Department of Radiation Sciences

Program SPECIFICATION FOR Ph.D. Degree in Radiobiology

Code: 1711800

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

Program Specification

A- Basic information

1- Programtitle:Ph.D. in Radiobiology

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

3- Department: **Radiation Sciences Department**

4- Coordinator: **Dr. Ebtsam Rizq Zaher**

5- External evaluator: **Prof. Samir Yousha El-khameesy**

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

B- Professional Information

1- Program aims:

This program aims to:

1. Outline the complete description of the latest knowledge on nuclear and radiation chemistry and their applications.
2. Introduce the effects of radiation and the molecular aspects related to these effects.
3. Apply modern Clinical Nuclear Medicine in both diagnostic and therapeutic applications.
4. Define radiation epidemiology, with a focus on radiation-related cancer.
5. Identify the impact of radioactivity on the environment including; biological impact of radiation, sources of radioactivity, routes of radiation exposure and radiotoxicity.
6. Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks.
7. Summarize the advancements in theory and applications of radiation detection instruments
8. Discuss nuclear generators and nuclear reactors.
9. Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research
10. Conduct research studies that add the existing specialty knowledge

2- Intended learning outcomes (ILOS)

a- knowledge and understanding:

a1- Recall the chemical basis of nuclear reactions.
a2- Review radiation biology of normal and neoplastic tissue systems in terms of the cell cycle and molecular effects.
a3-List modern clinical nuclear medicine applications including imaging, scanning and therapeutic techniques.
a4- Discuss the impact of radioactivity on the environment including; sources of radioactivity, routes of radiation exposure and biological radiotoxicity.
a5- Discuss radiation-induced carcinogenesis as documented by the emerging information from molecular radiation biology, genomic instability, bystander effects, hypersensitivity, and the adaptive response.
a6- Define the molecular effects of radiation on signaling modalities and nucleic acids
a7-Recall dosimeters and dosimetry services for measuring external exposures
a8-Recall types of radiation detectors.
a9- List the types of instruments involved in emergency plans and their role.
a10-Discuss Design, fuel and Uses of the nuclear generator
a11-List uses, types, kinetics and classifications of Reactors and nuclear fuel cycle of a reactor
a12-Discuss descriptive models that explain risk of radiation
a13- Define machines for producing X- and γ-rays, their basic properties and their clinical use.
a14- Describe Radiation Treatment Parameters
a15-Recall new modalities in radiotherapy and calculations for treatment.
a16- Discuss the national and international standards and regulations of radiation protection and monitoring.
a17- Design, conduction and explore publishing of scientific research.

b- Intellectual skills:

b1-Differentiate between Radioelements, Isotopes and Radionuclides.
b2-Classify molecular damage due to radiation and damage detection.
b3-Distinguish thephysical principles of radiotherapy.
b4- Analyze the impact of Radon in sight of Radiation Hormesis and the LNT Model
b5- Compare cancer induction via ionizing vs. non-ionizing radiations
b6-Distinguish radiation damage signaling and repair.
b7- Compare Individual monitoring for external and internal exposures in sight of biological dosimetry of exposure and dose recordings
b8-Distinguish between different theories of radiation detectors.
b9-Analyze data from monitoring devices and record keeping

b10-Distinguish the mode of action and safety aspects of a generator and take decisions in various emergency situations including radiation contamination and nuclear crises.
b11- Compare thermal and non-thermal nuclear reactors, and safety aspects in each.
b12-Analyze the epidemiological link between radiation exposure and cancer
b13- Compare and evaluate radiotherapy simulators and CT simulators.
b14-Distinguish parameters affecting treatment and treatment planning with photon beam
b15- Differentiate between conventional vs. modern modalities of radiotherapy.
b16- Prepare scientific articles/papers to be published in indexed journals.

c- Professional and practical skills:

c1- Practice radioimmunoassays.
c2- Practice the Production of radiolabeled Compounds.
c3- Demonstrate the managing of crises.
c4- Demonstrate the construction and assessment of survival curves.
c5- Illustrate handling of radioactive tracers.
c6- Practice principals of safety lab work.
c7- Interpret radiation effect on scope of Models for Cell Survival.
c8- Illustrate the preparation of samples.
c9- Practice basic principles of lab techniques
c10- Demonstrate DNA extraction and Troubleshooting.
c11- Use various types of radiation detectors.
c12- Demonstrate survey meters calibration.
c13- Practice a complete survey on lab and personnel using radiation detectors.

