Department: Chemistry

College: Education

University: Salahaddin

Subject: Nuclear Chemistry

Course Book: *Stage* 3; First semester

Lecturer's name: Khozan A. Haji

Academic Year: 2023-2024

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 Structure of Atom, Cathode rays – The discovery of electron MEASUREMENT OF e/m FOR ELECTRONS DETERMINATION OF THE CHARGE ON AN ELECTRON Mass of Electron, POSITIVE RAYS. Second week Neutrons, RUTHERFORD'S ATOMIC MODEL – THE NUCLEAR ATOM, COMPOSITION OF THE NUCLEUS. Third week RADIOACTIVITY, TYPES OF RADIATIONS, ALPHA RAYS, BETA RAYS, GAMMA RAYS. Fourth week DETECTION AND MEASUREMENT OF RADIOACTIVITY, Cloud Chamber, Ionisation Chamber, Geiger-Muller Counter. Fifth week TYPES OF RADIOACTIVE DECAY,	Dr.Khozan A. Haji 2 hours

Sixth week RADIOACTIVITY, TYPES OF RADIATIONS, PROPERTIES OF RADIATIONS. Seventh week DETECTION AND MEASUREMENT OF RADIOACTIVITY Eighth week TYPES OF RADIOACTIVE DECAY THE GROUP DISPLACEMENT LAW Ninth week RADIOACTIVE DISINTEGRATION SERIES RATE OF RADIOACTIVE DECAY Tenth week HALF-LIFE RADIOACTIVE DATING Eleventh week NUCLEAR REACTIONS NUCLEAR FISSION REACTIONS NUCLEAR FUSION REACTIONS Twelfth week NUCLEAR EQUATIONS ARTIFICIAL RADIOACTIVITY Thirteenth week NUCLEAR ISOMERISM	

Fourteenth week MASS DEFECT Fifteenth week NUCLEAR BINDING ENERGY	

19. Examinations:

Q1: Choose the best answer.
(27M)

1-The reaction of ^{3}H and ^{2}H to form ^{4}He and a neutron is an example of

a) a fission reaction b) a fusion reaction
c) a,b d) neither a fission or fusion reaction

2- Which of these points is not true for nuclear reactions?

a) One element may be converted into another.
b) Rate of reaction is influenced by external factors.
c) Proceed by redistribution of nuclear particles.
d) Often accompanied by release or absorption of enormous amount of energy.

3- Most nuclear reactions are studied by inducing a collision between two nuclei where one of the reacting nuclei is at rest (-------) while the other nucleus (----) is in motion.

a) nuclei , electron b) projectile, target
c) target, projectile. d) proton, neutron

4- A pair of nuclei having same number of protons and neutrons but different half-lives are called----------.

a)isotopes b)nuclear isomers c)isotones d)isobars

5- The Betatron accelerator is able to give any energy within the range between:

a) 1 to 5 MeV b) 5 to 15 MeV
c) 15 to 25 MeV d) 10 to 300 MeV

6- $^{14}_{7}N$ when struck by an α-particle first forms an intermediate unstable compound nucleus,----- , which at once cleaves to form stables $^{17}_{8}O$.

a) $^{18}_{8}O$ b) $^{16}_{8}O$ c) $^{18}_{9}F$ d) $^{19}_{9}F$

7- Very often, in a nuclear reaction, the mass of the reactants is ------ than that of the products.

a) less b) more c) equal d) all of these

8- For higher elements to be stable there must be more ------- than ---------.

a) electron, proton b) neutron, proton

c) proton, neutron d) neutron, electron

9- Binding energy per nucleon can be calculated by dividing the total binding energy by the -------- in the nucleus.

a) number of electrons b) number of neutrons

c) sum of the number of protons and neutrons d) number of protons

Q2: Proton Fusion is the Sun's Power Source, how? Explain your answer by equations (only).

(15M)

Q3: Write and complete these reactions:

(20M)

1) $^{14}N(\alpha, p)?$.

2) positron-decay by magnesium-50

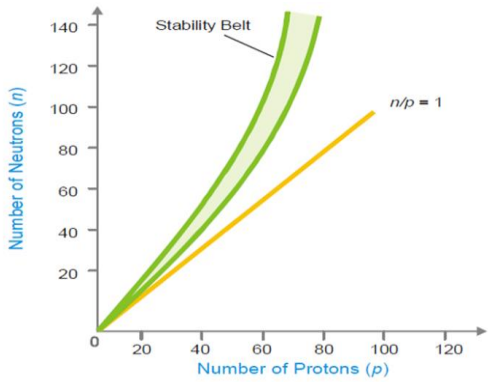
3) Absorption of neutron by Fe-58.

4) Alpha decay of $^{218}_{84}Po$

5) Fusion of lithium-7 and proton.

Q4: A nucleus that is above the stability belt how they become more stable or enters the stability belt? Give an example.

(15M)



Q5: Find the mass defect and binding energy (by J) per nucleon of a copper-63 nucleus if the actual mass of a copper-63 nucleus is

62.91367 amu. The mass of a proton is 1.00728 amu and a neutron is 1.00867 amu. (23M)

1J= 6.24×10^{18} eV, 1amu= 1.66×10^{-24}g, $c = 3 \times 10^{10} cm/sec$, $h = 6.626 \times 10^{-34}\ J.s$,

20. Extra notes:

21. Peer review