# Program SPECIFICATION FOR Master Degree in Radiobiology

## Code: 1711700

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

**Program Specification**

## A- Basic information

**1- Programtitle:Master in Radiobiology**

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

**3- Department(s) :Radiation Sciences Department**

**4- Coordinator:Dr.MarwaSamehAbou El-Eneen**

**5- External evaluator(s): 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. Recognize the various routs of exposure to radiation.
2. Define the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics.
3. Recall the basics of classical and molecular radiation chemistry.
4. Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries
5. Recognize the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels.
6. Demonstrate the major applications of radioactive isotopes in the various aspects of life.
7. Relate the nature, types and significance of radioactive waste with its sources and the major methods used for their management
8. Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.
9. Demonstrate the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals.

10. Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.
11. Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders.
12. Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace and environment
13. Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment.
14. Upgrading research interest and abilities.
15. Use systematic approaches to design and conduct scientific research

## 2- Intended learning outcomes (ILOS)

### a- knowledge and understanding:

**a1-**Recall the basic physical and chemical concepts underlying the process of radioactivity.
**a2-** Describe the different ways by which charged particles and photons may interact with matter.
**a3-** Discuss the Effects of low and high doses of radiation on the biological systemat the molecular and subcellular levels.
**a4-** List the industrial, medical, agricultural and environmental uses of radioactive Sources**.**
**a5-** State the components of a radiological monitoring program for contamination control and common methods used to accomplish them.
**a6**-Define dosimetry quantities, units and instruments, maximum permissible and annual dose limits.
**a7**-List methods of radiolabeling, isotopes used for the process, and physical and biological properties of radiolabeled product.
**a8**-Describe a crisis according to the guidelines for Incident Command and Emergency Medical Management**.**
**a9**-Recall the methods of survey for contamination and decontamination for both facilities and personnel.
**a10**- Recall types, sources, packaging and transportation of radioactive waste.
**a11**-List the pathways and sources of radiation in nature and their impact on the environment.
**a12**-Review the environmental and ecological impact of radioactivity.

### b- Intellectual skills:

**b1**-Differentiate between the types of radioactive decay based on their physical and chemical properties and with matter.
**b2**-Differentiate between directly and indirectly ionizing radiation.
**b3**-CompareAcute and Delayed Effects of Ionizing Radiation.
**b4**-Distinguish the different applications of radiation in medical and nonmedical field.
**b5**-Examine the protective measures and the contamination control program applied in the facility**.**

**b6-**Calculate the maximum permissible dose and dose limits for radiotherapy and nuclear imaging patients.
**b7-**Distinguish between occupational and non-occupational dose limits and different types of dosimetry.
**b8-**Compare exposures due to natural sources vs. man-made sources.
**b9-**Distinguish the uses, dosimetry and quality control of radiopharmaceuticals.
**b10**-Criticize an Emergency plane for the facility and personnel**.**
**b11-** Calculate the contamination risk to the environment after application of a waste management plane for the facility.
**b12-**Categorize the methods of internal and external decontamination.
**b13-**Derive the Radioactive Decay Low, activity and half-life Equations.
**b14-**Differentiate between direct and indirect radioimmunoassays.
**b15-** Write a thesis protocol using a scientific systematic approach to a research problem.

## c- professional and practical skills:

**c1**-Solve problems on nuclear binding energy and other quantum mechanical laws.
**c2-** Deduce the radioactive decay law and calculate activity and half-life.
**c3-**Practice radiation measurement using various survey meters and counters as gamma scintillation counter and GM survey meter.
**c4-** Solve problems involving basic units of radiation and radioactivity
**c5-**Calculate Internal and External dose equivalents.
**c6-** Practice how to use shields against penetrating radiations**.**
**c7-**Derive mathematical definitions of radiation exposure and absorbed dose**.**
**c8-S**olve variable dosimetric parameters.
**c9-** Apply the principles of maximum permissible dose and annual dose limits in calculating dose and dose rate for radiotherapy.
**c10-** Construct and use of Decay Tables.
**c11-** Apply Nuclear Counting Statistics.
**c12-** Perform assessment calculations of Radiolabeled Preparation.
**c13-** Apply radioanalytical techniques such as RIA and IRMA.
**c14-** Demonstrate radiolabeled compounds preparation.