d- General and transferable skills:

d1- Communicate effectively using scientific language and reasoning
d2- perform self and peer appraisal.
d3- Maintain an open and questioning mind toward ideas and alternative points of view.
d4-Ability to evaluate and solve problems based on scientific evidence
d5- Increase written and oral skills
d6- Utilize communicating skills
d7- Master the access to web sites to perform research or solve problems.
d8- Develop the skill of communication and sharing ideas with professors and colleagues.
d9- Develop team work skills
d10- Use information technology.
D11-Manage scientific meetings and appropriately utilize time

3- Academic standards

3a External references for standards (Benchmarks)

Generic Academic Reference Standards of 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 Council: 15/1/2023

3b Comparison of provision to selected external references

NAQAAE	ARS for PhD in radiobiology
A1-Basic facts , theories, of the specialty and related subjects/ fields	A1- Review the molecular basis of radiation biology of normal and neoplastic tissue systems. A2- Recognize the chemical basis of nuclear reactions.
A2-Mutual relation between professional practice and effects on environment	A3- Identify the impact of radioactivity on the environment including; sources of radioactivity, routes of radiation exposure and biological radiotoxicity.
A3-Recent advances in the field of practice	A4- Review modern clinical nuclear medicine applications including imaging, scanning and therapeutic techniques. A5-Review recent scientific research in the field of radiobiology.
A4-Details of ethical & legal practice	A6- Identify legal and ethical considerations in radiobiology practice and research according to national and international guidelines.
A5 -Quality standards of the practice	A7- Recognize quality standards in handling radioactive materials and production of radiolabelled compounds.
A6- Design, conduction & publishing of scientific research	A8- Design, conduction and explore publishing of scientific research.
A7- Ethical considerations in different types of scientific research	A9- Identify legal and ethical considerations in radiobiology practice and research according to national and international guidelines.
B1- Analyze, deduce, extrapolate & evaluation of information	B1- Understand the link between radiation exposure and cancer B2- Examine descriptive models that explain risk of radiation.

B2- Solve the majority of problems in the specialty according to the available data (complete or incomplete)	B3- Interpret data from monitoring devices in order to assess radiation protection programs in facilities. B4- Examine Individual monitoring for external and internal exposures in sight of biological dosimetry of exposure and dose recordings. B5- Analyze parameters affecting treatment and treatment planning with photon beam
B3- Conduct research studies that add to the existing specialty knowledge	B6- Design, conduct and publish scientific research that adds to the existing knowledge in radiobiology.
B4- Publish scientific articles/ papers (in indexed journals)	B7- Publish scientific articles/papers in indexed journals.
B5- Plan and implement (or supervise implementation of) enhancement & Improvement approaches to practice	B8- Plan for periodic self-enhancement of his/her skills.
B6- Take decisions in various professional situations (including dilemmas & controversial issues)	B9- Take decisions in various emergency situations including radiation contamination and nuclear crises.
B7- Add to the specialty field through creativity & innovation	B10- Add to the specialty field through creativity & innovation
B8- Manage discussions on basis of evidence and proofs	B11- Manage discussions on basis of evidence and proofs
C1- Competent in all basic and all required advanced professional skills (to be determined according to the specialty board/ department)	C1- completely perform radioanalytical procedures taking into consideration radiation lab safety measures.
C2- Write and appraise reports	C2- independently perform radiation surveying for labs and personnel, interpret the obtained readings and construct a plan suitable for any deviation from normal values.
C3-Evaluate *and improve* methods and tools used in specialty	C3- Evaluate the available tools for radiation detection and plan to improve methods for detection.
C4-Use technology to advance practice	C4- Use technology to enforce his knowledge in the field of radiation, analyze data and improve his practice
C5- Plan professional development courses to improve practice and enhance performance of juniors	C5- Plan for enhancing professional practice and improving performance of other radiobiologiests
D1- Communicate effectively using all methods	D1- Communicate effectively using different methods.
D2- Use information technology to improve his/her professional practice	D2- Use information technology to obtain data and improve his/her professional practice.

