	**16**	**16**

5.2- Elective (6)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1712709	Advanced topics in magnetic resonance imaging	**3**	**2**	**2**
1712710	3-D Reconstruction techniques in medical imaging	**3**	**2**	**2**
1712711	Advanced topics in ultrasound and laser biophysics	**3**	**2**	**2**
1712712	Advances in vascular imaging techniques	**3**	**2**	**2**
1712713	Advanced topics in electron microscopy	**3**	**2**	**2**
1712714	Advances in therapeutic medical devices	**3**	**2**	**2**
1712715	Mathematical methods I	**3**	**2**	**2**
1712716	Analysis of chemical signaling	**3**	**2**	**2**
1712717	Journal club in medical biophysicsI	**3**	**2**	**2**
1701720	Biochemistry	**2**	**1**	**2**
1703720	Physiology	**2**	**1**	**2**
1704720	Pharmacology	**2**	**1**	**2**

1706720	Bacteriology	**2**	**1**	**2**
1707720	Parasitology	**2**	**1**	**2**
1709720	Histochemisty and cell biology I	**2**	**1**	**2**
1721720	Medical statistics	**2**	**1**	**2**

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

Lectures

Practical sessions

Seminars

Group discussion

Self-learning

Brain storming

8- Regulations for progression and program completion

1-For the progression and completion of the program to obtain the degree of master's in medical biophysics, the student must complete 30 credit hours with CGPA of at least C+ through courses.

2- Complete 8 credit hours with CGPA of at least C+ through courses.

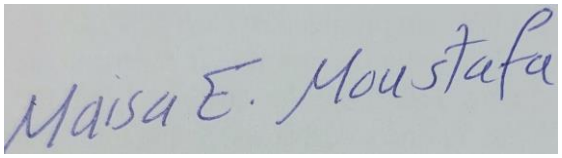
3- Submit a thesis validity report by an examination committee approved by the department council and their members include at least two external examiners.

9- Evaluation of program intended learning outcomes

Evaluator	Tool	Sample
1- Senior students	Questionnaire	All the students
2- Alumni	Questionnaire	NA
3- Stakeholders (Employers)	Meeting	NA
4- External Evaluator(S) External Examiner (s)	Report	**Prof/ Elsayed Mahmoud Elsayed Solayman**
5- Other	NA	NA

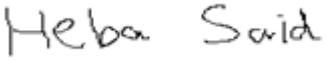
Program coordinator:

Name: Ass. Prof Dr. Maisa Elsayed Moustafa

Signature: 

Department head:

Name: Prof.Dr. Heba Said Ramadan

Signature: 

Date: 29/8/2023

Program Aims Vs Graduate Attribute

Generic Graduate Attributes of NAQAAE	Master Graduate Attribute By the end of this program, graduate should be able to	Program aims
Apply the basics and methodologies of scientific research and using its various tools proficiently.	- Apply the radiation dose and the maximum permissible dose of radiation laws in therapy planning. -Recall the advanced Physics and mathematics of three-dimensional reconstruction techniques in medical imaging. - Recognize the role of biomedical engineering in advancing all of biomedical sciences - Discuss advanced topics on radiation biophysics and dosimetry - Recognize the principals of bioelectricity, biotransport and biomechanics - Recognize the different research methodologies, statistical analyses and	-Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine. Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine. -Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems

	ethical considerations	
Use the analytical methods in the field of specialty	-Use methods for separation and concentration calculation of proteins and nucleic acids. - Employ a computer algorithm to formulate a mathematical model for testing. -Compare between different experimental methods used to study properties of biological molecules. - Calculate both the nonlinear strain in tissues and arterial flow rate.	-Discuss biological transport 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).
Apply specialized knowledge in the field of specialty and integrate it with relevant knowledge in his professional practice.	- Use mathematical equations to evaluate some mechanical parameters of biomaterials - Evaluate different physical parameters related to image quality and processing - Judge the applicability of different image modalities in diseases and organ dysfunction diagnosis - Use computer software to test mathematical models represent some biomedical systems	-Emphasis Tissue engineering theory and principles with cell behavior and morphology, cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs. -Discuss quantitative analysis of chemical signaling as bioelectronics, electron transport and second messenger production, receptor/Ligand binding and

