Course Specifications

Course Title:	Nuclear and Radiation Chemistry
Course Code:	324CHEM-2
Program:	Bachelor of Science in chemistry
Department:	Chemistry
College:	Science
Institution:	King Khalid University

Table of Contents

A. Course Identification

1. Credit hours:	2
2. Course type	
a.	University ☐ College ☐ Department ■ Others ☐
b.	Required ■ Elective ☐
3. Level/year at which this course is offered:	Level 6 / Year 3
4. Pre-requisites for this course (if any)**:**	222CHEM-2
5. Co-requisites for this course (if any)**:**	No co-requisite

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	2	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	0	0%

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	30
Other Learning Hours*		
1	**Study**	10
2	**Assignments**	10
3	**Library**	10
4	**Projects/Research Essays/Theses**	0
5	**Others** (specify)	0
	Total	30

***** The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

- Definition of vocabulary- The nature of nuclear and radiation chemistry
- Fundamental properties of the nucleus- nuclear species most of the differences between nuclear and chemical reaction equations.
- Standards atomic masses binding energy and how to account radius of the nucleus and how to account nuclear-Coulomb barrier and the way his account nuclear powers and nuclear stability.
- Radioactive decay- sources of radiation types of radiation (alpha, beta and gamma): Energies spectra radioactive decay chains.
- Detection of radioactivity- Gas counters- Proportional counter- Geiger – Muller counter- Scintillation counters- Transuranium elements.
- Nuclear reactions, types: Nuclear fission- Nuclear fusion energy released types of nuclear reactions according to their energies- dispersion elastic-- Low-energy reactions- High-energy reactions.
- Uranium enrichment- types of nuclear reactors- Breeder Reactor- Graphite reactor- Uranium reactors - heavy water- Materials testing reactors- Swimming-pool reactors
- Biological effect of radiation and prevention-factors controlling the effects of radiation exposure- stages of radiative forcing.
- The effects of radiation-Equivalent dose- Radiation dosimetry and measurement units -the relative biological effect (RBE)- Applications of different isotope in industrial , agriculture , medicine and chemistry (analytical and organic).
- The lanthanides and actinides are the reason for their name, their electronic configuration, their uses, and their physical and chemical properties

2. Course Main Objective

The main purpose of this course is to demonstrate to students the principles and applications of nuclear and radiation chemistry as well as the main nuclear changes and types of nuclear reactions. The course maintains the important nuclear process and their applications. The different methods for radiation measurement and types of detection methods. The course aims at teaching the students the effect of radiation on biological systems and the effective doses and dose rate.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	To demonstrate knowledge of the basic of nuclear chemistry concepts	K1and K3
1.2	To recognize concepts: isotopes, isobars, isotones and isomers	K1
1.3	To outline the underlying how to use the laws to calculate the half-life of radioactive material	K1 and K3
2	**Skills:**	
2.1	To apply laws concerning radiation in problem solving	S1
2.2	To learn scientific method and discuss issues by asking questions and answering them.	S2 and S4
2.3	To practice mathematical operations related to half life time of the radioactive materials.	S1
3	**Competence:**	
3.1	To learn scientific method discusses issues by asking questions and answering them.	C2, C3 and C4
3.2	Self-reliance in the work of homework and self-study.	C2, C3 and C4
3.3	Work individually or with a group	C1
3.4	Uses the computer at the solution of homework	C3
3.5	The use of communications technology to search for information and research reports and work	C2 and C5

C. Course Content

No	List of Topics	Contact Hours
1	Definition students vocabulary of Course scheduled and objectives and explain the study plan and how to distribute scheduled during the semester • Introduction to the decision and the importance of teaching in practical life • The nature of nuclear and radiation chemistry • most of the differences between nuclear and chemical reaction equations	2
2	fundamental properties of the nucleus • nuclear species • Standards atomic masses • binding energy and how to account • radius of the nucleus and how to account • nuclear Coulomb barrier and the way his account • nuclear powers and nuclear stability	4
3	• radioactive decay • sources of radiation • types of radiation (alpha, beta and gamma):	3