D3- Teach and evaluate others	D3- Perform self and peer appraisal.
D4- Perform self appraisal & seek continuous learning	D3- Perform self and peer appraisal. D4- To be motivated and able to seek continuous learning and help in teaching others.
D5- Use different sources of information to obtain data	D5- Use different sources of information to obtain data
D6- Work in teams as well as a member in larger teams	D6- Work in a team and understands the responsibilities of a team leader
D7- Manage scientific meetings and appropriately utilize time	D7- Manage scientific meetings and appropriately utilize time

4- curriculum structure and contents

4.a program duration: 3 years on average

Program durations was determined according to the average time needed for student graduation over the last 10 years

4.b Program structure:

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

Semester	**Core Courses**	**Elective Courses**
	No. of hours	**No. of hours**
First semester	**6 CH**	**3 CH**
Second semester	**6 CH**	**3 CH**
Third semester	**6 CH**	

+24 hrs for thesis

4.b.ii- No. of credit hours	**Lectures**	**19**	**Practical**	**5**	**Thesis**	**24**	**Total**		**48**
	Compulsory	**18**	**Elective**	**6**			**Optional**		**0**

4.b.iii- No. of credit hours of specialized courses **No.** **21** **%** **87.5**

4.b.iv- No. of credit hours of other courses **No.** **3** **%** **12.5**

4.b.v- 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 (18 CH)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1711801	Radiation chemistry	3	2	2
1711802	Radiobiology	3	2	2
1711803	Applications of radiation in Medicine	2	2	-
1711804	Environmental Radiation Sciences	2	2	-
1711805	Radiation and cancer	1	1	-
1711806	Experimental Radiobiology	2	1	2
1711807	Assessment of occupational radiation doses	1	1	-
1711808	Radiation Survey Instrumentation	2	1	2
1711809	Contamination Monitoring Instrumentation	2	2	-
	Total	**18**	**14**	**8**

5.2- Elective I (3 CH)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1711810	Generators and radiation power plants	2	2	-
1711811	Nuclear reactors	2	2	-
1711812	Epidemiology of radiations	1	1	-
1711813	Treatment machines for external beam radiotherapy	2	2	-
1711814	External Photon Beam: Physical aspects.	2	2	-
1711815	Clinical treatment planning in external photon beam radiotherapy	2	2	-

5.3- Elective II (3 CH)

Code No.	Course Title	No. of credit hours	No. of hours /week	
			Lecture	Practical
1701820	Biochemistry	3	2	2

1722820	Molecular biology	3	2	2
1721820	Medical statistics	3	2	2
1704820	Pharmacology	3	2	2
1721821	Computer	3	2	2

5.4- Optional – (none)

6- Program admission requirements

Postgraduate students with a M.Sc. in Radiobiology or an equivalent degree.

7- Teaching and Learning Methods:

- Lecture
- Practical
- Brainstorming
- Discussion Groups
- Problem Solving
- Self-Directed Learning
- Project

8- Regulations for progression and program completion

For the progression and completion of the program to obtain the degree of Ph.D. in Radiobiology, the student must:

1. Complete 24 credit hours with CGPA of at least C+ through courses;
2. Complete 24 credit hours with through thesis.
3. Submit a thesis validity report by an examination committee approved by the department council and their members include at least one external examiner.

8- Evaluation of Students enrolled in the program.

Tool evaluation	Intended learning outcomes being assessed
Written	ILOs a&b
Practical	ILOs c

Oral	ILOs a ,b &d
Semester Work	ILOs b& d

Evaluation of the Program

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) or External Examiner (s)	Report	Prof. Samir Yousha El-Khameesy

Program coordinator:

Name: Prof. Ebtsam R. Zaher Signature

Department Head:

Name: Prof. Ebtsam R. Zaher Signature

Date of Department Council Approval: 29 / 8 / 2023

- ***Program Aims vs Graduate Attribute matrix***

Generic Graduate Attributes of NAQAAE	Graduate Attributes of Doctor of Philosophy in Radiobiology	Aims
	By the end of this program, Graduate of Doctor of Philosophy in Radiobiology *should be able to:*	
Master the basics and methodologies of scientific research.	• Review epidemiologic studies concerned with radiation exposure. • Distinguish different experimental research designs.	• Define radiation epidemiology, with a focus on radiation-related cancer. • Employ general scientific skills relating to the systematic