### d- General and transferable skills:

**d1-** Communicate Effectively Using Scientific Language and Reasoning.
**d2-** Understand the cumulative nature of scientific knowledge.
**d3-** Maintain an open and questioning mind toward ideas and alternative points of view**.**
**d4-**Enhance students' written and oral skills.
**d5-** Master access to web sites to perform a research or solve problems.
**d6-** Develop team work skills.
**d7-** Use information technology.
**d8-**Evaluate and solve problems based on scientific evidence team work 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 Council: 15/1/2023**

### 3b Comparison of provision to selected external references

| NAQAAE | ARS for master in Radiobiology |
|---|---|
| **A1-Basic facts , theories, of the specialty and related subjects/ fields** | A1. Review the basics underlying the process of radioactivity and radiation kinetics.<br>A2. Recognize the major applications of radioactive isotopes |
| **A2-Mutual relation between professional practice and effects on environment** | A3. Identify the nature, types and significance of radioactive waste.<br>A4. Review the impact of contamination on the environment. |
| **A3-Main scientific advances in the field of practice** | A5. Review the recent industrial, medical and agricultural uses of radioactive sources. |
| **A4-Fundamentals of ethical & legal practice** | A6. Identify basic principles and ethics of scientific research |
| **A5 -Quality standards of the practice** | A7. Recognize quality standards in handling radioactive materials. |
| **A6- Basics and ethics of scientific research** | A6. Identify basic principles and ethics of scientific research. |
| **B1 -Interpret, analyze & evaluate the information to solve problems.** | B1. Assess the risk/benefit ratio of radiation use.<br>B2. Derive dosimetric calculations involving internal and external doses. |
| **B2- Solve some problems that do not conform to classic data (incomplete data)** | B3. Analyze events that require an effective and careful response to a radiological emergency. |
| **B3- Integrate different information to solve professional problems.** | B4. Apply different types of decontamination dealing with each type of accidents for personnel and workplace. |
| **B4- Conduct scientific research &/Or write scientific systematic approach to a research problem (hypothesis).** | B5. Write a thesis protocol using a scientific systematic approach to a research problem. |
| **B5- Evaluate risks imposed during** | B1. Assess the risk/benefit ratio of radiation use. |

| | |
|---|---|
| **professional practice.** | |
| **B6- Plan for professional improvement** | B8. Plan for periodic self-enhancement of his/her skills<br>Provide the student with practical skills of works to enhance his ability in the future employment |
| **B7- Take professional decisions in wide range of professional situations** | B3. Analyze events that require an effective and careful response to a radiological emergency.<br>B4. Apply different types of decontamination dealing with each type of accidents for personnel and workplace. |
| **C1- Competent in all basic and some of theadvanced professional skills ( to be determined according to the specialty board/ department)** | C1. Practice radiation measurement using various survey meters and counters (as gamma scintillation counter and GM survey meter). |
| **C2- Write and appraise reports** | C2. Analyze, interpret and write reports on radioactive decay modes. |
| **C3-Evaluate methods and tools used in specialty** | C3. Enhance the skills of the student in handling radioactive materials.<br>C4. Solve variable dosimetric parameters.<br>C5. Perform assessment calculations of Radiolabeled compounds' Preparation. |
| **D1- Communicate effectively using all methods** | D1. Communicate Effectively Using Scientific Language and Reasoning.<br>D2. Enhance students' written and oral skills. |
| **D2- Use information technology to improve his/her professional practice** | D3.Use information technology in handling data, information retrieval, document preparation, presentation and communication. |
| **D3-Practice self-appraisal and determines his learning needs** | D4.Develop an independent approach to learning as a preparation for continuous professional development |
| **D4- Share in determination of standards for evaluation of others (e.g.: subordinates/ trainees etc.)** | D5. Share in determination of standards<br>for evaluating others (e.g. subordinates, trainees). |
| **D5- Use different sources of information to obtain data** | D6. Master access to web sites to perform a research or solve problems. |
| **D6- Work in teams - Manage time effectively** | D7. Establish working relationship with colleagues, work effectively as a part of a team and develop a culture of disseminating and sharing information with peers. |
| **D7-Work as team leader in situations comparable to his work level** | D8. Work as team leader in situations comparable to his work level |
| **D8-Learn independently and seek continuous learning** | D9. Develop an independent approach to learning as a preparation for continuous professional development |

# 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 | 9 CH | |
| Second semester | 9 CH | 8 CH |
| Third semester | 8 CH | |

