Course Documentation Outline

School of Business, Biosciences and Justice Studies

SECTION I

1. Program (s): Biofood, Biotechnology, Chemical, Environmental

2. Course Name: Instrumentation 2

3. Course Code: CHEM 2002

4. Credit Value: 5 Course Hours: 75

Class	Lab	Field	Other	Total
30	45			75

5. Prerequisites/Co-requisites/Equivalent Courses

PR/CO/EQ	Course Code	Title
PR	CHEM2000	Instrumentation 1 Theory
PR	CHEM2006	Instrumentation Lab

6. **Faculty:** Elinor Brunet **Date:** Jan 12, 2011 **Effective Date:** Jan 13, 2011

7. Dean/Chair Approval: *Jim Whiteway* Date: Jan 2011

9. **Revision Number:** **Date:** **Effective Date:**

10: **Notes: A passing grade is 60%.**

Section II

11. **Calendar Description:**

This course reviews some of the basic concepts and techniques of chromatography (thin layer, column, gas, liquid and ion), spectroscopy (ultraviolet - UV, Visible, Flame and Furnace Atomic Absorption). Fluorescence and Infra red spectroscopy are introduced. A variety of sample preparation techniques are carried out as various unknowns are analysed in the labs

.

12. **Provincial Context:**
This course meets the following Ministry of Education and Training requirements:

a). **Prior Learning Assessment (PLA)**
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 by *

Challenge Exam	Portfolio	Interview	Other	Not Eligible
*	*	*		

PLAR Contact:

13. **Employability Skills emphasized in this course**

	communication - written		communication - visual		communication - oral
*	analytical		creative thinking	*	decision making
*	interpersonal	*	numeracy	*	organizational
*	problem solving	*	technological		other (specify)

14. **Required Texts, Materials, Resources or Technical Materials Required:**

Lab manual produced at the college, lab coat and safety eyewear (CSA approved) with colourless lenses, as well as a scientific calculator capable of linear regression. A formal textbook is not required for this course.

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

Assignment Description	Evaluation Methodology	Due Date
Assignments, quizzes and midterm	40%	On going
Lab reports	25%	One per week
Final Test	35%	April 2011

16. Other

- No late assignments will be accepted unless arrangements are made prior to the due date.
- A mark of 0 will be given for any tests missed by the student unless arrangements are made prior to the test.
- The midterm will cover material from the beginning of the semester to that point. The final will cover material from the entire semester from both the theory classes and the labs. The style of questions will be exactly the same as those contained in the assignments and quizzes
- All labs must be performed and the data recorded and initialled before leaving the lab.
- A lab report must be submitted for each lab, one week after the lab is completed.
- The labs will be performed in pairs.
- The labs will be returned at the end of the semester.
- There will be a make up period at the end of the semester: the students may perform only one make up lab this semester.
- There will be a 10% assessment mark that represents an evaluation of how well the students learn the lab techniques demonstrated, how safely the students work, the cleanliness of their workstation and their preparedness and punctuality.

Contact Information for Elinor Brunet:
Office: 2L25 a
Work Phone #: 613-969-1913, ext 2290
Home Phone #: 613-968-8695
E-mail: ebrunet@loyalistc.on.ca

Loyalist College has a Violence Prevention policy:

- All College members have a responsibility to foster a climate of respect and safety, free from violent behaviour and harassment.
- Violence (e.g. physical violence, threatening actions or harassment) is not, in any way, acceptable behaviour.
- Weapons or replicas of weapons are not permitted on Loyalist College property.
- Unacceptable behaviour will result in disciplinary action or appropriate sanctions.
- More information can be found in the “Student Manual and Guide - Rights & Responsibilities”.

Section III

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

Course Components/Content	Related Learning Outcomes	Learning Activities/Resources
Proper Lab Techniques **Various Topics**	The student will be able to: - discuss the following: • relative accuracy of the various types of lab glassware • TC/TD designation on volumetric pipet • Uses of graduated vs volumetric pipet • Grades of chemical purity • Treatment of water • Sample storage conditions • Methods of mixing solutions • Plastic vs. glass sample storage containers • Dessicators & dessicants: types, uses and regenerating • Cleaning glassware: biology vs. chemistry points of view • Ventilation of labs • Matched cells • Types of thermometers The student will be able to use • Reference books e.g. Standard Methods for Water Difco Manual Standard Methods for Dairy Reagent Chemicals Official Methods of Analysis Food Chemicals Codex Vogel (Organic and Inorganic) USP Annual Book of ASTM Standards Chemical Abstracts Services Merck Index CRC Handbook Commonly used acronyms and abbreviations	Curriculum objectives will be achieved through a combination of the following teaching strategies: 1. Lecture 2. Laboratory activities (guided and discovery) 3. Cooperative study 4. Independent study (i.e. required readings and exercises)