		trafficking, signal transduction and Cellular responses such as adhesion and migration. -Use systematic approaches to design and conduct scientific research.
Demonstrate awareness of current problems and modern visions in the field of specialty	-students must be aware to develop mathematical equations to represents a biological system using linear algebra, advanced calculus, ordinary and partial differential equations which help them in solving problems in a sophisticated manner. - Demonstrate the design and working of some high technology medical therapeutic devices .	-Apply the therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy, Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography . - Illustrate theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of

		scopes, freeze fracture and image analysis.
Identify professional problems in the field of specialty and propose solutions to them.	-Interpret abnormal lab results concerning different diseases in different organs. contrast the applicability of different image modalities in diseases and organ dysfunction diagnosis - differentiate between the suitability of various parameters used in radiotherapy - propose simple solutions to problems in work field like lack of quality and reduced time and cost effectiveness based on principles understanding and recent advances following	-Apply theory and measurement of radiation in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations. -Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.
Master an appropriate of professional skills in the field of including use of technology.	-use different software to present his work and analyze data. -calculate biophysical parameters used in radiotherapy and dosimetry	- Use Photographic techniques and some special applications include energy dispersive spectroscopy (EDS). -Recall the biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of

		lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation
Communicate efficiently and lead work teams.	-Develop team work during seminars and discuss advanced topics about different topics related to their field. - work in a team to solve quizzes and assignments	-Apply electrical and computer engineering contributions to biomedical engineering. -Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.
Take Decision in different professional contexts.	- criticize different scientific methods used in approaching problems	-Discuss the theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.
Employ the available resources to achieve the highest benefit and maintain them.	-analyze available data - use different software to present his work and analyze data	-Use the physical principals of magnetic resonance imaging and its clinical applications. Also discuss strategies for fast imaging, Clinical MRI techniques and topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient,

		Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques
Show awareness of his/her role in community development and environmental preservation in light of global and regional changes.	has basic knowledge about most popular diseases and medical conditions - know about radiation protection measures	-Explain electrical biophysics of nerve and muscle, electrical conduction in excitable tissue, quantitative models for nerve and muscle including the Hodgkin-Huxley equations and bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.
Act in a manner that reflects a commitment to integrity, credibility, professionality, and accountability.	- Examine a biomedical system with appropriate mathematical model. - Demonstrate the design and working of some high technology medical therapeutic devices - be committed to assignments deadlines - be aware of and practice academic ethics	-Discuss fundamental principles of mechanics applied to the study of biological systems, passive mechanical behaviors of biological materials and measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion
Realize the need for self-development and engaging in continuous learning.	-Workshops for the students in order to develop their practical skills - use websites that provide the service of	-Compare between Physics and mathematics of three-dimensional reconstruction techniques in medical imaging, Projection slice theorem, back -

	accessing specialized scientific publications - communicate with faculty members regarding carrier challenges	projection techniques, Analytical and iterative reconstruction algorithms, and numerical methods. Applications in X-Ray Computed Tomography, single Photon Emission Computed Tomography, Positron Emission Tomography and Nuclear Magnetic Resonance. - Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena

Aims vs Program ILO's Matrix

No.	Aim / ILOs	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17
1	Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems	√																
2	Emphasis Tissue engineering theory and principles with cell behavior and morphology, cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs.		√															
3	Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine.			√														
4	Apply theory and measurement of radiation in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations.				√													
5	Apply electrical and computer engineering contributions to biomedical engineering.					√												
6	Discuss biological transport 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).						√											
7	Explain electrical biophysics of nerve and muscle, electrical conduction in excitable tissue, quantitative models for nerve and muscle including the Hodgkin-Huxley equations and bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.							√										
8	Discuss fundamental principles of mechanics applied to the study of biological systems, passive mechanical behaviors of biological materials and measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion.								√									
9	Use the physical principals of magnetic resonance imaging and its clinical applications. Also discuss strategies for fast imaging, Clinical MRI techniques and topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient, Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques.									√								

10	Compare between 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, single Photon Emission Computed Tomography, Positron Emission Tomography and Nuclear Magnetic Resonance.										√							
11	Recall the biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation											√						
12	Discuss the theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.												√					
13	Illustrate theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of scopes, freeze fracture and image analysis.													√				
14	Use Photographic techniques and some special applications to include energy dispersive spectroscopy (EDS).														√			
15	Apply the therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy, Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography															√		
16	Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.																√	
17	Discuss quantitative analysis of chemical signaling as bioelectronics, electron transport and second messenger production, receptor/Ligand binding and trafficking, signal transduction and Cellular responses such as adhesion and migration.																	√
18	Use systematic approaches to design and conduct scientific research.																	