**+ 8 thesis hours**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **4.b.ii- No. of credit hours** | **Lectures** | **23** | **Practical** | **7** | **Thesis** | **8** | **Total** | **38** |
| | **Compulsory** | **18** | **Elective** | **12** | | | **Optional** | **0** |

| | | | | |
|---|---|---|---|---|
| **4.b.iii- No. of credit hours of specialized courses** | **No.** | **22** | **%** | **73.4** |
| **4.b. iv- No. of credit hours of other courses** | **No.** | **4** | **%** | **13.3** |

## 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 (18Cr)

| Code No. | Course Title | No. of credit hours | No. of hours /week | |
|---|---|---|---|---|
| | | | Lecture | Practical |
| **1711701** | Radiation physics | **3** | **2** | **2** |
| **1711702** | Basics of Radiation chemistry | **2** | **1** | **2** |
| **1711703** | Mathematics of radioactivity | **2** | **1** | **2** |
| **1711704** | Basics of Radiobiology | **2** | **2** | **-** |
| **1711705** | Applied radiation sciences | **2** | **2** | **-** |

| | | | | |
|---|---|---|---|---|
| **1711706** | Waste management | **2** | **2** | **-** |
| **1711707** | Radiation protection | **2** | **1** | **2** |
| **1711708** | Dose measurements | **2** | **1** | **2** |
| **1711709** | Exposures to radiation | **1** | **1** | **-** |
| | **Total** | **18** | **13** | **10** |

### 5.2- Elective I (4Cr)

| Code No. | Course Title | No. of credit hours | No. of hours /week | |
|---|---|---|---|---|
| | | | Lecture | Practical |
| **1711710** | Radiopharmaceuticals | **2** | **2** | **-** |
| **1711711** | Nuclear medicine | **1** | **1** | **-** |
| **1711712** | Crisis management | **1** | **1** | **-** |
| **1711713** | Decontamination | **2** | **2** | **-** |
| **1711714** | Environmental radiations | **2** | **2** | **-** |

### 5.3- Elective II (8 Cr)

| Code No. | Course Title | No. of credit hours | No. of hours /week | |
|---|---|---|---|---|
| | | | Lecture | Practical |
| **1701720** | **Biochemistry** | **2** | **1** | **2** |
| **1701721** | **Molecular biology** | **2** | **1** | **2** |
| **1721720** | **Medical statistics** | **2** | **1** | **2** |
| **1704720** | **Pharmacology** | **2** | **1** | **2** |
| **1721721** | **Computer** | **2** | **1** | **2** |

### 5.4- Optional – (none)

## 6- Program admission requirements

Graduate students with a M. B. Ch. B of Medicine, B.Sc. of Veterinary, Engineering, science, or Agriculture.

## 7- Teaching and Learning Methods:

Lecture
Practical
Brainstorming
Discussion Groups
Problem Solving
Case Study

Self-Directed Learning
Project
Role playing

**8- Regulations for progression and program completion**

For the progression and completion of the program to obtain the degree of M.Sc. in Radiobiology, the student must

1. Complete 30 credit hours with CGPA of at least C+ through courses
2. Complete 8 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 |

**9- Evaluation of program intended learning outcomes**

| **Evaluator** | **tool** | **Sample** |
|---|---|---|
| 1- Senior students | Questionnaire | All students |
| 2- Alumni | Questionnaire | Selected representatives |
| 3- Stakeholders ( Employers ) | Meeting | Representative sample |
| 4- External Evaluator | Report | Prof. Samir Yousha El-khameesy |

**Program coordinator:**

Name: Dr.Marwa Sameh Abou El-Eneen 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 Master of Science in Radiobiology<br>**By the end of this program, Graduate of Master of Science in Radiobiology *should be able to*** | Aims |
|---|---|---|
| Apply the basics and methodologies of scientific research and using its various tools proficiently. | • Apply the basic physical and chemical concepts of radioactivity to distinguish radiation interaction with matter. | • Define the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics.<br>• Recall the basics of classical and molecular radiation chemistry. |
| Use the analytical methods in the field of specialty | • Recall dosimetry quantities and various monitoring instruments used in the field of radiobiology to evaluate and assess analytically internal and external dosimetry. | • Recognize the various routs of exposure to radiation.<br>• Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries<br>• Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations. |
| Apply specialized knowledge in the field of specialty and integrate it with relevant knowledge in his professional practice. | • Apply the principles and calculations of radiation attenuation using different materials and evaluate its impact on the safety of personnel in various situations of radiation exposure. | • Define the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics.<br>• Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries<br>• Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders.<br>• Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace and environment |
| Demonstrate awareness | • Demonstrate competence in | • Recognize the effects of low and high |