	• Differentiate between experimental models used in radiobiology. • Practice common methods in the field of radiobiology.	approaches and critical analysis of data to design and conduct scientific research • Conduct research studies that add the existing specialty knowledge
Work continuously to add to his/her knowledge in the field of specialty.	• Review the recent updates in different aspects in radiobiology. • Distinguish modern clinical nuclear medicine applications in diagnosis and therapy.	• Introduce the effects of radiation and the molecular aspects related to these effects. • Apply modern Clinical Nuclear Medicine in both diagnostic and therapeutic applications.
Apply the analytical and critical approach to knowledge in the field of specialty and related fields.	• Appraise radiation-induced molecular damage and cancer cell response. • Evaluate different radiation dose-response models in risk assessments.	• Outline the complete description of the latest knowledge on nuclear and radiation chemistry and their applications • Introduce the effects of radiation and the molecular aspects related to these effects.
Integrate knowledge in the field of specialty with related knowledge, deduce and develop relationships between them.	• Apply external and internal dosimetry and assess its impact in treatment planning, environmental exposure, and nuclear contamination, among others. • Appraise the interplay between radiation-induced molecular damage and DNA repair mechanisms in carcinogenesis.	• Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks. • Introduce the effects of radiation and the molecular aspects related to these effects.
Demonstrate a deep awareness of current problems and modern theories in the field of specialty.	• Demonstrate competency and professionality in defining and assessing current challenges in the field of radiobiology, and applying recent updates and modern theories in radiobiology efficiently to face and modulate those challenges.	• Outline the complete description of the latest knowledge on nuclear and radiation chemistry and their applications.
Identify professional problems and find innovative solutions to solve them.	• Analyze and assess problems and challenges that face occupationally exposed individuals and demonstrate exceptional and innovative solutions to solve them.	• Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks.

		• Summarize the advancements in theory and applications of radiation detection instruments
Master a wide range of professional skills in the field of specialty.	• Demonstrate competency in applying RIA, IRMA, and basic lab techniques, radiolabeling, using and calibrating survey meters and dosimeters, and handling radioactive tracers.	• Apply modern Clinical Nuclear Medicine in both diagnostic and therapeutic applications
Develop new methods, tools and methods for professional practice.	• Plan a research design and develop new methodological approaches to face challenges and limitations of practice in different exposure scenarios.	• Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research • Conduct research studies that add the existing specialty knowledge
Use appropriate technological means to serve his professional practice.	• Demonstrate competency in selecting proper survey instruments according to different exposure scenarios.	• Summarize the advancements in theory and applications of radiation detection instruments
Communicate efficiently and lead work teams in various professional scenarios.	• Demonstrate proficiency in writing and speaking in a scientific and technical language in different exposure scenarios. • Demonstrate exquisite time management and teamwork skills in different scenarios.	• Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research • Conduct research studies that add the existing specialty knowledge
Take Decision in light of available data.	• Analyze different exposure scenarios and assess the risk, then accordingly provide an appropriate action plan, disseminate roles and responsibilities, and show insight in taking decisions according to the available data.	• Identify the impact of radioactivity on the environment including; biological impact of radiation, sources of radioactivity, routes of radiation exposure and radiotoxicity.
Employ and develop available resources efficiently and work to find new resources.	• Recall methods of assessment of cell survival and plan for its application through using the available resources, then propose a system to develop such resources efficiently and work to find new ones.	• Introduce the effects of radiation and the molecular aspects related to these effects • Identify the impact of radioactivity on the environment including; biological impact of radiation, sources of radioactivity,

		routes of radiation exposure and radiotoxicity.
Show awareness of his/her role in community development and environmental preservation	• Describe how global and regional changes affect the use and production of radionuclides and assess the doses received by occupationally exposed individuals and how it affects the environment.	• Identify the impact of radioactivity on the environment including; biological impact of radiation, sources of radioactivity, routes of radiation exposure and radiotoxicity. • Discuss nuclear generators and nuclear reactors
Act in a manner that reflects a commitment to integrity, credibility, and professionality.	• Review safety guidelines for working in a facility that uses radiation. • Demonstrate competency and commitment to integrity, credibility, professionality, and accountability during designing and performing radiobiological experiment with paying a great attention to the ethical considerations.	• Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks. • Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research
Commit to continuous self-development and transfer his/her knowledge and experiences to others.	• Use EKB and other online libraries through self-directed learning activities. • Demonstrate proficiency in continuous self-development to cope global scientific and professional trends. • Demonstrate commitment and enthusiasm not only in transferring knowledge and experience to their peers in the field, but also to augment the public awareness about hazards and significance of radiation.	• Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research • Conduct research studies that add the existing specialty knowledge