No.	Aim / ILOs	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13	b14	b15	b16	b17	b18
1	Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems	√																	
2	Emphasis Tissue engineering theory and principles with cell behavior and morphology, cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs.		√																
3	Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine.			√															
4	Apply theory and measurement of radiation in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations.				√														
5	Apply electrical and computer engineering contributions to biomedical engineering.					√													
6	Discuss biological transport 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).						√												
7	Explain electrical biophysics of nerve and muscle, electrical conduction in excitable tissue, quantitative models for nerve and muscle including the Hodgkin-Huxley equations and bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.							√											
8	Discuss fundamental principles of mechanics applied to the study of biological systems, passive mechanical behaviors of biological materials and measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion.								√										
9	Use the physical principals of magnetic resonance imaging and its clinical applications. Also discuss strategies for fast imaging, Clinical MRI techniques and topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient, Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques.									√									

10	Compare between 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, single Photon Emission Computed Tomography, Positron Emission Tomography and Nuclear Magnetic Resonance.										√									
11	Recall the biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation											√								
12	Discuss the theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.												√							
13	Illustrate theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of scopes, freeze fracture and image analysis.													√						
14	Use Photographic techniques and some special applications to include energy dispersive spectroscopy (EDS).														√					
15	Apply the therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy, Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography															√				
16	Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.																√			
17	Discuss quantitative analysis of chemical signaling as bioelectronics, electron transport and second messenger production, receptor/Ligand binding and trafficking, signal transduction and Cellular responses such as adhesion and migration.																	√		
18	Use systematic approaches to design and conduct scientific research.																			√

No.	ILOs Aim	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17
1	Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems	√																
2	Emphasis Tissue engineering theory and principles with cell behavior and morphology, cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs.		√	√														
3	Employ of mathematical methods to solve important problems in a wide variety of fields of biology and medicine.				√													
4	Apply theory and measurement of radiation in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations.					√	√											
5	Apply electrical and computer engineering contributions to biomedical engineering.							√										
6	Discuss biological transport 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).								√									
7	Explain electrical biophysics of nerve and muscle, electrical conduction in excitable tissue, quantitative models for nerve and muscle including the Hodgkin-Huxley equations and bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.									√								
8	Discuss fundamental principles of mechanics applied to the study of biological systems, passive mechanical behaviors of biological materials and measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion.										√							
9	Use the physical principals of magnetic resonance imaging and its clinical applications. Also discuss strategies for fast imaging, Clinical MRI techniques and topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient, Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques.											√						
10	Compare between 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, single Photon Emission Computed												√	√				

	Tomography, Positron Emission Tomography and Nuclear Magnetic Resonance.																	
11	Recall the biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation													√	√	√	
12	Discuss the theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.																√

No.	**ILOs** **Aim**	**c18**	**C19**	**C20**	**C21**	**C22**	**C23**	**C24**	**C25**	**C26**	**C27**	**C28**	**C29**	**C30**
12	The theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.	√	√											
13	Illustrate theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of scopes, freeze fracture and image analysis.			√	√									
14	Use Photographic techniques and some special applications to include energy dispersive spectroscopy (EDS).					√								
15	Apply the therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy, Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography						√							
16	Test mathematical and computational methods and concepts are needed in the analysis of a wide range of medical and biological phenomena.							√	√	√				
17	Discuss quantitative analysis of chemical signaling as bioelectronics, electron transport and second messenger production, receptor/Ligand binding and trafficking, signal transduction and Cellular responses such as adhesion and migration.										√	√	√	√
18	Use systematic approaches to design and conduct scientific research.													

