Course Specification

(Bachelor)

Course Title:	Nuclear and Radiation chemistry
Course Code:	CHM 1417
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1446-10-v1
Last Revision Date:	1446-10-v1

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (3, 0, 0)					
3 (3 Lectures, 0 Lab and 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 7/ Fourth year					
4. Course general Description:					
The course covers the following topics: introduction to nuclear chemistry, types of radiations, nuclear reactions, kinetics of nuclear decay, half-life, reactors, radiation detection, isotope separation and applications.					
5. Pre-requirements for this course (if any)**:**					
Physical Chemistry- CHM 1346					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s): Industrial Catalysis, Reactions					

Students should be able to:

- ✓ Improve their knowledge of the basic information of Radiation and Nuclear chemistry; requirements, methods of preparation, uses of Radioelements.
- ✓ Be aware of the contributions of chemistry to society
- ✓ Improve their knowledge of types of radioactive decay, natural decay series, nuclear models, nuclear properties, Mass energy, relationships, nuclear reactions, rates of radioactive decay, interaction of radiation with matter.
- ✓ Improve their knowledge of instrumentation and Introduction to health – physical applications in nuclear and radiochemistry.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100%**
2	E-learning	**9**	**0**
3	Hybrid • Traditional classroom • E-learning	**0**	**0**
4	Distance learning	**0**	**0**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recognize the basic information of radioactive and nuclear chemistry and to identify instrumentation and health applications in nuclear and radiochemistry.**	**K1, K2, K3**	• Lectures and Group Discussions • A Private study including home exam.	Direct: ✓Quizzes ✓Discussion ✓Participatio ✓Exams
1.2	**To list types of radioactive decay, natural decay series, nuclear models, nuclear properties, Mass energy.**	**K1, K3**	• Lectures with • group discussion. • Think, talk, and discuss types of radioactive decay, natural decay series	Direct: ✓Oral Discussion ✓Exams ✓Participation
1.3	**To define environmentally harmful nuclear materials and name some applications of radio-isotopes.**	**K1, K3**	▪ Lectures with group discussion. ▪ Think, talk, and discuss environmentally harmful nuclear materials	Direct: ✓ Quizzes ✓ Home exam ✓ Oral discussions.

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	Skills			
2.1	**To differentiate between the different types of radioactive decay and predict nuclides stability and nuclear reaction products.**	**S2, S3**	✓ Interactive lectures ✓ Brainstorming ✓ Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.2	**To calculate the mass defect and binding energy for fission and fusion reaction.**	**S1, S2**	✓ Interactive lectures ✓ Group discussions	**Direct:** ✓ Questions in Lectures. ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.3	**To estimate ages of materials using carbon and uranium dating.**	**S1, S2**	✓ Interactive lectures ✓ Brainstorming ✓ Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
2.4	**To develop effective written and oral communication skills, ability to present data in graphs through electronic mail, and Network skills with others**	**S1, S3**	✓ Interactive lectures ✓ Brainstorming ✓ Group discussions	**Direct:** ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion,
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise coordination and raise knowledge during various evaluations, initiatives, and mini reports to uphold scientific integrity.**	**V1; V2**	• **Group discussion and assignments** • **homework**	**Direct:** ✓ **Oral tests** ✓ **Assignments homework marks**

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction, Nuclear binding energy, Mass defect and binding energy, The average binding energy per nucleon.	3
2.	Radioactivity, Nuclear emissions, Nuclear transformations, The kinetics of radioactive decay, Units of radioactivity, Artificial isotopes, Bombardment of nuclei by high-energy a-particles and neutrons, Bombardment of nuclei by 'slow' neutrons.	9
3.	Nuclear fission, The fission of uranium, The production of energy by nuclear fission, Nuclear reprocessing, Syntheses of transuranium elements, The separation of radioactive isotopes.	9
4.	Chemical separation, The Szilard–Chalmers effect, Nuclear fusion, Applications of isotopes, Infrared (IR) spectroscopy, Kinetic isotope effects, Radiocarbon dating, Analytical applications, Sources of 2H and 13C, Deuterium: electrolytic separation of isotopes.	6
5.	Carbon-13: chemical enrichment, Multinuclear NMR spectroscopy in inorganic chemistry, Which nuclei are suitable for NMR spectroscopic studies?	9
6.	Chemical shift ranges, Spin–spin coupling, Stereochemically non-rigid species, Exchange processes in solution, Mo¨ ssbauer spectroscopy in inorganic chemistry, The technique of Mo¨ ssbauer spectroscopy, What can isomer shift data tell us?	9
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	20 %
2.	Midterm 2	11th/ 12th week	20 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
5.	Final Exam	16thweek	40 %
6.	Total	All weeks	100 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Catherine Housecroft, Alan G Sharpe,, **Inorganic Chemistry**, Pearson; 5th edition (May 31, 2018), ISBN-10 : 1292134143, ISBN-13 : 978-1292134147
Supportive References	Peter Atkins, Tina Overton, Jonathan Rourke, Fraser Armstrong , Mark T. Weller, **Shriver & Atkins' Inorganic Chemistry**, Oxford University Press, (January 1, 2009), ISBN-10 : 0199236178, ISBN-13 : 978-0199236176
Electronic Materials	• **Blackboard** • **www. Elesevier.com**
Other Learning Materials	**None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (projector, smart board, software)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist- Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of students assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	**Students** **Faculty (Academic Advisory)** **Program Leaders**	**Indirect:** Second examiner checklist- Course report. **Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review. **Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible** **Program Leaders**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist- Course report. **Indirect:** Exams.
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**3 (NO. 1/3)**
DATE	**5/3/1446- 8/09/2024**