



DEPARTMENT OF SCIENCE
COURSE INFORMATION SHEET FOR
CHE260 – INSTRUMENTAL ANALYSIS

All members of the Science Department at Clinton Community College use the respective course templates as a basis for their course syllabi. Faculty may, at their discretion, change the order of the course content or add course content.

COURSE NUMBER AND TITLE: CHE260 – Instrumental Analysis

COURSE SECTION: *TBA*

CONTACT HOURS: 5 **CREDIT HOURS:** 4

SEMESTER AND YEAR: *TBA*

INSTRUCTOR'S NAME, TELEPHONE NUMBER, EMAIL ADDRESS, OFFICE NUMBER, AND OFFICE HOURS: *TBA*

I. COURSE DESCRIPTION:

This course provides an intensive study of instrumental analysis for the evaluation, separation, isolation, and identification of the chemical components of a variety of both pharmaceutical and environmental samples. Introductory topics covered are measurements, sampling protocol, methods involving the preparation of standards and the basic components common to most instruments. Specific topics deal with sample preparation, instrument design, calibration, operation, data collection, spectral analysis and troubleshooting for each instrument being studied. The instruments used in this course are UV/VIS, FTIR, AA, GC/MS and HPLC. There are two hours of lecture and one four-hour laboratory per week.

II. PREREQUISITE: CHE112 – General Chemistry II or its equivalent

III. COURSE OBJECTIVES:

As the result of instructional activities, students will be able to:

- Obtain, store, log and prepare samples for instrumental analysis.
- Obtain a fair amount of knowledge about environmental samples.
- Prepare a variety of standards for use in instrumental analysis.
- Calibrate a UV/VIS, FTIR, AA, GC/MS and HPLC.
- Describe the theory of how each instrument works.
- Operate a UV/VIS, FTIR, AA, GC/MS and HPLC.
- Interpret spectral data of UV/VIS, FTIR, AA, GC/MS, and HPLC.
- Troubleshoot when instrumental problems arise.

IV. REQUIRED TEXTBOOK AND MATERIALS:

REQUIRED TEXTBOOK:

N/A

REQUIRED MATERIALS:

Safety glasses are required for all on-campus sections.

V. METHODS OF INSTRUCTION/COURSE ORGANIZATION: *To be determined by the respective instructor.*

VI. ATTENDANCE PROCEDURE (INCLUDING MAKEUP POLICY): *To be determined by the respective instructor.*

VII. BIBLIOGRAPHY OF READINGS (IF APPLICABLE): *To be determined by the respective instructor.*

VIII. METHODS OF EVALUATION (INCLUDING THE CALCULATION OF COURSE GRADE): *To be determined by the respective instructor. The methods of evaluation shall include tests (test types, length and weight of each), papers (weight of each), projects (weight of each), and other forms of evaluation (weight of each).*

IX. GRADING SCALE: *To be determined by the respective instructor. The grading scale shall indicate what numerical scores correspond to the following grades: A, A-, B+, B, B-, C+, C, C-, D+, D, and F.*

Please Include: If you have, or suspect you may have, any type of disability or learning problem that may require extra assistance or special accommodations, please speak to me privately after class or during my office hours as soon as possible so I can help you obtain any assistance you may need to successfully complete this course. You should also contact Laurie Bethka, Room 420M in the Academic Assistance Center, for further assistance.

X. GENERAL TOPICS OUTLINE:

- I. Introduction to Chemical Instrumentation
- II. Measurements and Sampling Protocol
 - A. Sampling
 1. Sampling & storage procedures
 2. Standard and sample preparation
 3. Basic units of measurement
 - B. Instrument components
 1. Basic electronics
 2. Detectors
 3. Amplifiers and signal to noise ratio
 4. Microcomputers
 5. Data handling, display and storage
- III. Ultraviolet and Visible Spectroscopy (UV/VIS)
 - A. Basic instrument design
 - B. Sample preparation

