Department of Physics

College of Education

University of Salahaddin

Subject: Environmental Radiation

Course Book – *For 4rd year Physics Student s*

Lecturer's name: Habeeb Hanna Mansour, PhD

Academic Year: 2023/2024

Course Book

1. Course name	**Environmental Radiation**
2. Lecturer in charge	**Habeeb Hanna Mansour**
3. Department/ College	**Education College- Dept. of Physics**
4. Contact	**e-mail: mansourhabib48@yahoo.com , habeeb.mansour@su.edu.krd** **Tel: (optional)**
5. Time (in hours) per week	**2**
6. Office hours	Wednesday 10:30AM-02:00PM , Thirstday 08:30AM-11:00AM in the my room., other timings I will be available in the . " Advance Nuclear Lab" in College.
7. Course code	
8. Teacher's academic profile	***Educational Qualifications:*** B.Sc. In General Physics , Salahaddin University, College of Education, Department of Physics,1985. M.Sc. In Nuclear Physics, Salahaddin University ,College of Science, Department of Physics,1988.**MSc Research Title** : **Study of Fission Tracks In A Glass Detector And The Detector Characteristics For Measuring Neutron Flux 1988 .** The thesis prepared under supervision Prof. Dr. D.S.SRIVASTAVA.(From India). Ph.D. In Nuclear Physics, Baghdad University , College Of Ebn-al-Haytham for Education , Department of Physics ,2000. **Ph.D. Research Title Design of Long-Tube Technique For Discrimination of Radon (Rn-222) From Thoron (Rn-220) In Building Materials and Soil Gas Using CN-85 Nuclear Track Detector. 2000 .** The thesis prepared under supervision Prof. Dr.Shaker mahmud Al-Jabori. (From Iraqi Atomic Energy) and Prof. Dr. Muayyed G. Yousef (from Baghdad University College of Ebn-Alhaytham Education College.) ***Specialization :*** A- Experimental Nuclear Physics in the Field of Solid State Nuclear Track Detector at MSc Level. B-Experimental Nuclear Physics in the Field of Environmental Radioactive Pollution at PhD Level . ***Academic Degress*** 2011Assis.Prof. of Nuclear Physics

1994 Lecturer of Nuclear physics

1989 Assistant lecturer

1985 Demonstrater **,** Department of Physics, College of Education, Salahaddin University-Erbil Iraq.

From2002 to date, Supervisor of several undergraduate students projects ,and Supervising four M.Sc. Students in the field of environmental radiation pollution , physics department, College of Education, Salahaddin University- Erbil Iraq.

MSc. Student Thesis Titles:

1- Measurement of radon activity concentration in Iraqi-Kurdistan soil by CR-39 plastic track detectors 2004.

2-Study of radon and thoron release from Iraqi- Kurdistan building materials using passive and active methods 2009.

3-Calibration of Diffusion cup for Long Term Radon Activity Concentration Measurement Using CR-39 Plastic Nuclear Track Detectors.2011.

4-Radon-222 and Radium-226 Activity Concentration Measurement in Erbil Governorate Drinking Water Resources Using Active and Passive Detection Methods 2014

PhD student Thesis Titles :

1-Natural Radioactivity and Dose Assessment In Plant Fertilizers Used In Iraqi Kurdistan Region and Its Environmental Impacts
Under Preparation

***Main* field of interest**

Is applied nuclear physics , with special reference to the application and development of nuclear track detectors like glasses, plastics etc, in nuclear reactions , nuclear fission trace element, alpha radiography and measurement analysis of uranium and thorium , of environmental radiation and radon activity concentration using , gamma spectrometry (HPGe and NaI(Tl) , alpha spectrometry (RAD7) and Solid State nuclear track detectors.

Details of Courses Taught for BSc and MSc Students:

Modern Physics, Nuclear Physics, Nuclear Reactor Physics , Electrostatic ,Nuclear Detectors , Electromagnetic Theory, Advance of Electromagnetic Fields ,Advance Statistical Physics, Properties of Matter, Nuclear Tracks In Solids ,Nuclear Electronics , Health Physics,

Classical Mechanics and Environmental Radiation ..

Research Applications

1- **Habib.H.Mansour** , **N.T.Patto and A.z. Al-Abdin** Fission fragment track detection characteristics of Iraqi Soda Lime glass detectors., J- College of Education, V.3,(1993), No.2 .