	- Energies, spectra • radioactive decay chains	
4	• detect radioactivity: - Gas counters - Proportional counter - Geiger – Muller counter - Scintillation counters -Transuranium elements	3
5	-nuclear reactions, types: - Nuclear fission - Nuclear fusion energy released - types of nuclear reactions according to their energies: - dispersion elastic - Low-energy reactions - High-energy reactions	4
6	-nuclear fission reactor and its basic components and the idea of his work chain reaction -liquid-drop model	4
7	• uranium enrichment • types of nuclear reactors: - Breeder Reactor - Graphite reactor - Uranium reactors - heavy water - Materials testing reactors - Swimming-pool reactors	3
8	• biological effect of radiation and prevention • factors controlling the effects of radiation exposure • stages of radiative forcing	2
9	• Lanthanides and actinides, and their isotopes , chemical and physical properties – Applications. For examples (in smoke detectors (americium) and gas mantles (thorium), they are mostly used in nuclear weapons and use as a fuel in nuclear reactors	2
10	• the effects of radiation • Equivalent dose • Radiation dosimetry and measurement units • the relative biological effect (RBE) * Applications of different isotope in industrial, agriculture, medicine and chemistry (analytical and organic).	3
Total		30

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	To demonstrate knowledge of the basic of nuclear chemistry concepts	-Lectures, Interactive teaching sessions -Lectures - Discussions in lectures	-Open discussion -Homework - Exams and quizzes
1.2	To recognize concepts: isotopes, isobars, isotones and isomers		
1.3	To outline the underlying how to use the laws to calculate the half-life of radioactive material		
2.0	**Skills**		
2.1	To apply laws concerning radiation in problem solving	Lectures, problem solving sessions Tutorials, problem	-Open discussion -Homework - Exams and quizzes
2.2	To learn scientific method and discuss issues by asking questions and answering them.		
2.3	To practice mathematical operations related to half life time of the radioactive materials.	Interaction with the students and encourage them to discussion during lectures	
3.0	**Competence**		
3.1	To learn scientific method discusses issues by asking questions and answering them.	Interaction with the students and encourage them to discussion during lectures	-Oral presentation. -Open discussion -Homework - Exams and quizzes
3.2	Self-reliance in the work of homework and self-study.	Open discussion and presentations	
3.3	Work individually or with a group	Group learning	
3.4	Uses the computer at the solution of homework	Reports and discussion	-Oral presentation. -Open discussion -Homework - Exams and quizzes
3.5	The use of communications technology to search for information and research reports and work	Using Blackboard	

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework 1: On-line and in class. Qize -1: On-line and in class	4th	10%
2	Homework 1: On-line and in class. Qize -2: On-line and in class	9th	10%
3	Mid-1	6th	15%
4	Mid-2	10th	15%
4	Final exam	16th	50%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice: 10 office hours are offered for students for individual consultations. Communications are available on-site, phone conversations, and chatting by social media.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1- Nuclear Chemistry: Theory and Practice (in Arabic language) / by J. Dr.. Gopin, J. Raidbreak; Translated by Issam Gerges Saloumi, Zohour Fathy Daoud - University of Mosul, First Edition 1985 2- Nuclear chemistry and Radiation in the service of mankind (in Arabic language) authored by Dr. Mahmoud Barakat Fouad - Arab Thought House - 2009.
Essential References Materials	1- Radiochemistry and Nuclear Chemistry. Gregory Choppin, Jan-Olov Liljenzin, Jan Rydberg, Christian Ekberg. 2013. 4th ed. Academic Press. ISBN: 978-0124058972 2- Nuclear and Radiochemistry: Fundamentals and Applications. Jens-Volker Kratz, Karl Heinrich Lieser. 2013. 3rd ed. Wiley-VCH. ISBN: 978-3527329014 3- Fundamentals of Radiation and Chemical Safety. Ilya Obodovskiy. 2015. 1st ed. Elsevier. ISBN: 978-0128020265
Electronic Materials	1- http://en.wikipedia.org/wiki/Nuclear_chemistry 2- https://www.youtube.com/watch?v=cOE40P5rHCA 3- https://www.youtube.com/watch?v=bjuZSvZukAw
Other Learning Materials	No other learning materials.

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom and computer lab
Technology Resources (AV, data show, Smart Board, software, etc.)	Accessible databases and internet
Other Resources (Specify, e.g. if specific laboratory	-

Item	Resources
equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivery (teaching methods and assessment methods)	Students	Questionnaire
	Departmental Plan and curriculum committee; external reviewers	Report and workshops
	Program Leader	Meetings
Course contents (update)	Departmental Plan and curriculum committee; external reviewers	Report and workshops
Quality of learning resources	External reviewers	Reports

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Department counsel
Reference No.	1/22/142
Date	15-9-1442