# Course Documentation

## School of Biosciences

**Program:** Chemical Engineering Technology

**Academic Year:** 2011-12 Fall [ ] Winter [x] Spring [ ]

**Program Year:** 3 **Program Semester:** 6

**Course Name:** Radiochemistry

**Course Code:** CHEM 3007 **Course Hours:** 42 **Credit Value:** 3

**Faculty:** Don Todd

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**Office Location:** 2L33a
**Phone:** 613 969 1913Ext.2353
**Instructions:** Lecture

| Class | Lab | Field | Other | Total |
|---|---|---|---|---|
| 40 | 2 | | | 42 |

**Prerequisites/Corequisites/Equivalent Courses**

| PR/CO/EQ | Course Code | Course Name | Conditions |
|---|---|---|---|
| PR | CHEM 2005 | Analytical Chemistry 2 | |
| CO | CHEM 3004 | Physical Chemistry | |
| EQ | N/A | | |

**This Course is A Prerequisite For:**

| Course Code | Course Name |
|---|---|
| N/A | |

### 1. Calendar Description

This course covers the basics of radioactive decays and nuclear chemistry.
Prerequisites: CHEM 2005 & CHEM 3004

### 2. Course Learning Outcomes: Upon successful completion of the course, the student will be

Understand and do calculations (where applicable) as related to:
- atomic makeup - electrons and nucleus
- compare radioactive decay types
- predict why some nuclides are stable and why some are not
- compare details of radioactive decay types
- basis of detector design
- absorption of radiation by various metals - radiation as a function of distance and shielding
- usefullness to society

Dean/Chair Approval:  Date: 12/21/20

- Canadian Technology - the CANDU reactor

**3. Essential Employability Skills Outcomes: This course will contribute to the achievement of the following essential employability skills**

[x] 1. communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.

[x] 2. respond to written, spoken, or visual messages in a manner that ensures effective communication.

[x] 3. execute mathematical operations accurately.

[x] 4. apply a systematic approach to solve problems.

[x] 5. use a variety of thinking skills to anticipate and solve problems.

[x] 6. locate, select, organize, and document information using appropriate technology and information systems.

[x] 7. analyze, evaluate, and apply relevant information from a variety of sources.

[x] 8. show respect for the diverse opinions, values, belief systems, and contribution of others.

[x] 9. interact with others in groups or team in ways that contribute to effective working relationships and the achievement of goals.

[x] 10. manage the use of time and other resources to complete projects.

[x] 11. take responsibility for one's own actions, decisions, and consequences.

**4. General Education:**

Indicate if this course is identified as a General Education course in the program of study.

[ ] Yes [x] No

If yes, indicate which General Education theme this course addresses.

[ ] 1. Arts in Society
[ ] 2. Civic Life
[ ] 3. Social and Cultural Understanding
[ ] 4. Personal Understanding
[ ] 5. Science and Technology

**5. Prior Learning Assessment and Recognition:**

Students may apply to receive credit by demonstrating achievement of the course learning outcomes through previous life and work experiences.
This course is eligible for challenge through the following method(s) indicated

| Challenge Exam | Portfolio | Interview | Dual Credit | Other | Not Eligible |
|---|---|---|---|---|---|
| [x] | [ ] | [ ] | [ ] | [ ] | [ ] |

PLAR Course instructor

**6. Required Texts, Materials, Resources or Technical Materials Required**

A formal textbook is not required for this course, however, a set of course notes produced by the instructor (to be purchased), is used to facilitate the learning of the concepts. In addition, the course notes and results of lab experiments will be used as examples in the presentation of the practical and theoretical concepts for this course. Some texts on nuclei and radioactivity are available in the Resource Centre and from the instructor.