| | | |
|---|---|---|
| of current problems and modern visions in the field of specialty | defining major and current challenges in the field of radiobiology.<br>• Distinguish recent updates in radiobiological techniques or newly developed instruments and clarify how they used to face current challenges. | doses of radiation on the organism and at the cellular and subcellular levels.<br>• Demonstrate the major applications of radioactive isotopes in the various aspects of life.<br>• Relate the nature, types and significance of radioactive waste with its sources and the major methods used for their management<br>• Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.<br>• Demonstrate the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders. |
| Identify professional problems in the field of specialty and propose solutions to them. | • Describe limitations of radiation therapy through highlighting the role of cancer biology and demonstrate exceptional solutions to such a major problem in radiobiology. | • Recognize the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels.<br>• Demonstrate the major applications of radioactive isotopes in the various aspects of life.<br>• Demonstrate the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals.<br>• Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders. |
| Master an appropriate of professional skills in the field of including use of technology. | • Demonstrate competency in applying radioanalytical techniques, optimizing imaging modalities, using shields, and surveying. | Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries<br>• Recognize the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels.<br>• Demonstrate the major applications of radioactive isotopes in the various aspects of life.<br>• Relate the nature, types and significance of radioactive waste with its sources and the major methods used for their |

| | | |
|---|---|---|
| | | management<br>• Demonstrate the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders. |
| Communicate efficiently and lead work teams. | • Demonstrate proficiency in writing and speaking in a scientific and technical language.<br>• Demonstrate exquisite time management and teamwork skills. | • Recognize the various routs of exposure<br>• Upgrading research interest and abilities.<br>• Use systematic approaches to design and conduct scientific research |
| Take Decision in different professional contexts. | • Analyze different exposure scenarios and assess the risk, then accordingly provide an appropriate action plan. | • Recognize the various routs of exposure to radiation.<br>• Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries<br>• Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment. |
| Employ the available resources to achieve the highest benefit and maintain them. | • Recall elements of a radiation protection program and plan for its implementation through using the available resources. | • Recognize the various routs of exposure to radiation.<br>• Recognize the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels.<br>• Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Define the principles and the types of |

| | | |
|---|---|---|
| | | decontamination dealing with each type of accidents for personnel, workplace and environment<br>• Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment. |
| Show awareness of his/her role in community development and environmental preservation in light of global and regional changes. | • Describe how global and regional changes affect the use of radioactive materials and plan a review and audit system for different facilities using radiation to assess their environmental and ecological impact. | • Recognize the various routs of exposure to radiation.<br>• Define the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics.<br>• Recall the basics of classical and molecular radiation chemistry.<br>• Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries<br>• Relate the nature, types and significance of radioactive waste with its sources and the major methods used for their management<br>• Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace and environment<br>• Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment. |
| Act in a manner that reflects a commitment to integrity, credibility, professionality, and accountability. | • Review responsibilities of personnel working in a facility that uses radiation.<br>• Demonstrate competency and commitment to integrity, credibility, professionality, and accountability during decontaminating and reporting different contamination scenarios. | • Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.<br>• Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation.<br>• Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace and environment |

| | | |
|---|---|---|
| Realize the need for self-development and engaging in continuous learning. | • Use the information technology through self-directed learning activities.<br>• Search for updates in the field and propose solutions based on their own research. | • Upgrading research interest and abilities.<br>• Use systematic approaches to design and conduct scientific research |