2- **Habib.H.Mansour** , Radon measuring for the determination of uranium in Iraqi-Soda lime glass by track method ., J. College of education, V.3, 1993 No.4

3- **Habib.H.Mansour, Sherzad A.T. and S.R.hussen** , Annealing of latent fission fragment tracksin Iraqi soda lime glass detector., J. College of Education,V.4, No.4,1993.

4- **Habib.H. M., S. per Khdar, H.Y. Abdulla, N.Q. Muhamad, M.M. Othman, S. Qader** . Measurements of Indoor Radon levels in Erbil Capital Using Solid State Nuclear Track Detectors .Radiation Measurement 40 (2005) 544-547 www.Sciencedirect.com

5-**Habib H.M.**," On Depleted Recycled Uranium and its Impact on Environment

"Report Prepared During Visit to Abdus Salam International Centre for Theoretical Physics From 19th January to 8th April 2006.

6- **Asa'd H., Habib H. M** ,Measurement of radon activity concentration in Iraqi- Kurdistan soil by using CR-39 plastic track detectors. Zanko J. of pure and applied sciences 2004.

7-**Habib H. M.** Measurement of radon permeability through some commercial PVA- sponge . Zanco Journal of pure and applied sciences/ Salahaddin University –Hawler Vol. 19 No.3 2008.

8-**Habib H.M**. Measurement of Radium Concentration and Radon Exhalation Rate in Iraqi Kurdistan Rocks Type Limeston Using LR-115 Plastic Track Detectors. Zanko, J. of pure and applied sciences. Vol.22, No.3, 2010.

9- Samal. S. Faki and **Habib H. Mansour ,**Calibration of a permeable cup provided with CR-39 nuclear track detectors for indoor radon activity concentration measurement , 4th ICOWOBAS-RAFSS 2013,JohorBahru,Malaysiak,3-5September 2013.

10- Hiwa H. Azeez , Samal S. Faki , & **Habeeb H. Mansour ,** Radon Activity Concentration Measurement In Erbil Typical Schools. , 2nd International Conference on Ecology, Environment and Energy(ICEEE 2015), 12-13 April, 2015 by Ishik and Salahaddin Universities Erbil-Iraq.

11- Hiwa H. Azeez and **Habeeb H. Mansur**,A Study of Radon Gase Release from Iraqi-Kurdistan Building Materials Using Passive and Active Methods. 2nd International Conference on Ecology, Environment and Energy(ICEEE 2015), 12-13 April, 2015 by Ishik and Salahaddin Universities Erbil- Iraq.

12- Saman K. Ezzaddin , **Habeeb H. Mansour** and Hewa H. Azez , An Investigation of Activity concentration of 238U,232Th, 137Cs and 40K Radionuclides in Drinking water resources in Iraqi Kurdistan Region. Accepted for publication in Zanko Journal of Pure and Applied Sciences 2016.

13- Ali H. Ahmed, **Habeeb H. Mansour**, Saman K. Ezzulddin, Ahmed I. Samad , Radon (222) Content in Bottled Water of Kurdistan Region using Active and Passive Methods, Accepted for publication in Zanko Journal of Pure and Applied Sciences 2016.

14- Saman K. Euzzaddin and **Habeeb H. Mansour** , Assessment of Radon Exposure in Erbil Drinking Water Resources, Zanko J.ournal of Pure and Applied Physics ZJPAS (2017), 29 (s4); s184.

15- Hiwa H. Azeez ,Saddon T. Ahmad and **Habeeb Hanna Mansour**, Assessment of radioactivity levels and radiological-hazard indices in plant fertilizers used in Iraqi Kurdistan Region. Journal of Radio analytical and Nuclear Chemistry, September 2018, Volume 317, Issue 3, pp 1273–1283**.** **https://link.springer.com/article/10.1007/s10967-018-6001-3**

16- Hiwa H. Azeez, **Habeeb Hanna Mansour**, S. T. Ahmad, Transfer of natural radioactive nuclides from soil to plant crops. Journal of Applied Radiation and Isotopes, Volume 147 May 2019, Pages 152-158. https://doi.org/10.1016/j.apradiso.2019.03.010

17- Hiwa H. Azeez**1**, **Habeeb Hanna Mansour**, Saddon T. Ahmad**,**

Effect of Using Chemical Fertilizers on Natural Radioactivity Levels

in Agricultural Soil in the Iraqi Kurdistan Region *Pol. J. Environ.*

Stud. Vol. 29, No. 2 (2020), 1-10

18- Saman Khabbat Ezzulddin · **Habeeb Hanna Mansour**, Radon and radium activity concentration measurement in drinking water resources in Kurdistan Region-Iraq. Journal of Radioanalytical and Nuclear Chemistry (2020) 324:963–976.

