UNIVERSITI TEKNOLOGI MARA

CHM571: BASIC INSTRUMENTAL ANALYSIS

Course Name (English)	BASIC INSTRUMENTAL ANALYSIS APPROVED
Course Code	CHM571
MQF Credit	3
Course Description	This course will interactively engage students cognitively and scientifically in areas of spectroscopy and chromatography. Students will define concepts, state and explain spectroscopic and chromatographic theories, make decision and justification as to the possible outcome of an analysis, perform investigations via laboratory exercises and in writing, discuss results of investigations leading to its relation to the spectroscopic and chromatographic principles or theories. The lecture session is used to discuss the instrumentation and application of each spectroscopic and chromatographic technique. The outcomes shall be assessed through a variety of tools which include the final examination, tests and quizzes, laboratory reports and classroom engagement.
Transferable Skills	Able to conduct instrumental analysis
Teaching Methodologies	Lectures, Blended Learning, Lab Work
CLO	CLO1 Explain the concepts and theories in atomic and molecular spectroscopic and chromatographic methods. CLO2 Apply spectroscopic and chromatographic theories to solve qualitative and quantitative problems. CLO3 Conduct and write report on scientific investigation in areas of spectroscopic and chromatographic methods of analysis.
Pre-Requisite Courses	No course recommendations

Topics
1. 1.0 Spectrometric Methods 1.1) 1.1 An introduction to spectrometric methods. 1.2) 1.2 Properties of electromagnetic radiation. 1.3) 1.3 Emission of radiation; line spectrum, band spectrum and continuum spectrum. 1.4) 1.4 Absorption of radiation. 1.5) 1.5 Atomic and molecular spectrometry.
2. 2.0 Quantitative aspects of spectrometric measurements 2.1) 2.1 Absorption methods; transmittance, absorbance, Beer's law. 2.2) 2.2 Limits of Beer's law. Real limitations to Beer's law, chemical deviation and instrumental deviation. 2.3) 2.3 Emission methods.
3. 3.0 Components of Optical Instruments 3.1) 3.1 General design of optical instruments. 3.2) 3.2 Sources of radiation; continuum and line sources. 3.3) 3.3 Wavelength selectors; monochromators. 3.4) 3.4 Sample cells. 3.5) 3.5 Radiation transducers; photon and thermal transducers. 3.6) 3.6 Signal processors and readouts.
4. 4.0 Molecular Spectroscopy, UV-visible (UV-Vis) and FTIR spectrometers 4.1) 4.1 UV-Vis active molecular species 4.2) 4.2 Electronic transitions 4.3) 4.3 Sample preparation 4.4) 4.4 Wavelength and solvent selection 4.5) 4.5 Quantitative analysis; Beer's law 4.6) 4.6 UV-Vis spectrometer, major components

5. 5.0 FTIR spectroscopy
5.1) 5.1 Introduction and basic theory
5.2) 5.2 Rotational and vibrational transitions
5.3) 5.3 Types of vibrational modes
5.4) 5.4 Infrared absorption and molecular structure
5.5) 5.5 Qualitative analysis; interpretation of spectra, use of characteristic group frequencies and identification of molecular structures.
5.6) 5.6 FTIR spectrometer, major components
5.7) 5.7 Sample preparation; gases, liquids and solids

6. 6.0 Atomic Spectroscopy Atomic absorption spectrometry (AAS) and Atomi
6.1) 6.1 Principles of atomic absorption and atomic emission
6.2) 6.2 Major components of the instruments
6.3) 6.3 Radiation source
6.4) 6.4 Atomizers; flame and graphite furnace atomizers (AAS) and Inductively coupled plasma (AES)
6.5) 6.5 Interferences; spectral and chemical interferences and methods to minimize the interferences
6.6) 6.6 Application of quantitative elemental determination, standard addition method.
6.7) 6.7 Comparison between AAS and AES

7. 7.0 Separation Methods
7.1) 7.1 General introduction to chromatography
7.2) 7.2 Principles and theory of chromatography
7.3) 7.3 Relative migration rates of solutes; retention time, retention and selectivity factors
7.4) 7.4 Column efficiency; Quantitative measures of column efficiency, number of theoretical plates
7.5) 7.5 Column resolution
7.6) 7.6 Quantitative analysis; external and internal standard methods

8. 8.0 Gas Chromatography (GC)
8.1) 8.1 Principles of gas chromatographic separation
8.2) 8.2 Components of the instrument
8.3) 8.3 Carrier gas
8.4) 8.4 Injection port
8.5) 8.5 Columns; packed and capillary
8.6) 8.6 Stationary phases; polar and nonpolar
8.7) 8.7 Detectors; Flame ionization detector, thermal conductivity detector and electron capture detector
8.8) 8.8 Applications of GC

9. 9.0 High Performance Liquid Chromatography (HPLC)
9.1) 9.1 Scope of liquid chromatography
9.2) 9.2 Components of HPLC; mobile phase, pump, injection port, column and detectors
9.3) 9.3 Partition HPLC; Bonded phase packing, normal phase and reversed phase HPLC
9.4) 9.4 Application of partition HPLC
9.5) 9.5 Ion exchange HPLC; principles of separation,
9.6) 9.6 Cationic and anionic ion exchange
9.7) 9.7 Ion exchange equilibria
9.8) 9.8 Ion exchange stationary phases
9.9) 9.9 Suppressor column
9.10) 9.10 Application of ion exchange HPLC
9.11) 9.11 Size exclusion HPLC; principles of separation
9.12) 9.12 Gel filtration and gel permeation
9.13) 9.13 Size exclusion stationary phases
9.14) 9.14 Application of size exclusion HPLC.

10. Lab Practical
10.1) 1 Gas chromatography; qualitative analysis and effects of column temperature on the separation.
10.2) 2 Gas chromatography; quantitative analysis using external standard
10.3) 3 HPLC; qualitative and quantitative analysis
10.4) 4 UV-Vis spectrometer; quantitative analysis
10.5) 5 FTIR spectrometer; qualitative analysis
10.6) 6 Flame AAS; quantitative analysis

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Assignment	Assignment	20%	CLO1
Practical	Lab Report	20%	CLO3
Test	Test	20%	CLO1

Reading List

Recommended Text	• **Holler, F. J., Skoog, D. A. and Crouch, S. R 2007, *Principles of Instrumental Analysis*, 6 Ed., Thomson Brooks/Cole**
Reference Book Resources	• **Skoog D.A., West D.M., Holler F.J. and Crouch 2004, *Fundamentals of Analytical Chemistry*, 8 Ed., Thomson Brooks/Cole**

Article/Paper List	This Course does not have any article/paper resources
Other References	This Course does not have any other resources