- ***Ph.D. of Radiobiology Program Aims vs ILO's Matrix***

Program Aims	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13	b14	b15	b16
Provide the candidate with a complete description of the latest knowledge on nuclear and radiochemistry and their applications.	x																	x														
Introduce the effects of radiation and the molecular aspects related to these effects.		x			x	x													x				x									
Highlight modern Clinical Nuclear Medicine in both diagnostic and therapeutic applications.			X											x	x					x										x	x	x	
Present an overview of radiation epidemiology, with a focus on radiation-related cancer.					x																	x							x				
Identify the impact of radioactivity on the environment including; biological impact of radiation,				x																	x												

sources of radioactivity, routes of radiation exposure and radiotoxicity.																															
Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks.							x		x			x				X								x							
Summarize the advancements in theory and applications of radiation detection instruments								x			x		x												x	x					
Introduce nuclear generators and nuclear reactors.										x																	x	x				
9.Employ general scientific skills relating to the systematic approaches and critical analysis of data to design and conduct scientific research																	x														x

Conduct research studies that add the existing specialty knowledge																	x													x

Program Aims	**c 1**	**c 2**	**c 3**	**c 4**	**c 5**	**c 6**	**c 7**	**c 8**	**c 9**	**c 10**	**c 11**	**c 12**	**c 13**	**d 1**	**d 2**	**d 3**	**d 4**	**d 5**	**d 6**	**d 7**	**d 8**	**d 9**	**d 10**	**d 11**
Provide the candidate with a complete description of the latest knowledge on nuclear and radiochemistry and their applications.	x	x			x			x	x															
Introduce the effects of radiation and the molecular aspects related to these effects.				x			x	x		x														
Highlight modern Clinical Nuclear Medicine in both diagnostic and therapeutic applications.		x			x	x																		
Present an overview of radiation epidemiology, with a focus on radiation-related cancer.																								
Identify the impact of radioactivity on the environment including; biological impact of radiation, sources of radioactivity, routes of radiation exposure and radiotoxicity.																								
Illustrate the needs of occupationally exposed workers to have a basic understanding of the risks posed by exposure to radiation and managing these risks.			x								x	x	x											
Summarize the advancements in theory and applications of radiation detection instruments											x	x	x											
Introduce nuclear generators and nuclear reactors.																								
Encourage the acquisition of general scientific skills relating to the systematic assembly, critical analysis, interpretation and discussion of factual information and data.														x	x	x	x	x	x	x	x	x	x	x

- ***Ph.D. of Radiobiology Courses vs Program ILOs matrix***

Courses	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13	b14	b15	B16
1711801 Radiation chemistry	x																	x															
1711802Radiobiology		x																	x														
1711803Applications of radiation in Medicine			x																	x													
1711804 Environmental Radiation Sciences				x												x					x												
1711805 Radiation and cancer					x																	x											
1711806 Experimental Radiobiology						x																	x										
1711807 Assessment of occupational radiation doses							x									x								x									
1711808 Radiation Survey Instrumentation								x																	x								
1711809 Contamination Monitoring Instrumentation									x																	x							
1711810 Generators and radiation power plants										X																	x						
17118011 Nuclear reactors											x																	x					
1711812 Epidemiology of radiations												x																	x				
1711813 Treatment machines for external beam radiotherapy													x																	x			
1711814 External Photon Beam: Physical aspects.														x																	x		

1711815 Clinical treatment planning in external photon beam radiotherapy														x															x	
Thesis																x														x

Courses	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	C13	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	D11
1711801 Radiation chemistry	x	x												x	x	x			x					
1711802Radiobiology			x	x	x	x								x	x	x			x					
1711803Applications of radiation in Medicine														x	x	x		x	x			x	x	
1711804 Environmental Radiation Sciences														x			x		x	x		x		
1711805 Radiation and cancer														x	x	x			x					
1711806 Experimental Radiobiology							X	x	x	x				x	x	x			x		x			
1711807 Assessment of occupational radiation doses																x				x		x	x	
1711808 Radiation Survey Instrumentation											x	x	x	x				x	x				x	
1711809 Contamination Monitoring Instrumentation														x	x					x				x
1711810 Generators and radiation power plants														x			x			x				
17118011 Nuclear reactors																x			x	x				x
1711812 Epidemiology of radiations														x			x				x			
1711813 Treatment machines for external beam radiotherapy														x	x	x								
1711814 External Photon Beam: Physical aspects.														x	x					x				
1711815 Clinical treatment planning in external photon beam radiotherapy															x	x						x	x	