19- Jahfer M. Smail · Saddon T. Ahmad · **Habeeb Hanna Mansour,** Estimation of the natural radioactivity levels in the soil along the Little

Zab River, Kurdistan Region in Iraq. Journal of Radioanalytical and Nuclear Chemistry https://doi.org/10.1007/s10967-021-08064-5

20- Ari I Muhammad, **Habeeb H. Mansour**, 222Rn Activity Concentration Measurement and Its Radiological Risks in the Environment of Barserin Village, Erbil-Iraq. Zanko Journal of Pure and Applied Science 2022. https://doi.org/10.21271/ZJPAS.34.2.2,.

21- Hindreen R. Awlla, **Habeeb H. Mansour**, Evaluation of Radon (^{222}Rn) Exhalation Rates from Imported Granite Tiles Used as a Building Materials in Erbil Governorate, Kurdistan Region -Iraq. Zanko J.ournal of Pure and Applied Physics 2023.

22-- Jahfer M. Smail ,**Habeeb Hanna Mansour** & Saddon T. Ahmad , Evaluation of radiological hazards in lower zab river sediments. Radiation Effects and Defects in Solids , Received 26 Apr 2023, Accepted 27 Jul 2023, Published online: 10 Aug 2023

23-Jahfer M. Smail, Hiwa H. Azeez, **Habeeb H. Mansor** and Saddon T. Ahmad, Radon Activity Concentration Measurements in the Water Collected from the Lower Zab River in the Kurdistan Region of Iraq. ARO-The Scientific Journal of Koya University Vol. XI, No. 1I (2023), Article ID: ARO.11192. 08 pages Doi: 10.14500/aro.11192

24-Hiwa Hamad Azeez, Jahfer Majeed Smail, Hemn Muhammad Salh, Habeeb Hanna Mansour, Saddon Taha Ahmad, Comparative Study Between Virgin and Agriculture Soil Radon Activity Concentration and Their Radiological Risks. **. https://doi.org/10.59341/2707-7799.1802 2707-7799/© 2024, Erbil Polytechnic University. This is an open access article under the CC BY-NC-ND 4.0 Licence (https://creativecommons.org/licenses/by-nc-nd/4.0/).**

ResearchUnder Preparation

1-Effects of Stirring on the Bulk Etch Rate of CN-85 Nuclear Plastic Track Detectors .

2- Natural Radioactivity and the Radiation Dose Levels In Cigarettes Available In Iraqi Kurdistan Markets Using Passive and Active Methods.

	3- Assessment of Radiation Dose Due to Exposure to Radon in Different Café Rooms and Indoor Cigarette Smoking Using Solid State Nuclear Track Detectors. 4- A Study of Seasonal Variation in Radon Concentrations in Iraqi Kurdistan Drinking Water Resources Using RAD7 Solid State Detector ***<u>Membership of Professional Bodies</u>*** Member of Iraqi Physics and Mathematics Society. Member of Iraqi-Kurdistan Physics Society **<u>Foreign research institutes visited</u>** ICTP -Trieste/ Italy , Elletra, Synchrotron Radiation , Padova , Ion beam accelerators , Trieste University/ Dept. of Physics (
9. Keywords	Environment , Ionization Radiation , Non ionization radiation ,Radioactivity , Radiation Dose , Dosimeters , Radiation Protection , Radioisotope's , Gamma Ray , X-Ray , Alpha Particles , Beta Particles , Neutron , Environmental Isotopie's , Uranium , Thorium , Americium , Cobult-60 , strontium, uses of radioisotopes, nuclear reactors , radioactive west , NORM , radioactive therapy and diagnostic , biological effects, Radioactive pollution, Radiation Protection , Micro wave, Ultraviolet wave, --------- **.**

10. Course overview:

- In these two courses we will discuss about the ionization and non-ionization radiations which are the cause of radioactive pollution. These radiations (natural or man-made) emitted by radioactive decay of unstable heavy atoms nuclei. Exposure of these radiations can cause damage to living cells and environment.
- Concern for radioactive pollution increased after the discovery of artificial radioactivity, development of nuclear weapons and installation of nuclear reactors for generating electricity.
- In these two courses also, we shall discuss the possible threat to human health and environment due to nuclear radiations both from natural and anthropogenic (man-made) sources.