No.	Aim / ILOs	d1	d2	d3	d4
1	Survey of definitions and computational methods for the calculation of intermolecular forces, molecular dynamics and protein folding and biophysics and energetics of enzymatic reactions in biological systems	√	√	√	√
2	Tissue engineering theory and principles with emphasis on cell behavior and morphology. Cellular attachment, Extracellular matrix, Tissue organization, Cell culture, Synthetic biomaterials and artificial cells and organs.	√	√	√	√
3	Employment of mathematical methods to solve important problems in a wide variety of fields of biology and medicine	√	√	√	√
4	Theory and measurement of radiation as applied in medicine and the laboratory with emphasis on wide variety of radiation sources from health physics perspective, and Radiation risks and radiation protection guidelines, including international current regulations.	√	√	√	√
5	Introduction to the electrical and computer engineering contributions to biomedical engineering	√	√	√	√
6	The biological transport 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)	√	√	√	√
7	Electrical biophysics of nerve and muscle. Electrical conduction in excitable tissue. Quantitative models for nerve and muscle including the Hodgkin-Huxley equations. Bio mapping potential, Cardiac electrophysiology, and Functional electrical stimulation.	√	√	√	√
8	Fundamental principles of mechanics applied to the study of biological systems. Passive mechanical behaviors of biological materials. Measurement of nonlinear strain in tissues, arterial flow. Mechanical interactions of implants with tissue. Skeletal muscle mechanics. Segmental biomechanics. Control of motion	√	√	√	√
9	The physical principals of magnetic resonance imaging and its clinical applications. Strategies for fast imaging, Clinical MRI techniques. Topics include: Proton environments and T1 relaxation, Transverse magnetization and T2 contrast, Magnetic field gradient, Pulse sequences, Signal-to-noise ratio and spatial resolution, Receiver coils, Magnetic field strength, Gradient echo and spin echo, multi echo techniques	√	√	√	√
10	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.	√	√	√	√
11	The biophysics principals of Ultrasound and lasers, Acoustic-wave propagation in biological materials, Ultrasound laboratory equipment. Basic concepts for a laser, different types of lasers, Laser interaction with biological tissues. Laser in Medicine and Biology and LASER Regulation	√	√	√	√

12	The theoretical background and theory of function of cutting-edge technologies used to image blood vessels, particularly for: Cardiovascular, Cerebrovascular, and Peripheral vessel disease.	√	√	√	√
13	Theory, fundamental and operating principles techniques of transmission electron microscope (TEM) and scanning electron microscopy (SEM). The structure and function of the electron microscopes (TEM, SEM, and STEM), Tissue preparation for both types of scopes, freeze fracture and image analysis.	√	√	√	√
14	Photographic techniques and some special applications to include energy dispersive spectroscopy (EDS)	√	√	√	√
15	The therapeutic medical devices such as Pacemakers and defibrillators, Neural assist devices, Prosthetic joints, Physical therapy equipment, Cardiac valves, angioplasty, Arterial stents, Anesthesia machine and ventilator, Artificial kidney and pancreas, gastrointestinal therapy, Photodynamic therapy,Computerized Tomography, Magnetic Resonance Imaging, Radiotherapy linear accelerator, Gamma Camera, Positron Emission Tomography	√	√	√	√
16	Mathematical and computational methods and concepts needed in the analysis of a wide range of medical and biological phenomena.	√	√	√	√
17	The quantitative analysis 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.	√	√	√	√

Program Courses vs Program ILO's Matrix

Course code	ILOs / Course title	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17
1712701	Biophysics of proteins and nucleic acids-I	√																
1712702	Fundamentals of tissue engineering -I		√															
1712703	Introduction to mathematical modeling in medical biophysics-I			√														
1712704	Advances in radiological biophysics and dosimetry-I				√													
1712705	Advances in biomedical engineering -I					√												
1712706	Biotransport -I						√											
1712707	Bioelectricity							√										
1712708	Biomechanics								√									
1712709	Advanced topics in magnetic resonance imaging									√								
1712710	3-D Reconstruction techniques in medical imaging										√							
1712711	Advanced topics in ultrasound and laser biophysics											√						
1712712	Advances in vascular imaging techniques												√					
1712713	Advanced topics in electron microscopy													√				
1712714	Advances in therapeutic medical devices														√			
1712715	Mathematical methods I															√		
1712716	Analysis of chemical signaling																√	
1712717	Journal club in medical biophysicsI																	√
	Thesis																	