Thesis																							

- ***Ph.D. of Radiobiology Program ARS vs ILO's Matrix***

Program ARS	a1	a2	a3	a4	a5	a6	a7	a8	a 9	a10	a 11	a 12	a 13	a 14	a 15	A16
A1- Review the molecular basis of radiation biology of normal and neoplastic tissue systems.		x														
A2- Recognize the chemical basis of nuclear reactions.	x															
A3- Identify the impact of radioactivity on the environment including; sources of radioactivity, routes of radiation exposure and biological radiotoxicity.				X												
A4- Review modern clinical nuclear medicine applications including imaging, scanning and therapeutic techniques.			x							x	x		x		x	
A5-Review recent scientific research in the field of radiobiology.					X	x						x		x		
A6- Identify legal and ethical considerations in radiobiology practice and research according to national and international guidelines.							x		x							x
A7- Recognize quality standards in handling radioactive materials and production of radiolabelled compounds.			x					x								

Program ARS	b1	b2	b3	b4	b5	b6	b7	b8	b9	b 10	b11	b 12	b 13	b 14	b 15
B1- Understand the link between radiation exposure and cancer		x			X										
B2- Examine descriptive models that explain risk of radiation.		x		x								x			
B3- Interpret data from monitoring devices in order to assess radiation protection programs in facilities.							x	x	x						
B4- Examine Individual monitoring for external and internal exposures in sight of biological dosimetry of exposure and dose recordings.							x		x						
B5- Analyze parameters affecting treatment and treatment planning with photon beam														x	x
B6- Design, conduct and publish scientific research that adds to the existing knowledge in radiobiology. thesis															
B7- Publish scientific articles/papers thesis															
B8- Plan for periodic self-enhancement of his/her skills.															
B9- Take decisions in various emergency situations including radiation contamination and nuclear crises.										x					

B10- Add to the specialty field through creativity & innovation															
B11- Manage discussions on basis of evidence and proofs											x				

Program ARS	**c 1**	**c 2**	**c 3**	**c 4**	**c 5**	**c 6**	**c 7**	**c 8**	**c 9**	**c 10**	**c 11**	**C 12**	**c 13**	**d 1**	**d 2**	**d 3**	**d 4**	**d 5**	**d 6**	**d 7**	**d 8**	**d 9**	**d 10**	**D1 1**
C1- completely perform radioanalytical procedures taking into consideration radiation lab safety measures.	x	x				X			x															
C2- independently perform radiation surveying for labs and personnel, interpret the obtained readings and construct a plan suitable for any deviation from normal values.													x											
C3- Evaluate the available tools for radiation detection and plan to improve methods for detection.											x	x												
C4- Use technology to enforce his knowledge in the field of radiation, analyze data and improve his practice										x														
C5- Plan for enhancing professional practice and improving performance of other radiobiologists																								
D1- Communicate effectively using different methods.														x					x		x			
D2- Use information technology to obtain data and improve his/her professional practice.																				x			x	
D3- Perform self and peer appraisal.															x									

D4- To be motivated and able to seek continuous learning and help in teaching others.																								
D5- Use different sources of information to obtain data																				x				
D6- Work in a team and understands the responsibilities of a team leader																					x	x		
D7- Manage scientific meetings and appropriately utilize time																								x

- ***Ph.D. of Radiobiology Teaching and Learning Methods Vs Courses Matrix***

	1811801	1811802	1811803	1811804	1811805	1811806	1811807	1811808	1811809	1811810	1811811	1811812	1811813	1811814	1811815
Lecture	x	x	x	x	x	X	x	x	x	x	x	x	x	x	x
Practical	x	x				X		x							
Brainstorming	x	x	x	x		X	x	x	x	x		x		x	
Discussion Groups	x	x	x		x	X	x	x		x	x	x	x		x
Problem Solving	x		x									x			
Case Study			x									x			
Self-Directed Learning		x	x	x		X	x	x	x			x		x	
e-learning															
Project	x						x			x			x		x