11. Course objective:

1- Provide a basic understanding of ionizing and none ionizing radiations. Includes x-rays, gamma rays, alpha particles, beta particles, neutrons, microwave, radar wave, laser and the varieties of cosmic rays and how it interacts.
2-Introduce basic concepts of radiation and radioactivity.
3-How radiation doses are calculated and measured.
4-list various radioactive sources used in medical therapy and diagnostic, nuclear power generation and in industry.

5-Understanding of the principles of radiation protection, their origin and applications. This will provide a tool for evaluating possible dangers in the use of ionizing radiation.
6-Understanding the biological consequences and hazards of ionizing radiation exposure.
7- Account for the release of radioactive products resulting from nuclear waste, nuclear accidents and from therapy and diagnostic radiology.
8-Enumerate the ill-effects of radioactive radiation on human body
.

12. Student's obligation

Homework Assignments:

Every chapter end homework problems will be assigned. Problems are to be returned on the date indicated. Problems returned after the deadline will receive a grade of zero (0). Solution to the home work problems will be given in the discussion sessions in the class room .

You are encouraged to work together with follow students to discuss home work concepts, and you are allowed to work out the solutions together.. Be aware that , when working together with a fellow student , you should actually attempt to solve the problems together , not just copy answers and solutions .Home work will count for 5% of the final grade.

Class room activity: 5%

Examinations

There will be two closed book test exams , given only on the dates shown in the syllabus, each lasting an entire class period , and each counting %15 OF THE FINAL GRADE . The exams will consist of various types of questions as well as problems.

The final exam will be given only on the date shown in the syllabus .It will consist of multiple choice questions as well as short questions and problems addressing all the material covered in the course. Final Exam will count for 60% of the final grade.

13. Forms of teaching

Lectures will be given using data show and power point, by writing on the white board, and also on the chalk board

14. Assessment scheme

Homework	**5%**	
Class room activity	**5%**	
1st Test.	**15%**	
2nd TEST	**15%**	
Final Exam.	**60%**	
Total	**100%**	

16. Course Reading List and References:

Textbooks:

1. Nuclear Physics " Principle and Application" John Lilley.
2. Radioactivity " Introduction and History " Michael F.L.
3. Nuclear Physics , D.C. Tayal (Ch.2 , Ch.3 , Ch.14 , Ch.15, Ch.16).

17. The Topics:	**Lecturer's name**
Chapter One : Origin and Nature of Radiation 1-1 The Discovery of Radiation 1.2 Basic of Radiation. 1-2-1 X-Ray 1-2-2 Gamma Ray 2-2-3 Alpha particles 2-2-4 Beta particles	

2-2-5 Neutrons

1-3 Natural Decay Law

1-4 Units of Activity

1-5 Radioactivity Decay Schemes

1-6 Classification of radiation

1-6-1 Types of Directly Ionizing Radiation

1-6-2 Types of Indirectly Ionizing Radiation

1-7 Radioactive Pollution and Their Sources

1-7-1 Natural Sources of Radioactivity

1-7-2 Anthropogenic Sources of Radioactivity

- **Chapter Two : Interaction between radiation and matter**

2-1 Basic Concepts of Interaction of photons with matter

2-1-1 Photoelectric Effect

2-1-2 Compton Scattering

2-1-3 Pair Production

2-2 Neutral particle : Neutron scattering

2-2-1 Elastic Scattering

2-2-2 Inelastic scattering

2-2-3 Neutron Capture

2-3 Photon beam attenuation

2-4 Interactions Of Particulate Radiation With Matter.

2-5 Range of charged particles in matter

2-6 Linear Energy Transfer

Chapter three : Radiation Exposure and Dose

3-1 Dosimetry Units

3-2 Dose Equivalent

3-3 Effective Dose

3-4 Absorbed Dose

3-5 Relation between absorbed dose and Exposure

3-6 ALARA Techniques

Chapter Four : Biological Effects and Risks of Ionizing Radiation

4-1 Damage from Radiation.

4-2 Factors Determining Damage.

4-3 Biological Organization

4-3-1 Biological Organization: Cell

4-4 Radiosensitivity.

4-5 Factors Affecting Radiosensitivity.

4-5-1 Organ / Tissue Radiation Effects

4-6 Radiation Effects on Humans.