Spectrophotometric Work **Spec 20, Scanning Spec., IR, Flame and Furnace Atomic Absorption**	- Identify the parts and their position in a single and double beam instrument - Compare the uses for single and double beam instruments - Discuss: types of energy sources (effective region), wavelength selectors (filters, prisms, gratings), sample holder (materials available), and detectors (their effective region) - **IR**: To start up the instrument and become familiar with the software that controls the instrument so that spectra of various organic liquids (presented between NaCl plates) and KBr pellets of benzoic acid (prepared by the student) can be analyzed to observe what frequencies of energy the bonds in some common organic groups absorb	**Lab**: Arsenic by Furnace AA Copper and Iron in Soil by Flame AA IR
Beer's Law	- Be adept at rearranging the Beer's Law equations regardless of which concentration units or constant are involved to calculate whatever parameter is desired - Explain the significance of λ_{max} and determine it from either a printed wavelength scan or absorbance vs. wavelength data - Measure %T and convert %T to Absorbance - Plot Absorbance vs. Concentration results - Work with a two component system and determine the concentration of each component - Be able to perform linear regression on a set of results that obey Beer's Law - Be able to perform basic standard addition calculation and recognize when matrix effects are being observed - Plot a Standard Addition calibration curve (Absorbance vs. Concentration)	Micropipetting ASA in Aspirin
Beer's Law and Standard Addition		Cobalt and Chromium Nickel Standard Addition Iron Standard Addition

Florescence	- Display an understanding of how some compounds emit energy in the form of fluorescence - Understand what purpose is served by filters in a fluorometer - Use the relationship between emitted energy and concentration to determine the concentration of fluorescein in an unknown by linear regression on the fluorescence measurements of the standards vs. concentration of the standards.	**Lab**: Fluorescein
Solution Preparation for Ions	- carry out calculations for the preparation of solutions containing the designated ion from a particular source at the concentration indicated - perform calculations for the preparation of solutions in any of the typical concentration units based on dissolution or dilution techniques.	
Standard Chromatographic Parameters	- be able to define and perform calculations involving: • retention time • capacity factor • theoretical plates • height equivalent to a theoretical plate • selectivity factor • resolution	

Chromatography (gas, liquid, ion)	- Describe the difference between separation performed using the processes of adsorption and partition and identify which one is happening in a specified environment - Define and give examples of stationary and mobile phases - Describe how to start up, calibrate, and introduce a sample to a GC, LC, and IC - Discuss the form a GC, LC and IC chromatogram will take - Be able to calculate the retention time of compounds - Be able to use the retention time to identify the components present in an unknown - **IC**: Perform linear regression on the Peak Area vs. concentration data obtained from the chromatograms of the standards. This information will be used to determine the concentration of each ion present in an unknown solution - **GC**: Perform spiking on an unknown sample to confirm identification of components. Perform temperature ramping on a standard to decrease the retention times yet maintain resolution of the components - **HPLC**: Perform linear regression on the Peak Area vs. concentration data obtained from the chromatograms of the standards. This information will be used to calculate the concentration of the acetone present in the unknown.	**Lab**: GC 2 Quantitative HPLC IC
Electrophoresis	For the 20 amino acids commonly found in proteins : draw the ionic forms present at various pH's including the zwitterion : state the significance of the isoelectric point : discuss some of the key points about: • Zone electrophoresis • Different gels (e.g. agarose) • PAGE • SDS-PAGE • Isoelectric focussing Capillary electrophoresis	

Common Terms	: give the meaning and/or examples and/or equation and/or application where appropriate for: • density & specific gravity • ampules • BOD • Amorphous • Boiling point and melting point (effect on with contamination of a pure compound) • Rf value • ppm • pH/pK • refractive index (with discussion of how to calculate the constant used to convert a value from one temp. to one at another temp. • Extract • Viscosity • Absolute vs. denatured ethanol • Hygroscopic • Deliquescent • Derivatization • Allotropic • Amphoteric • Zwitterions • Anion/cation • Anode/cathode • Oxidation/reduction • Eluant • Flash point • Saturated solution	

Upon successful completion of this course, the student will be able to:

a) Prepare standards and samples accurately by dilution or dissolution (the appropriate technique)
b) Set up and calibrate the instruments (GC, HPLC, IC, Flame and Furnace AA, fluorometer, IR and other spectrophotometers)

c) Discuss the following topics for the instruments listed above:
   - Types of samples analyzed
   - Parts of the instrument, and their purpose
   - Design of the instrument
   - Path of the light or mobile phase
   - What happens to the sample during analysis
   - What form the instrumental output can take
   - How the samples are introduced to the instrument

d) Discuss what is happening (adsorption and partition processes) during a thin layer or column chromatography analysis

e) Manipulate the quantitative data obtained using graphing and linear regression techniques and interpret the results

f) Express the results of **all** calculations to the appropriate number of significant figures or decimal places **with** the appropriate units

g) Demonstrate a working knowledge of Beer's Law, Standard Addition and matrix effects

h) Use the appropriate reference material (Merck Index, CRC handbook, AWWA Standard Methods etc.) to obtain the required information

i) Discuss proper lab techniques

j) Define and give the application of many common chemical terms

k) Calculate and manipulate the common chromatographic parameters: retention time, capacity factor, theoretical plates, height equivalent to a theoretical plate, selectivity factor and resolution

l) Describe, for the 20 amino acids commonly found in proteins, the ionic forms at various pH's and the significance of the isoelectric point

m) Discuss some of the key points about performing the following: zone electrophoresis, using gels (e.g. agarose), PAGE, SDS-PAGE, isoelectric focussing, and capillary electrophoresis.

n) Relate the polarity of an organic compound to its retention time or Rf value

o) Express the difference between the amount of analyte claimed to be present in a sample and what was found to be present as a % Difference.