- ***M.Sc. of Radiobiology Program Aims vs ILOs matrix***

| Program Aims | a 1 | a 2 | a 3 | a 4 | a 5 | a 6 | a 7 | a 8 | a 9 | a 10 | a 11 | a 12 | b 1 | b 2 | b 3 | b 4 | b 5 | b 6 | b 7 | b 8 | b 9 | b 10 | b1 1 | b 12 | b 13 | b 14 | b 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Recognize the various routs of exposure to radiatio. | | | | | | | | | | | | x | | | | | | | | x | | | | | | | |
| 2. Define the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics. | X | | | | | | | | | | | | x | | | | | | | | | | | | | | |
| 3. Recall the basics of classical and molecular radiation chemistry. | X | x | | | | | | | | | | | x | x | | | | | | | | | | | | | |
| 4. Apply the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries | | | x | | | | | | | | | | | | x | | | | | | | | | | | | |
| 5. Recognize the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels. | | | | x | | | | | | | | | | | | x | | | | | | | | | | | |
| 6. Demonstrate the major applications of radioactive isotopes in the various aspects of life. | | | | | | | | | | x | | | | | | | | | | | | | x | | | | |
| 7. Relate the nature, types and significance of radioactive waste with its sources and the major methods used for their management | | | | | | x | | | | | | | | | | | | x | x | | | | | | | | |
| 8. Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations. | | | | | | | x | | | | | | | | | | | | | | x | | | | | | |
| 9. Demonstrate the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals. | | | | | | | | x | | | | | | | | | | | | | | x | | | | | |
| 10. Relate the complex events that require an effective and careful response to a radiological emergency and extensive preparation. | | | | | | x | | | | | | | | | | | | | x | | | | | x | x | | |
| 11. Identify the safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders. | | | | x | x | | | | | | | | | | | | x | | | | | | | | | x | |
| 12. Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace | | | | | | | | | x | | | | | | | | | | | | | | | x | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **and environment** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **13. Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment .** | | | | | | | | | | | x | | | | | | | | | | | | | | |
| **14.Upgrading research interest and abilities.** | | | | | | | | | | | | | | | | | | | | | | | | | x |
| Use systematic approaches to design and conduct scientific research | | | | | | | | | | | | | | | | | | | | | | | | | |

| Program Aims | c 1 | c 2 | c 3 | c 4 | c 5 | c 6 | c 7 | c 8 | c 9 | C1 0 | C1 1 | C1 2 | C 13 | C 14 | d 1 | d 2 | d 3 | d 4 | d 5 | d 6 | d 7 | d 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Introduce the student to the various routs of exposure to radiation.** | | | | | | | | | | | | | | | | | | | | | | |
| **2. Provide the student with the physical basics underlying the process of radioactivity, quantum physics and its implementation in the field of radiation kinetics.** | x | x | x | | | | | | | | | | | | | | | | | | | |
| **3. Provide knowledge of the basics of classical and molecular radiation chemistry.** | | | | x | X | | | | | | | | | | | | | | | | | |
| **4. Introduce the student to the detailed mathematics of radioactive decay, calculation for the assessment of radiolabelled compounds and internal and external dosimetries** | | | | | | | | | | | | x | | x | | | | | | | | |
| **5. Introduce the effects of low and high doses of radiation on the organism and at the cellular and subcellular levels.** | | | | | | | | | | | | | | | | | | | | | | |
| **6. Highlight the major applications of radioactive isotopes in the various aspects of life.** | | | | | | | | | | | | | x | | | | | | | | | |
| **7. Introduce the nature, types and significance of radioactive waste, its sources and the major methods used for their management** | | | | | | | x | x | x | | | | | | | | | | | | | |
| **8. Illustrate all aspects of personal and environmental dosimetry and monitoring for both ionizing and non-ionizing radiations.** | | | | | | | | | | | | | | | | | | | | | | |
| **9. Focus on the basic techniques used for radiolabeling, quality control and clinical uses of the radiolabeled pharmaceuticals.** | | | | | | | | | | | | x | | x | | | | | | | | |
| **10. Introduce the complex events that require an effective and careful response to a radiological emergency and extensive preparation.** | | x | | | | | | | | x | x | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11. Focus on safe and effective use of radioactive materials for the diagnosis of various pathological disease states and for the treatment of some specific disorders.** | | | x | | X | x | | | | | | | | | | | | | | | | |
| **12. Define the principles and the types of decontamination dealing with each type of accidents for personnel, workplace and environment** | | | | | | | | | | | | | | | | | | | | | | |
| **13. Illustrate sources and routes of radioactivity in the environment, environmental surveillance and radiological impact assessment .** | | | | | | | | | | | | | | | | | | | | | | |
| **14.Upgrading research interest and abilities.** | | | | | | | | | | | | | | | x | x | x | x | x | x | x | x |
| Use systematic approaches to design and conduct scientific research | | | | | | | | | | | | | | | | | | | | | | |