**7. Evaluation: Students will demonstrate learning in the following ways**

| Assessment Description | Course Learning Outcome(s) | Assignment Weighting |
|---|---|---|
| Hand in Assignment #1<br><br>Hand in Assignment #2 & #3<br>"<br><br><br><br>In Class assignment #4<br><br>"<br>Hand in Assignment #5<br><br><br>Hand in Assignment #6 & #7 | Overall leads to understanding smaller sections of the course.<br><br>Basic designations of isotopes<br>Calculation of Binding Energy<br>Mass-Energy Balances for alpha, beta and gamma Reactions - Calculations<br>Plotting Activity as a function of Time<br>Determining Half Life from the above plots using Log activity as a function of Time<br>Writing nuclear reaction equations using isotopic formula forms<br>Determining activities, amounts, half lives, decay constants using nuclear (first order) mathematical equation relationships. | 25% of the total course mark |
| Test #1Feb<br>Test #2Mar<br>Lab Apr<br>. | Isotopes, isobars, isotones, binding energy.<br>mass-energy calculations,<br>Z, A, and N<br>nuclear reaction equations, nuclear radii, coulomb barrier, half lives, n/p ratio, nuclear abundance, magic numbers.<br><br>reaction equations, half life from plots alpha, beta (negatron, positron & electron capture) and gamma cases, mathematical nuclear reaction relationships<br><br>Measurement of radioactivity of some (sealed) samples emitting alpha, beta and gamma radiation. Proper handling of. !!<br>Determination of the type of radioactivity.<br>Demonstrates the use of detectors and | 30% of the total course mark |

| | | |
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| | counters which are used to see the effect of shielding and distance on the activity level coming from the samples | |
| Final Exam (3 hours) Review of all topics, main emphasis is on those topics not previously tested on. | End of April<br><br>Inter-relates the whole course concepts | 35% of the total course mark |
| Personal Assessment by Instructor and Lab Tech. | The importance of working well with others. | 10% of the total course mark |

**8. Other:**

**Loyalist College has a Violence Prevention policy:**

All College members have a responsibility to foster a climate of respect and safety, free from violent behavior and harassment.

- Violence (e.g. physical violence, threatening actions or harassment) is not, in any way, acceptable behavior.
- Weapons or replicas of weapons are not permitted on Loyalist College property.
- Unacceptable behavior will result in disciplinary action or appropriate sanctions.
- Moreinformationcanbefoundinthe“StudentManual” .

Passing Grade is 60%

**9. Curriculum, Delivery, Learning Plan and Learning Outcomes:**

| Course Components/Course Learning Outcomes | Related Elements of Performance | Learning Activities/Assessment/Resources |
|---|---|---|
| 1. The Atom and Its Nucleus<br>some history, general review and isotopes, some quantum theory concepts | atomic makeup - its electrons and nucleus | show electron distribution in atoms and ions |
| 2. Radioactive Nuclides - Intro<br>alpha, beta, and gamma types, fusions, fissions, half lives. | to compare decay types | write isotopic reaction equations |
| 3. The Nucleus<br>nuclear mass, binding energy, radius, barrier, forces, and stability (n/p ratio, nuclear types, isobars, magic numbers) | to understand and predict why some nuclides are stable and why some are not | calculations on masses and energies |
| 4. Details of Radioactive Decays<br>alpha, beta (negatron, positron, electron capture, spectra), & gamma decays, decay relationships (activity & half life, plots, decay equations), and general concepts (penetrating power, natural radioactivity, 4n+x series, parent/daughter relationships, age of the earth, natural abundance of uranium) | compare details of decay types | calculations on mass, energies, activities & half lives |
| 5. Detection Methods<br>nature of matter, energies, interaction | basis of detector design<br>absorption of radiation by various metals | describe how each type works<br>Lab–GMdetector |

| | | |
|---|---|---|
| with radiation and penetration, and detectors (ionization, proportional, GM, scintillation) | - radiation as a function of distance | and counter |
| 6. Uses of Radioisotopes<br>chemical (organic, mechanisms, kinetics) medical (thyroid, blood volumes, tumours, choice of radioisotope), dating (carbon, tritium) | usefulness to society | example calculations |
| 7. Nuclear Power<br>the Candu Reactor, uranium, heavy water.... | Canadian Technology | Nuclear Power Plants |