Department: Chemistry

College: Education

University: Salahaddin

Subject: Radiation Chemistry

Course Book: *Stage* 3; Second semester

Lecturer's name: Khozan A. Haji

Academic Year: 2022-2023

Course Book

1. Course name	Nuclear Chemistry
2. Lecturer in charge	Dr.Khozan A. Haji
3. Department/ College	Chemistry/ Education
4. Contact	e-mail:khozan.haji@su.edu.krd
5. Time (in hours) per week	Theory: 4
6. Office hours	Thursday 10.5am – 12.5 pm or by appointment
7. Course code	
8. Teacher's academic profile	I graduated from the College of Education, Department of Chemistry in 1997 and got a bachelor's degree BSc in chemistry. After that. I then started to study MSc/Analytical Chemistry in 1998 at Salahaddin University. After finishing my MSc study in 2000, I worked in Collage of Education / Chemistry department, as an assistant lecturer. The teaching experience is practical in the analytical Physical, Industrial &Organic Chemistry. Finally, I received my PhD-Physical Chemistry in the same University in 2015. My academic and research program interest focus on Kinetic study; I have more than 4 published articles and going to publish some other articles.
9. Keywords	**Kinetic study, chalcones, spectrophotometry, bromination, rate of reaction.**

10. Course overview:

This course covers the nuclear reactions brought about by absorption of slow neutrons or by radioactive decay, and the chemical effects produced in a system by the absorption of ionizing radiation, alpha-, and beta-particles and gamma- and x-rays. Sources of radiation, collision of high energy radiation with electrons in matter, differences between photochemistry and radiation chemistry (solvent-oriented), the formation of ions and free radicals along the radiation tracks and the diffusion and chemical reaction kinetics of ions and free radicals are described at an introductory level. Nuclear reactors, accelerators, medical radioisotopes and other applications of nuclear technologies are also described.

11. Course objective:

To know the changes that occur inside the nucleus due to the emission of alpha or beta rays, or even neutrons, and the interactions that occur due to high-energy photons such as X-rays and gamma rays with matter.

12. Student's obligation

The student attendance in class two hours a week, preparation of the home works examinations and participate in the discussion in the classroom.

13. Forms of teaching

Different forms of teaching will be used to reach the objectives of the course: Direct questions, Quizzes, Discussion and conclusions. Power point presentations

14. Assessment scheme

Exams: There will be one closed book exams given throughout the semester.
The test will be to take 90 minutes. Which carry out 40 degrees, they considered = 40%.

Final Exam: The Final Exam is Comprehensive in all course outlines. Carry out 60% degrees of the grade.

15. Student learning outcome:

The student learns the dangers of using radioactive materials and also their use in various fields such as energy, medicine, industry, agriculture and others

16. Course Reading List and References:

1- **A. Mozumder, "Fundamentals of radiation chemistry**
2- **G. Friedlander, "NUCLEAR AND RADIOCHEMISTRY**
3- **W. D. LOVELAND, " Modern Nuclear chemistry"**

17. The Topics:	Lecturer's name
. First week Radiation chemistry (definition) WHAT ARE ISOTOPES? What are isotones? What are isobars? Second week Types of Radioactive decay & Nuclear Reaction Third week RATE OF RADIOACTIVE DECAY Fourth week THE ACTIVITY OF A RADIOACTIVE SUBSTANCE Fifth week Solving mathematical questions Sixth week RADIOACTIVE DATING	Dr.Khozan A. Haji 2 hours

Seventh week Types of radiometric dating Eighth week Types and sources of radiation Ninth week Accelerators Tenth week Neutron Sources Eleventh week How Do X-Rays work? Properties of X-Rays Types of X-Rays X-Rays Uses Twelfth week Detection and measurement of radioactivity: Thirteenth week Interaction of Gamma Radiation with Matter Fourteenth week Interaction of Neutrons with Matter Fifteenth week FOOD IRRADIATION	

19. Examinations:

Q1// Choose the best answer: **(5M)**

1- Radium decays by α-emission to form a new element --------.

a) Th b) Rn c) U d) Po

2- An example of ------ is the conversion of lead to bismuth.

a) beta absorption b) electron capture c) beta decay
d) fission reaction

3- A ---------- is a quantity of radioactive material decaying at the same rate as 1 g of Radium (3.7×10^{10} dps)(disintegrations/second).
a) Rutherford b) Becquerel c) Curie d) dps

4- --------- is a type of particle accelerator which is used to accelerate charged particles using a spiral path.
a) Cyclotron b) Betatron c) X-ray d) Van de Graaff

5- A sample is 70 % as active after 20 hours have elapsed. The value of the decay constant is:
a) 0.000297 min^{-1} b) 0.1783 h^{-1} c) 4.28 d^{-1} d) all of these

Q2// Calculate the followings: **(5M)**

a) 40 MeV=? nm b) 8 nm=? keV

Q3// When 10gm of Mo-93 emitted 40ml of alpha particles after 100years at 25^{o}C and 1atm, calculate the half live of Mo-93. **(10M)**

Q4// A) Draw an x-ray machine and write the names of its parts. **(5M)**

B) A bone taken from a garbage pile buried under a hill-side had $^{14}C/^{12}C$ ratio 0.477 times the ratio in a living plant or animal. What was the date when the animal was buried? **(5M)**

Q5// A) Write/or complete the following reactions: **(5M)**
1- alpha decay by Po-218

2- Positron emission by O-15

3- Electron capture by Ni-59

4- $^{238}U(n,\beta)?$

5- $^{246}Cm + {}^{12}C \longrightarrow {}^{254}No + ?$

B) A rock containing $^{238}_{92}U$ and $^{206}_{82}Pb$ was examined to determine its approximate age. Analysis showed the ratio of $^{206}_{82}Pb$ atoms to $^{238}_{92}U$ atoms to be 0.35. Assuming that no lead was originally present, that all the $^{206}_{82}Pb$ formed over the years has remained in the rock, and that the number of nuclides in intermediate stages of decay between $^{238}_{92}U$ and $^{206}_{82}Pb$ is negligible, calculate the age of the rock. The half-life of $^{238}_{92}U$ is 4.5×10^9 years. **(5M)**

20. Extra notes:

21. Peer review