Course code	ILOs Course title	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13	b14	b15	b16	b17	b18
1712701	Biophysics of proteins and nucleic acids-I	√																	
1712702	Fundamentals of tissue engineering -I		√																
1712703	Introduction to mathematical modeling in medical biophysics-I			√															
1712704	Advances in radiological biophysics and dosimetry-I				√														
1712705	Advances in biomedical engineering -I					√													
1712706	Biotransport –I						√												
1712707	Bioelectricity							√											
1712708	Biomechanics								√										
1712709	Advanced topics in magnetic resonance imaging									√									
1712710	3-D Reconstruction techniques in medical imaging										√								
1712711	Advanced topics in ultrasound and laser biophysics											√							
1712712	Advances in vascular imaging techniques												√						
1712713	Advanced topics in electron microscopy													√					
1712714	Advances in therapeutic medical devices														√				
1712715	Mathematical methods I															√			
1712716	Analysis of chemical signaling																√		
1712717	Journal club in medical biophysicsI																	√	
	Thesis																		√

Course code	ILOs / Course title	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16
1712701	Biophysics of proteins and nucleic acids-I	√															
1712702	Fundamentals of tissue engineering -I		√														
1712703	Introduction to mathematical modeling in medical biophysics-I			√													
1712704	Advances in radiological biophysics and dosimetry-I				√												
1712705	Advances in biomedical engineering -I					√											
1712706	Biotransport –I						√		√								
1712707	Bioelectricity							√		√							
1712708	Biomechanics										√						
1712709	Advanced topics in magnetic resonance imaging											√	√				
1712710	3-D Reconstruction techniques in medical imaging													√			
1712711	Advanced topics in ultrasound and laser biophysics														√	√	√

Course code	ILOs / Course title	C17	c18	c19	c20	c21	c22	c23	c24	c25	c26	c27	c28	c29	c30
1712712	Advances in vascular imaging techniques	√	√	√											
1712713	Advanced topics in electron microscopy				√	√									
1712714	Advances in therapeutic medical devices						√								
1712715	Mathematical methods I							√							
1712716	Analysis of chemical signaling								√	√	√				
1712717	Journal club in medical biophysicsI											√	√	√	√
	Thesis														

Course code	ILOs Course title	d1	d2	d3	d4
1712701	Biophysics of proteins and nucleic acids-I	√	√	√	√
1712702	Fundamentals of tissue engineering -I	√	√	√	√
1712703	Introduction to mathematical modeling in medical biophysics-I	√	√	√	√
1712704	Advances in radiological biophysics and dosimetry-I	√	√	√	√
1712705	Advances in biomedical engineering -I	√	√	√	√
1712706	Biotransport –I	√	√	√	√
1712707	Bioelectricity	√	√	√	√
1712708	Biomechanics	√	√	√	√
1712709	Advanced topics in magnetic resonance imaging	√	√	√	√
1712710	3-D Reconstruction techniques in medical imaging	√	√	√	√
1712711	Advanced topics in ultrasound and laser biophysics	√	√	√	√
1712712	Advances in vascular imaging techniques	√	√	√	√
1712713	Advanced topics in electron microscopy	√	√	√	√
1712714	Advances in therapeutic medical devices	√	√	√	√
1712715	Mathematical methods I	√	√	√	√
1712716	Analysis of chemical signaling	√	√	√	√
1712717	Journal club in medical biophysicsI	√	√	√	√
	Thesis				

ARS vs Program ILO's Matrix

No	ILOS / ARS	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
1	A1. Explore the theoretical understanding of biological macromolecules, intermolecular forces, and enzymatic reactions, as well as tissue engineering principles, stem cell types, extracellular matrix biochemistry, and cell culture conditions.	√	√															
2	A2. Discus the Mathematical modeling in medicine, bioheat transfer, hyperthermia, artificial neural network applications, radiation types, dose measurements, tissue sensitivity, biological effects, and radiation hazards.			√	√	√												
3	A3. Examine the biophysics of nerve and muscle, electrical conduction in excitable tissue, bio-potential mapping, and fundamental principles of mechanics applied to biological systems.						√	√	√									
4	A4. Recall the physical principles of magnetic resonance imaging, including relaxation factors, magnetic field gradient, pulse sequences, signal-to-noise ratio, and spatial resolution, and its applications in medical imaging.									√	√							
5	A5. Cover the acoustic-wave production, laser beam production, dose calculation, and laser hazard avoidance, as well as hypertension, atherosclerosis, coronary artery, peripheral, and cerebrovascular diseases, and in vivo vascular imaging principles.											√	√					
6	A6. Provide an overview of transmission electron microscopy, scanning electron microscopy, signal detectors, and their applications in physical therapy equipment, artificial kidneys and pancreas, and computerized Tomography and magnetic resonance imaging.													√	√			
7	A7. Discus linear algebra, advanced calculus, differential equations, and chemical signaling, as well as topics like receptor/ligand binding and trafficking, and their quantitative analysis.															√	√	
8	A8. Examine the standard methods for experimental research design, the fundamentals of scientific writing, basic statistical analysis techniques, ethics of scientific research, publishing, and copyrights.																	√