- ***.Sc. of Radiobiology Courses vs Program ILOs matrix***

| Courses | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | a9 | a 10 | a 11 | a 12 | b1 | b2 | b3 | b4 | b5 | b6 | b7 | b8 | b9 | b1 0 | b1 1 | b1 2 | b1 3 | b1 4 | B1 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1711701 Radiation physics** | X | | | | | | | | | | | | x | | | | | | | | | | | | | | |
| **1711702 Basics of Radiation chemistry** | X | x | | | | | | | | | | | x | x | | | | | | | | | | | | | |
| **1711703 Mathematics of radioactivity** | | | x | | | | | | | | | | | | | | | | | | | | | | x | | |
| **1711704 Basics of Radiobiology** | | | x | | | | | | | | | | | | x | | | | | | | | | | | | |
| **1711705 Applied radiation sciences** | | | | x | | | | | | | | | | | | x | | | | | | | | | | | |
| **1711706 Waste management** | | | | | | | | | | x | | | | | | | | | | | | | x | | | | |
| **1711707 Radiation protection** | | | | | X | | | | | | | | | | | | x | | | | | | | | | | |
| **1711708 Dose measurements** | | | | | | x | | | | | | | | | | | | x | | | | | | | | | |
| **1711709 Exposures to radiation** | | | | | | | x | | | | | | | | | | | | x | x | | | | | | | |
| **17117010Radiopharmaceuticals** | | | | | | | x | | | | | | | | | | | | | | x | | | | | | |
| **17117011Nuclear medicine** | | | | x | | | | | | | | | | | | | | | | | | | | | | x | |
| **17117012Crisis management** | | | | | | | | x | | | | | | | | | | | | | | x | | | | | |
| **17117013Decontamination** | | | | | | | | | x | | | | | | | | | | | | | | | x | | | |
| **17117014Environmental radiations** | | | | | | | | | | | X | x | | | | | | | | x | | | | | | | |
| **Thesis** | | | | | | | | | | | | | | | | | | | | | | | | | | | x |

| Courses | c1 | c2 | c3 | c4 | c5 | c6 | c7 | c8 | c9 | c10 | c11 | c12 | C13 | C14 | d1 | d2 | d3 | d4 | d5 | d6 | d7 | d8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1711701 Radiation physics** | x | x | x | | | | | | | | | | | | x | x | x | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1711702 Basics of Radiation chemistry** | | | | x | x | | | | | | | | x | | | | | x | x | x | | |
| **1711703 Mathematics of radioactivity** | | x | | | | | | | | x | x | x | | x | x | x | | | | | x | |
| **1711704 Basics of Radiobiology** | | | | | | | | | | | | | | | | | x | | | x | x | |
| **1711705 Applied radiation sciences** | | | | | | | | | | | | | | | x | x | x | | | | | |
| **1711706 Waste management** | | | | | | | | | | | | | | | x | | | x | x | | | x |
| **1711707 Radiation protection** | | | x | | x | x | | | | | | | | | x | | x | x | | | | |
| **1711708 Dose measurements** | | | | | | | x | X | x | | | | | | x | x | x | | | | | |
| **1711709 Exposures to radiation** | | | | | | | | | | | | | | | x | x | | | | | x | |
| **17117010Radiopharmaceuticals** | | | | | | | | | | | | | | | x | | | x | | | x | |
| **17117011Nuclear medicine** | | | | | | | | | | | | | | | | | x | | | x | x | |
| **17117012Crisis management** | | | | | | | | | | | | | | | x | | | x | | | | x |
| **17117013Decontamination** | | | | | | | | | | | | | | | x | x | x | | | | | |
| **17117014Environmental radiations** | | | | | | | | | | | | | | | x | x | | | | | x | |
| **Thesis** | | | | | | | | | | | | | | | | | | | | | | |

