

**OHLONE COLLEGE**  
**Ohlone Community College District**  
**OFFICIAL COURSE OUTLINE**

**I. Description of Course:**

- |  |   |
|--|---|
| <p>1. <b>Department/Course:</b> <u>CHMT - 104C</u></p> <p>2. <b>Title:</b> <u>IR and UV-Vis Spectroscopy</u></p> <p>3. <b>Cross Reference:</b> IR and UV-Vis Spectroscopy BIOT - 104C</p> <p>4. <b>Units:</b> <u>0.5</u><br/><b>Lec Hrs:</b> <u>0.25</u><br/><b>Lab Hrs:</b> <u>0.75</u></p> <p>5. <b>Repeatability:</b> <u>No</u></p> <p>6. <b>Grade Options:</b> Grade Only (GR)</p> | <p>7. <b>Degree/Applicability:</b><br/>Credit, Degree Applicable, Not Transferable (D)</p> <p>8. <b>General Education:</b></p> <p>9. <b>Field Trips:</b> <u>Not Required</u></p> <p>10. <b>Requisites:</b><br/><b>Prerequisite</b><br/>CHEM 106B Principles of Chemistry or<br/>CHEM 109 Biochemistry for Health Science and Biotechnology or</p> |
|--|---|

**12. Catalog Description:**

A hands-on lab-based course designed to introduce infrared spectroscopy, this course outlines the various sample handling methods and the numerous transmission and reflectance methods available for infrared analysis. Lab-based lectures will focus on Fourier Transform Infrared (FT-IR) spectroscopy and its advantages, plus instrument set-up and parameters as well as FTIR sample analysis methods. The course provides hands-on training for obtaining representative infrared spectra of analytical samples. Data manipulation, spectral analysis, and functional group identification will also be taught. This course will also focus on UV-Vis spectroscopy as a complementary method to IR analysis. The UV-Vis spectroscopy will focus on general principles such as wavelength, absorption, transmittance, standard curves, Beers-Lambert's Law, solvent effects, hypsochromic and bathochromic shifts, chromophores, conjugation, and UV spectral analysis. This course is designed for all levels of UV-Vis/IR instrument users.

**13. Class Schedule Description:**

Hands-on training for obtaining infrared, ultraviolet and visible spectra for analysis.

**14. Counselor Information:**

This course prepares students for careers as laboratory technicians and researchers in chemistry, biology, biochemistry, and other sciences.

**II. Student Learning Outcomes**

The student will:

1. Evaluate instrument and accessory performance for obtaining the ideal spectrum
2. Demonstrate proper protocols for IR sampling techniques for transmission measurements using KBr pellets, mulls, liquid cells, and films; demonstrate proper protocols for UV-Vis sampling techniques, including handling of cuvettes.
3. Compare and contrast the benefits and disadvantages of various transmission and reflectance measurement methods; choose the best method and/or accessory for collecting infrared data in a particular application.

4. Use one's understanding of functional groups to interpret FTIR spectra.
5. Generate an IR and UV-Vis spectrum, perform quantitative and qualitative analysis where applicable, and be able to manipulate, store, and interpret data.
6. Perform a series of dilutions of a solution and establish a standard curve using Beer's Law; use this curve for finding the concentration of an unknown.
7. Generate a set of UV spectra for a series of common solvents: water, methanol, hexane, etc; demonstrate solvent effects.
8. Generate and interpret a set of UV spectra for a number of known chromophores that contain aromatics and carbonyls.
9. Generate and interpret UV spectra for a series of conjugated and isolated pi bonded organic compounds.

### III. Course Outline:

#### Infrared spectroscopy

Operation of the FT-IR instrument

Theory of FT-IR frequency and wavelength, stretching and bending vibrations

Weak (w), medium (m), strong (s) peaks

Free vs. H-Bonded samples

Dilute and concentrated samples and its effects on the spectra

Solid and liquid sampling techniques - KBr pellets, Nujol mulls, liquid cells and thin films

Common pitfalls to avoid during sample preparation

Functional group identification

Regions of the IR spectrum: fingerprint regions and diagnostics bands

Quantitative analysis using an FT-IR spectrometers

Various sampling accessories to collect data from representative analytical samples

Reflection methods of sample analysis

Library database search procedures and electronic data manipulation

Generate and interpret of IR spectra

Benefits and limitations of the FT-IR sampling methods

#### UV-Visible spectroscopy

Familiarizing with the operation of the many UV-VIS instruments available

Fundamental principles of wavelengths, absorption, transmission, maximum wavelength, electronic transitions

Instrument control:

    spectral measurement

    time course

    fixed wavelength

    Abs/%T monitor

    quantitative analysis

Wavelength selection

Sample compartment

Detectors

Diode array instruments

Cuvette selection and handling

Standard curves

Beer-Lambert's law

Solvent effects on UV spectra

Hypsochromic and bathochromic shifts

Chromophores  
Conjugation and its effects on UV spectra  
Generation and interpretation of IR spectra  
Data manipulation  
Interferences, deviations, maintenance and troubleshooting

#### IV. **Course Assignments:**

##### A. Reading Assignments

1. Textbook
2. Handouts

##### B. Projects, Activities, and other Assignments

1. Lab-based activities such as loading samples, and analyzing spectra, checking system suitability, adjustment of system parameters, monitoring system components, and troubleshooting.

##### C. Writing Assignments

1. Follow acceptable protocols in keeping a lab notebook.

#### V. **Methods of Evaluation/Assessment:**

- A. Exams and quizzes
- B. Laboratory procedures and behavior will be monitored and assessed
- C. Teacher-student conferences
- D. Objective and practical evaluation of students' laboratory skills as demonstrated by the appropriate use of the IR/UV-Vis instruments
- E. Assessment of students' choice of appropriate run parameters, sample preparation, success in obtaining optimum results, and troubleshooting.

#### VI. **Methods of Instruction:**

- A. Lecture
- B. Laboratory
- C. Discussion
- D. Demonstration
- E. Audiovisual
- F. Computer Assisted Instruction
- G. Collaborative Learning
- H. Other
  1. Individual assistance
  2. PowerPoint presentations enhanced by electronic notes made available on instructor's web page
  3. Hands-on industry-based lab experience

#### VII. **Textbooks:**

##### Required

1. John Kenkel *Analytical Chemistry for Technicians* 3rd Edition, CRC Press, 2003 ISBN: 1-56670-519-3
2. Robert B. Silverstein, Francis X. Webster, and David Kiemle *Spectrometric Identification of Organic Compounds* 7th Edition, John Wiley and Sons, 2005 ISBN: 978-0-471-39362

Optional

**VIII. Supplies:**

- A. Goggles with indirect venting and side shielding
- B. Lab coat
- C. Lab gloves
- D. Lab notebook
- E. Scientific calculator

CID 2826