NO	ILOS / ARS	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18
1	B1. Compare the various experimental methods used to study the properties of biological molecules and different tissue engineering processes.	√	√																
2	B2. Examine a biomedical system using a mathematical model and comparing various radio diagnostic and therapeutic modalities.			√	√														
3	B3. Asses and compare various physical parameters related to image quality and processing in medical imaging techniques.					√	√												
4	B4. Discuss bio-transport mechanisms in living systems and analyzes cardiac electrophysiology.							√	√										
5	B5. Calculate nonlinear strain in tissues and arterial flow rate using X-Ray Computed Tomography, Nuclear Magnetic Resonance, and positron emission tomography.									√	√								
6	B6. Discuss the production of acoustic waves, piezoelectric effects, and laser beams, and evaluates the effectiveness of various vascular imaging techniques based on anatomical, physiological, and physical parameters.											√	√						
7	B7. Examine column design in transmission and scanning electron microscopes and electron beam interaction mechanisms with specimens, and examines the functionality of neural assist devices, prosthetic joints, and cardiac valves.													√	√				
8	B8. Create mathematical equations to represent biological systems using linear algebra, advanced calculus, and differential equations, and analyzing chemical signaling using bioelectronics.															√	√		
9	B9. Outline the importance of distinguishing between various scientific research methodologies and developing a thesis protocol using a scientific systemic approach to address a research problem.																	√	√

No	ILOS / ARS	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30
1	C1. Examine methods for calculating protein and nucleic acid concentration, illustrating cell components and tissue types using light and electron microscopes, and demonstrating cell culture conditions and scaffold preparation techniques.	√	√	√																											
2	C2. Utilize computer algorithms for testing mathematical models, apply radiation dose laws for therapy planning, and demonstrate low dose electromagnetic magnetic field use in medical applications.				√	√	√																								
3	C3. Demonstrate ECG and EMG apparatus in lab, calculate mass and energy in biological cell biotransport, and evaluate electrical conduction in excitable tissue of experimental animals.							√	√	√																					
4	C4. Utilize mathematical equations to assess biomaterial mechanical parameters, computerized methods to calculate MRI physical parameters, and computer programming languages for analytical and iterative reconstruction algorithms.										√	√	√																		
5	C5. Demonstrate image processing techniques in clinical X-ray computed tomography, demonstrate ultrasound and laser devices, and practice experimental procedures in biomedical research.													√	√	√															
6	C6. Create mathematical equations to calculate laser dose, peripheral blood flow rate, and use computational methods for processing vascular images.																√	√	√												
7	C7. Interpret vascular imaging outcomes, judge vessel health, prepare buffers, fixatives, and resins for transmission electron microscopy specimens, and demonstrate																			√	√	√									

	cutting sectioning, staining, support films, and negative staining.																												
8	C8. Demonstrate clinical MRI, linear accelerator, kidney dialysis machine, use programming languages like FORTRAN and C++ for algorithm testing, and demonstrate bioelectronics acquisition of chemical signals.																				√	√	√						
9	C9. Utilize computer software to process bioelectronics chemical signals, observe cell adhesion and migration using light and electron microscopes, and employ the appropriate research methodology.																							√	√	√			
10	C10. Emphasize the importance of using statistical methods for experimental data analysis, adhering to scientific writing principles to avoid errors, and discussing ethical issues in scientific research.																										√	√	√

No	ILOS / ARS	D1	D2	D3	D4
1	D1. Develop skills in reading.	√			
2	D2. Develop team work.		√		
3	D3. Use information technology.			√	
4	D4. Increase written and oral skills.				√

Teaching and Learning Methods Vs Courses Matrix (Degree: Master) Code: 1712700

	701	*702*	*703*	*704*	*705*	*706*	*707*	*708*	*709*	*710*	*711*	*712*	*713*	*714*	*715*	*716*	*717*	*720*
Lectures	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Practical sessions	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Seminars	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Group discussion	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Self-learning	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Brain storming	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√