SYLLABUS

A. Course Description

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Language*
CHM	**415**	**Nuclear & Radiation Chemistry**	**2**	**2**	**0**	**0**	**4**	**CHM 313**	**8**	**English**

This course provides students with an fundamental of nuclear chemistry and the radiations emitted during nuclear reactions. Topics covered in the course include nuclear instability and its relation of alpha, beta, gamma, electron capture, neutron to proton change reactions, kinetics of nuclear reactions radiochemical series, nuclear plants, applications of nuclear radiations, hazarous of nuclear radiation.

At the end of this course the student will be able to

- Know the basic information of Radiation and Nuclear chemistry; requirements, methods of preparation, uses of Radioactive elements.
- Improve their knowledge of instrumentation and Introduction to health – physical applications in nuclear and radiochemistry.
- Be aware of the contributions of nuclear chemistry to beneficial applications and hazardous effects.
- Understand the 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.
- Know the radiation detection techniques and instrumentaion.

B. References: Required Textbook & Internal Website

I shall use

Modern Nuclear Chemistry, Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg (2^{nd} Ed.) (2017), Wiley, ISBN: 978-0-471-11532-8.

Students are required to purchase the textbook/materials (it is an obligation). The book contains the lecture notes as well as activities for the students to take part in; the book serves as a workbook.Other references:

- ***Atoms, Radiation, and Radiation Protection***, James E. Turner, (3^{rd} Ed). (2007) WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN 978-3-527-40606-7.

Google Classroom Webpage: http://www.imamm.org/

C. Topics Outline

Disclaimer: this is a very fast-paced course. There will be little time-if any-for review. What follows is an approximate outline of the pace of the course. We may go faster or slower, contingent on the class response. The tentative list of topics to cover:

1. Introduction: Nuclear Chemistry, radioactivity. Comparison among α, β, and γ Rays, Electron Capture, Nuclear Stability, Predicting Type of Decay.

2. The Kinetics of Radioactive Decay: Radioactive decay, Variation of radioactivity over time, Units of measurement for radioactivity, Plotting radioactive decay, radioactive equilibrium, Transient radioactive equilibrium, radioactive disintegration series, artificial radioactivity.

3. Mass Defect and Binding Energy: Mass defect, Mass-energy equivalence, Binding energy, Binding energy per nucleon, Nuclear fission, Energy released in a fission reaction, Liquid drop model of a nucleus, Nuclear fusion.

4. Nuclear Reactors: Nuclear reactors, Types of fuel, Reactor core, Reflector, Moderator, Coolants, Shielding, Breeder reactor.

5. Reactor Theory and Neutron Interactions: Scattering, Inelastic scattering, Absorption reactions, Radiative capture, Particle ejection, Neutron characteristics, Neutron sources, Nuclear cross sections and neutron flux, Atom density, Cross sections, Mean free path, Calculation of macroscopic cross section and mean free path, Effects of temperature on cross section, Neutron flux, Reactor power calculation, Relationship between neutron flux and reactor power, Neutron slowing down and thermalization, Neutron flux spectrum, Most probable neutron velocities.

6. Radiation Detectors: Gas counters, Neutron detectors, Scintillation counters, Solid state detectors, Statistics of counting, Pulse height analysis, Advanced detectors.

7. Isotope separation: Uranium enrichment, Separation technologies, Mass spectrograph, Gaseous Diffusion Separator, Gas Centrifuge, Laser Isotope Separation, Nozzle process, Helikon process, Thermal diffusion, Chemical exchange, Distillation, Separation of Deuterium by Electrolysis.

8. Applications of Radioisotopes: Photosynthesis in plants, Agriculture Industry, Research, Biological research, Isotopic dating in Geology, Radio-carbon dating technique, Trace analysis of elements and compounds - neutron activation analysis, isotope dilution analysis.

D. Exams & Grading System

The semi-official dates of the exams for this course, with all the caveats, that the word "semi-official" entails, can be found here:

- **Midterm 1:** 6th or 7th week &**Midterm 2:**11th or 12th week
- **Quizzes & Homeworks: During the semester**

Your course grade will be based on Final Exam, Midterms, Homework, Quizzes, Participation, Attendance and Project.

Midterm 1: 20 %	**Midterm 2:** 20 %	**Final Exam:** 40 %
Quizzes, Homework, Attendance & Participation:20 %		

Grading distribution:

A^+: [95, 100], A: [90, 95), B^+: [85, 90), B: [80, 85), C^+: [75, 80), C: [70, 75), D^+: [65, 70), D: [60, 65), F: [0, 60).

E. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Examsgoo.gl/ykm7t3

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