Course Prefix/Number: **CHM 225**
Course Title: **Modern Chemical Analysis**
Lecture Hours/Week: **3.0**
Laboratory Hours/Week: **3.0**
Credit Hours/Semester: **4.0**

Distance Learning Attendance/VA Statement
Textbook Information

COURSE DESCRIPTION

This course is a study of chemical analysis and includes traditional and modern instrumental techniques employed in industrial, physical science, and life science laboratories.

COURSE COMPETENCIES / PERFORMANCE OBJECTIVES

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

Module 1: Introduction to Instrumental Analysis and the Science of Measurement

1. Understand a basic electrical circuit containing resistive, capacitive, and inductive components
2. Apply Ohm's Law to determine current and voltage in simple circuits in series and parallel configurations
3. Describe the function and application of operational amplifiers in circuits
4. Describe methods to reduce noise in instrument signals
5. Distinguish analog and digital signals and describe typical applications of each in instruments
6. Apply tests of precision to evaluate an analytical method
7. Describe typical physical and chemical properties that lend themselves to instrumental methods
8. Discuss precision, bias, sensitivity, detection limit, dynamic range, and selectivity of methods

Module 2: Introduction to Electroanalytical Methods

1. Describe the different types of metallic indicator electrodes used in potentiometry and the common reference electrodes
2. Demonstrate the ability to calculate cell potentials in electrochemical cells
3. Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot an automated electrochemical system
4. Discuss the construction and principles of operation of typical ion selective electrodes
5. Identify the parts of an electrochemical cell and describe conduction in the cell
6. Demonstrate the skill of performing a typical acid-base, halide, redox, complexometric, or Karl
7. Fischer analysis using an automated electrochemical system
8. Describe a pH, potentiometric, and coulometric electrochemical system for automated analysis
9. Describe the electrochemcial principles of potentiometric and coulometric analysis

Module 3: Introduction to Molecular Spectroscopy and Ultraviolet/Visible Methods

1. Describe the operation and function of the components of a typical UV/VIS system and general aspects of the technique

2. Discuss the origins of molecular absorption of ultraviolet and visible light and the relationship to molecular structure
3. Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot a typical UV/VIS system
4. Describe Beer's Law, its application and limitations
5. Identify and discuss the major operational parameters in UV/VIS techniques and the impact of changes in each
6. Demonstrate the skill of performing an analysis using a UV/VIS technique employing a calibration curve and standard addition method Discuss wavelength selection in absorption spectroscopy

Module 4: Introduction to Infrared Spectrometry

1. Describe the operation and function of the components of a typical Infrared system and general aspects of the technique
2. Discuss the relationship between molecular structure and the absorption of infrared radiation
3. Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot an Infrared system
4. Discuss the limitations of quantitative IR analysis
5. Identify and discuss the major operational parameters in Infrared analysis and the requirements of sample preparation
6. Demonstrate the skill of performing a qualitative IR analysis with interpretation of the spectra and comparison with reference spectra of known species

Module 5: Introduction to Atomic Spectroscopy

1. Describe the operation and function of the components of a typical atomic absorption / atomic emission system and general aspects of the technique Discuss matrix effects, sensitivity, and linear range in
2. AA/AE spectroscopy Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot an
3. AA/AE system
4. Discuss the safety aspects of AA/AE techniques
5. Identify and discuss the major operational parameters in AA/AE techniques and the impact of changes in each
6. Demonstrate the skill of performing an AA/AE analysis using different methods of standardization and
7. Calibration

Module 6: Introduction to Chromatography and Gas Chromatographic Separations

1. Describe the operation and function of the components of a typical GC system and general aspects of the technique
2. Discuss isothermal operation and temperature programming techniques and the advantages and disadvantages of each
3. Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot a GC system
4. Discuss the advantages and disadvantages of different GC detectors
5. Identify and discuss the major operational parameters in GC and the impact of changes in each
6. Demonstrate the skill of performing a GC analysis using different typical methods of standardization and calibration

Module 7: Introduction to High Performance Liquid Chromatography

1. Describe the operation and function of the components of a typical HPLC system and general aspects of the technique
2. Discuss isocratic and gradient techniques and the advantages and disadvantages of each
3. Demonstrate the skill to setup, operate, maintain, calibrate, and troubleshoot an HPLC system
4. Discuss the advantages and disadvantages of different HPLC detectors, such as Refractive Index, UV, Conductivity, and Electrochemical
5. Identify and discuss the major operational parameters in HPLC and the impact of changes in each

6. Demonstrate the skill of performing an HPLC analysis using different typical methods of standardization and calibration

MINIMAL STANDARDS

Minimal standards of performance for course competencies are indicated by achieving a 60% accuracy level on all evaluation instruments used in the course performance evaluation strategy.

COURSE REQUIREMENTS Attendance Policy

Students are responsible for attending class and laboratory meetings in the course and for completion of all reading and written assignments. If a student is absent from a class or laboratory meeting, it is the student's responsibility to obtain and complete any assignment that may have been made in the missed meeting. Students who are absent from more than 10% of the total contact class and laboratory hours may be withdrawn from the course in accordance with the York Technical College attendance policy.

Withdrawal From a Course

A student may withdraw from a course after the drop/add period until midterm with a grade of "W" (withdrawn). Students who withdraw after midterm may receive a "W" at the discretion of the instructor if performance has been satisfactory to the point of withdrawal. Otherwise, such withdrawals will receive a grade of "WF."

Student Conduct

Students are required to conform to all conduct codes as specified in the York Technical College Handbook and Catalog. In addition, any incidents of cheating or other academic dishonesty shall result in mandatory withdrawal of the student from the course, assignment of a grade of "F," and possible further disciplinary action as appropriate.

EVALUATION STRATEGIES/GRADING

The competencies of each module may be evaluated by any of the following methods: examination (written or oral), presentation, written report, written assignment, daily quiz, laboratory quiz, homework, or other appropriate instruments. The grading scale for the course will be as follows:

~ Module 1 12% of course grade
~ Module 2 12% of course grade
~ Module 3 12% of course grade
~ Module 4 12% of course grade
~ Module 5 12% of course grade
~ Module 6 12% of course grade
~ Module 7 12% of course grade
~ Final Exam 16% of course grade

A = 90 – 100
B = 80 – 89
C = 70 – 79
D = 60 – 69
F = Below 60

The above requirements and topics are standard and required for the course. Attached is a statement of the instructor's additional requirements and/or policy.

ENTRY LEVEL SKILLS: Microcomputer skills

PREREQUISITES: CHM 220

CO-REQUISITES: None

TOPIC/CONTENT OUTLINE:

- Properties of Measurement
- Molecular Spectroscopy
- Atomic Spectroscopy
- Ultraviolet / Visible Spectrometry
- Atomic Emission Spectrometry
- Atomic Absorption Spectrometry
- Potentiometric Analysis
- Coulometric Analysis
- Electrochemical Analysis
- Chromatography
- Gas Chromatography
- High Performance Liquid Chromatography
- Infrared Spectroscopy

Disability Statement: Any student who feels s/he may need an accommodation based on the impact of a disability should contact the Special Resources Office (SRO) at 803-327-8007 in the 300 area of Student Services. The SRO coordinates reasonable accommodations for students with documented disabilities.