

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: Organic Chemistry - Spectroscopy
Course Code: CHEM 3006 **Course Hours:** 42 **Credit Value:** 3
Faculty: Don Todd **Email:** dtodd@loyalistic.on.ca
 Office Location: 2L33a
 Phone: 613 969 1913 Ext. 2353
 Instructions: Lecture

Class	Lab	Field	Other	Total
42				42

Prerequisites/Corequisites/Equivalent Courses

PR/CO/EQ	Course Code	Course Name	Conditions
PR	CHEM 2002 CHEM 2005 CHEM 3002	Instrumentation 2 Analytical Chemistry 2 Organic Chemistry - Chromatography	
CO	N/A		
EQ	N/A		

This Course is A Prerequisite For:

Course Code	Course Name
N/A	

1. Calendar Description

Covers the theoretical aspects of spectroscopy. Interpretation of spectroscopy is emphasized. Areas studied are UV, IR, NMR and mass spectrometry.
 Prerequisite: CHEM 2002; CHEM 2005 & CHEM 3002

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

- The learner will be able to:
1. Understand the concepts of absorption and emission spectroscopies.
 2. Understand the concepts of electronic transitions, energy required (absorption position - lambda max)

Dean/Chair Approval:

Date: 2/23/2011

and the probability of excitation (molar absorptivity-epsilon) of the transition. Predict the UV spectrum of an organic molecule - given the structural formula of that molecule.

3. Understand the concepts of infra red absorption and carry out spectral analyses of an infra red spectra combined with other organic chemical information. Understand sample preparation/analysis methods in ir spectroscopy.

4. Understand the basic concepts of nuclear (proton) magnetic resonance spectroscopy - chemical shift, integration, spin-spin splitting, TMS, D2O exchange, deuterated solvents. Analyze simpler nmr spectra to determine the organic molecule which produced it.

5. Understand the basic concepts of mass spectroscopy theory and instrument design.
Analyze a mass spectrum - assess molecular weight & basic fragmentation patterns.

6. Relate and combine the organic concepts learned in the previous course (CHEM 3002) to the combined spectroscopic methods for the purpose of structural elucidation of some unknown compounds.

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

- 1. communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.
- 2. respond to written, spoken, or visual messages in a manner that ensures effective communication.
- 3. execute mathematical operations accurately.
- 4. apply a systematic approach to solve problems.
- 5. use a variety of thinking skills to anticipate and solve problems.
- 6. locate, select, organize, and document information using appropriate technology and information systems.
- 7. analyze, evaluate, and apply relevant information from a variety of sources.
- 8. show respect for the diverse opinions, values, belief systems, and contribution of others.
- 9. interact with others in groups or team in ways that contribute to effective working relationships and the achievement of goals.
- 10. manage the use of time and other resources to complete projects.
- 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

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]	[]	[]	[]	[]	[]

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Don Todd

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

A formal textbook is not required for this course, however, a set of course notes (to be purchased) - produced by the instructor is used to facilitate the learning of the concepts.

In addition, the course notes and results of the lab experiments in spectroscopy performed in the student's previous courses (Chemical Instrumentation-Sem 1&2) will be used as examples in the presentation of the practical and theoretical concepts for this course.

Several texts on organic spectroscopy 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
Determining lambda max and molar absorptivities values in UV using Woodward Rules	Outcomes 1 and 2 via In class Assignments plus UV Hand-in Assignments #1,2,3 & 4	25% of the total course mark
Determining organic structures using IR and other organic properties	Outcome 3 via IR Assignments #1,2, & 3	
Determining organic structures using NMR analyses		
Determining organic structures using MS analyses	Outcome 4 via NMR In Class and Hand-in Assignments	
Combining all four spectroscopic methods to determine unknown molecular structures	Outcome 5 via MS In Class Assignments Outcome 6 via In Class Assignments	
Ultra violet theory and problems	Outcome 1 and 1 via Test #1 Feb	30% of the total course mark
Infra Red theory and problems	Outcome 3 via Test #2 Mar	

Nuclear Magnetic Resonance spectrum interpretation.	Outcome 4 via Assign or Test Apr	
Mass spectroscopy theory and spectral analysis.	Outcome 5 via in class assign	
Final Exam - 3 hours Review of all topics	Outcomes 1 to 6 Inter-relates the whole course contents.	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.
- More information can be found in the "Student Manual".

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. Introduction to Spectroscopy absorption, emission, electromagnetic (EM) spectrum	introduces the nature of EM radiation and interaction with molecules	correlation of energies, wavelengths & frequency
2. Ultra Violet Spectroscopy electronic considerations, molar absorptivity, chromophores, conjugation, Woodward Rules	relates molecular structure to absorption spectroscopy to predict max and	assignments spectral tables
3. Infra Red Spectroscopy vibrations (stretching & bending), resonance, Hooke's Law (atom size & bond effects), major stretching & bending vibrations, interpretation of spectra, techniques of sample preparation, structural elucidation,	spectral analysis of infra red spectra	as above
4. Nuclear Magnetic Resonance magnetic properties of nuclei, magnetic field and radio frequencies, basic instrumentation, chemical shift (tau & delta scales), shielding effects, spin-spin interaction (coupling), interpretation	spectral analysis of nmr spectra	as above

of spectra, sample preparation.		
5. Mass Spectroscopy basic principles and instrumentation, mass ion formation and fragmentation patterns, structural studies.	spectral analysis of mass spectra	as above
6. Spectral Methods Correlation structural elucidation of some unknown molecule	the use of the four spectroscopy methods above - plus additional organic properties of that molecule.	correlating spectroscopy and organic info