- ***M.Sc. of Radiobiology Program ARS vs ILO's Matrix***

| **Program ARS** | **a1** | **a2** | **a3** | **a4** | **a5** | **a6** | **a7** | **a8** | **a9** | **a10** | **a11** | **a12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1- A1.Review the basics underlying the process of radioactivity and radiation kinetics. | x | | | | | | | | | | | |
| A2.Recognize the major applications of radioactive isotopes. | | x | x | x | | | | | | | | |
| A3. Identify the nature, types and significance of radioactive waste. | | | | | | | | | | x | x | |
| A4. Review the impact of contamination on the environment. | | | | | x | x | | | x | | | x |
| A5. Review the recent industrial, medical and agricultural uses of radioactive sources. | | | x | x | | | | | | | x | |
| A6.Identify basic principles and ethics of scientific research. | | | | | | x | | | | | | |
| A7. Recognize quality standards in handling radioactive materials. | | | | | x | | x | x | x | | | |
| A6.Identify basic principles and ethics of scientific research. | | | | | | | | | | | | |

| **Program ARS** | **b1** | **b2** | **b3** | **b4** | **b5** | **b6** | **b7** | **b8** | **b9** | **b10** | **b11** | **b12** | **b13** | **b14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1. Assess the risk/benefit ratio of radiation use. | | x | x | x | x | x | x | x | x | | | | | |
| B2. Derive dosimetric calculations involving internal and external doses. | | | | | | x | | | | | | | | |
| B3. Analyze events that require an effective and careful response to a radiological | | | | | x | | | | | x | x | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| emergencies. | | | | | | | | | | | | | | |
| B4. Apply different types of decontamination dealing with each type of accidents for personnel and workplace. | | | | | x | | | | | x | x | x | | |
| B5- Understand the cumulative nature of scientific knowledge. | | | | | | | | | | | | | | |
| B7- Plan for periodic self-enhancement of his/her skillsProvide the student with practical skills of works to enhance his ability in the future employment | | | | | | | | | | | | | | |

| **Program ARS** | **c1** | **c2** | **c3** | **c4** | **c5** | **c6** | **c7** | **c8** | **c9** | **c 10** | **c 11** | **C 12** | **c 13** | **c 14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1. Practice radiation measurement using various survey meters and counters (as gamma scintillation counter and GM survey meter). | | | x | | | x | | | x | | | | | |
| C2. Analyze, interpret and write reports on radioactive decay modes. | | x | | | | | | | | x | | | | |
| C3. Enhance the skills of the student in handling radioactive materials. | | | | | | x | | | | | | | | |
| C4. Solve variable dosimetric parameters. | x | | | x | | | | x | | | | | | |
| C5. Perform assessment calculations of Radiolabeled compounds' Preparation. | | | | | | | | | | | | x | x | x |

| **Program ARS** | **d1** | **d2** | **d3** | **d4** | **d5** | **d6** | **d7** | **d8** |
|---|---|---|---|---|---|---|---|---|
| D1. Communicate Effectively Using Scientific Language and Reasoning. | x | | | | | | | |
| D2. Enhance students' written and oral skills. | | | | x | | | | |
| D3.Use information technology in handling data, information retrieval, document preparation, presentation and communication. | | x | x | | x | x | X | x |
| D4.Develop an independent approach to learning as a preparation for continuous professional development | | | | | x | | X | |
| D5. Share in determination of standards for evaluating others (e.g. subordinates, trainees). | | | x | | | x | | x |
| D6. Master access to web sites to perform a research or solve problems. | | | | | x | | | |
| D7. Establish working relationship with colleagues, work effectively as a part of a team and develop a culture of disseminating and sharing information with peers. | | | x | | | x | | x |
| D8.Work as team leader in situations comparable to his work level | | | | | | x | | x |
| D9.Develop an independent approach to learning as a preparation for continuous professional development | | | | | x | | X | |

- ***M.Sc. of Radiobiology Teaching and Learning Methods Vs Courses Matrix***

| | **1711701** | **1711702** | **1711703** | **1711704** | **1711705** | **1711706** | **1711707** | **1711708** | **1711709** | **1711710** | **1711711** | **1711712** | **1711713** | **1711714** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lecture | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Practical | **x** | **x** | **x** | | | | x | **x** | | | | | | |
| Brainstorming | x | **x** | x | **x** | x | **x** | **x** | x | x | x | | **x** | **x** | **x** |
| Discussion Groups | x | | x | x | x | | | x | | **x** | x | **x** | **x** | **x** |
| Problem Solving | x | **x** | x | | | x | x | | | | | | **x** | |
| Case Study | | | x | | | | | | | | | | **x** | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Training Workshops | | | | | | | | | | | | | | |
| Self-Directed Learning | x | | x | x | x | | x | x | x | | x | **x** | **x** | |
| e-learning | | | | | | | | | | | | | | |
| Project | | x | | | | | | | x | | | | | |