4-6-1 Radiation Type.

4-6-2 Portion of Body Exposed.

4-6-3 Rate of Exposure.

4-6-3-a Chronic Exposure.

4-6-3-b Acute Exposure.

4-7 Linear Energy Transfer (LET)

4-7-1 Relationship between RBE and LET.

4-7-2 Typical Linear Energy Transfer Values.

4-8 Radiation Damage Mechanisms

4-8-1 Direct Action

4-8-2 Indirect Action

4-9 Action of Radiation at the Biological Level.

4-10 Biological effects of high dose of radiation.

4-11 The risk assessment of Radiation.

Chapter Five : Radiation Protection

5-1 EXTERNAL RADIATION PROTECTION

5-1-1 Time

5-1-2 Distance

5-1-2-a The Inverse Square Law

5-1-2-b Gamma Constants

5-1-2-c Gamma Exposure Rate Formula

5-1-3 Shielding

5-1-3-a Alpha and Beta Radiation

5-1-3-b X- and Gamma Radiation

5-1-3-c Half Value Layer

5-1-4 Posting and Labelling of Radioactive

5-1-4-a Cautionary Signs

5-1-4-b Department of Transportation

Warning Labels

5-1-5 ALARA (As Low As Reasonably Achievable)

5-2 INTERNAL RADIATION PROTECTION

5-2-1 Radioactive Materials in the Body

5-2-2 Guidelines

5-2-3 Limits

5-2-4 Internal Exposure Monitoring

5-3 The ICRP and Radiation Protection

5-4 Techniques Used to Decrease the amount of Radiation

Chapter Six : Detecting Ionising Radiation

Radiation Dosimeters

6-1 what is dosimeter.

6-2 Properties of dosimeters :

6-2-1 Accuracy and Precision.

6-2-2 Linearity.

6-2-3 Dose rate.

6-2-4 Energy.

6-2-5 Directional.

6-2-6 Spatial resolution .

6-3 Dosimeter types:

6-3-1 Ionization chamber dosimetry systems

6-3-2 Film dosimetry

6-3-3 Luminescence dosimetry

6-3-4 Semiconductor dosimetry

6-4 Dosimetry Applications

Chapter Seven : Radiation in Our Environment 1- Uranium. 2- Thorium. 3-Radium. 4- Potassium . 5-Amerishium. 6-Poloinum 210.	
18. Practical Topics (If there is any)	
In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture	Lecturer's name ex: (3-4 hrs) ex: 14/10/2015

19. Examinations: There will be three <u>closed book test exams</u> , given only on the dates shown in the syllabus, each lasting an entire class period , and each counting %15 OF THE FINAL GRADE . The exams will consist of various types of questions as well as problems.

<u>The final exam</u> will be given only on the date shown in the syllabus .It will consist of multiple choice questions as well as short questions and problems addressing all the material covered in the course. Final Exam will count for 60% of the final grade.

Type of Examinations:

1. Compositional:

For soft body tissue the average ionization energy is ≈36.5 J/C.
The absorbed dose for 1 R exposure would be therefore:
$D = 9.5 \cdot 10^{-3}$ Gy = 0.95 rad.

EXAMPLE What is the absorbed dose you receive by working for 2 hours at an average distance of 50 cm from a A=100 μCi ^{22}Na source?

$$ER = \frac{\Gamma}{d^2} \cdot A$$

$$ER = \frac{12}{50^2} \cdot 0.1 = 0.48 \frac{mR}{h}$$

After two hours the exposure is 0.96 milliRoentgen.

This corresponds to an absorbed dose of

$D = 0.96 \cdot 10^{-3} \cdot 9.5 \cdot 10^{-3}$ Gy $= 9.12 \cdot 10^{-6}$ Gy = 0.912 mrad

2. True or false type of exams:

Manmade sources of radioactive sources are produced by introducing an extra neutron to the atom of the source material .

3. Multiple choices:

Which two types of radiation-matter interactions account for the majority of attenuation in typical industrial radiography?

- Compton Scattering and photoelectric absorption
- Compton Scattering and pair production
- Pair production and photoelectric absorption
- None of the above

20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

21. Peer review پێداچوونەوەی هاوەڵ

This course book has to be reviewed and signed by a peer. The peer approves the contents

of your course book by writing few sentences in this section.
(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).
ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەڕۆکی کۆرسەکە و واژووی لەسەر بکات.
هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.