1. Standard curve
 2. Typical solvents used for analysis
 3. Cells and cuvettes
 - C. Instrument operations
 1. Calibration
 2. Attenuation
 3. Zeroing
 - D. Collection and interpretation of spectral data
 1. Basic chromophores
 2. Determining lambda max
 3. Beer's Law
 4. Interpolation and extrapolation of data
 - E. Troubleshooting
- IV. Gas Chromatography (GC)
- A. Basic instrument design
 - B. Sample preparation
 1. Typical solvents used for analysis
 2. Internal and external standards
 3. Types of syringes and sample ports
 - C. Instrument operations
 1. Carrier gases
 2. Column specifications
 3. Flow rates
 4. Calibration and theoretical plates
 - D. Collection and interpretation of spectral data
 1. R_f values
 2. Peak height vs. area under the peak
 3. Determining unknowns
 4. Evaluation of spectra for successful separation of samples
 5. Evaluation of spectra for successful isolation of samples
 6. Evaluation of spectra for successful identification of samples
 - E. Troubleshooting
- V. Mass Spectroscopy (MS)
- A. Basic instrument design
 1. Mass analyzers – quadrupole vs. ion trap
 2. Types of MS
 - B. Sample preparation
 - C. Instrument operations
 1. Calibration
 2. Signal processing
 - D. Collection and interpretation of spectral data
 1. Mass-to-charge ratio
 2. Base peak determination
 3. Mass peak determination

4. M^+ , M^{+2} and M^{+3} peaks
5. Fragmentation patterns
- E. Troubleshooting
- VI. GC/MS - Varian 2000 series
 - A. Integration of the two instruments
 1. Method writing
 2. Separation and identification of samples
 3. Spectral analysis and reporting data
 - B. Using the library
- VII. High-Performance Liquid Chromatography (HPLC)
 - A. Basic instrument design
 - B. Sample preparation
 1. Typical solvents used for analysis
 2. Internal & external standards
 3. Mobile-phase preparation
 4. Polar vs. non-polar samples
 - C. Instrument operations
 1. Determining mobile-phase reservoirs & treatment
 - a. Isocratic vs. gradient elution
 2. Column specifications – normal vs. reverse phase
 3. Flow rates and pumps
 4. Detectors
 5. Calibration
 - D. Collection and interpretation of spectral data
 1. R_f values
 2. Peak height vs. area under the peak
 3. Determining unknowns
 4. Evaluation of spectra for successful separation of samples
 5. Evaluation of spectra for successful isolation of samples
 6. Evaluation of spectra for successful identification of samples
 7. Improving separation efficiency
 - E. Troubleshooting
- VIII. Fourier Transfer Infrared Spectroscopy (FTIR)
 - A. Basic instrument design
 - B. Sample preparation
 1. KBr pelleting
 2. 3M sample films
 3. “Neat” samples
 4. Rock salt cells
 - C. Instrument operations
 1. Calibration
 2. IR sources & transducers
 3. Rotation and vibrational modes
 4. Optical system functions
 - D. Collection and interpretation of spectral data
 1. Basic spectral analysis

- a. Functional group region analysis
 - b. Fingerprint region analysis
 - c. % Transmittance
 - d. Wavenumbers
 - E. Troubleshooting
- IX. Atomic Absorption Spectroscopy (AA)
- A. Basic instrument design
 - 1. Flame atomization
 - 2. Graphite furnaces
 - 3. Lamps
 - B. Sample preparation
 - C. Instrument operations
 - 1. Calibration curves
 - 2. Standard addition method
 - 3. Flame control
 - 4. Detection limits
 - D. Collection and interpretation of spectral data
 - 1. Method setup
 - 2. Spectral analysis
 - 3. Data reports
 - E. Troubleshooting
- X. **ACADEMIC INTEGRITY:** Academic honesty is expected of all Clinton Community College students. It is academically dishonest, for example, to misrepresent another person's work as one's own, to take credit for someone else's work or ideas, to accept help on a test, to obtain advanced information on confidential test materials, or to intentionally harm another student's chances for academic success.
- XI. **COURSE CONTINUITY PLAN:** In the case that the college officially closes because of an emergency which causes a short term disruption of this course, we will utilize e-mail to continue this course in the short term (1-3 weeks). All students need to utilize their campus e-mail to receive course related information.