



UNIVERSITI TEKNOLOGI MARA

CHM221: CHEMICAL ANALYSIS

Course Name (English)	CHEMICAL ANALYSIS APPROVED
Course Code	CHM221
MQF Credit	4
Course Description	This course is an introduction to quantitative chemical analysis inclusive of the theoretical and practical aspect including the treatment of data using the statistical analysis. The emphasis is on the preparation of standard solution, dilution, cleaning calibrating glassware, the various types of volumetric analysis, gravimetric analysis and chromatography. The outcomes shall be assessed through paper examination, tests, quizzes laboratory skills as well as written laboratory reports.
Transferable Skills	Demonstrate analytical skill using scientific apparatus and basic instruments
Teaching Methodologies	Lectures, Lab Work
CLO	<p>CLO1 State and define the steps and terms involved in various volumetric, gravimetric and basic chromatographic techniques of analysis. (LO1,C1)</p> <p>CLO2 Analyze quantitatively various methods in volumetric analysis, gravimetric analysis and ion-exchange chromatography. (LO4,C4)</p> <p>CLO3 Perform calculations and evaluate the reliability of chemical analysis based on the accuracy, precision, deviation, error and statistical methods. (LO3,C6)</p> <p>CLO4 Conduct experiments and relate the experimental data to the theory of volumetric analysis, gravimetric analysis and chromatography in a written report. (LO2,A4)</p>
Pre-Requisite Courses	No course recommendations
Topics	
1. Introduction to chemical analysis. 1.1) Definition of chemical analysis (qualitative versus quantitative analysis) 1.2) Analyte and interferent 1.3) General steps in analytical process 1.4) Selection of method (wet versus instrumental) 1.5) Sampling and sample preservation 1.6) Sample preparation (homogenizing, drying, dissolution, dry ashing wet digestion)	
2. Basic tools in chemical analysis. 2.1) Correct techniques in using apparatus (analytical balances, oven, furnace, desiccators) 2.2) Correct techniques in using and calibrating volumetric glass wares (burette, pipettes, volumetric flasks) 2.3) Classification of the purity of chemical reagents (Industrial/Technical, Analytical /Reagent ACS grade, Primary standard grade) 2.4) 2.5) Expressing quantities and concentration units 2.6) Moles and millimoles 2.7) Molarity and Normality 2.8) Gravity and specific gravity of solution 2.9) % concentration (% w/w, v/v, w/v), ppm, ppb for liquid and solid	
3. Errors and statistical evaluation of experiment data. 3.1) Classifying experimental errors 3.2) Determinate or systematic error (examples and sources of the error) 3.3) Indeterminate or random error (examples and sources of the error) 3.4) Methods to overcome the errors 3.5) Definition and application of statistical terms 3.6) Precision and accuracy 3.7) Error, absolute error and relative error	

- 3.8) Mean, median, deviation, standard deviation and relative standard deviation.
- 3.9) Population and sample, population mean and sample mean
- 3.10) Methods for reporting analytical data
- 3.11) Q- test
- 3.12) Confidence limit (CL) and confidence interval (CI)

4. Titrimetric analysis

- 4.1) Introduction to volumetric analysis
- 4.2) Primary and secondary standards
- 4.3) Standard solutions, standardization, secondary standard solutions.
- 4.4) Titration, titre, titrant, end point, equivalence point
- 4.5) Direct titration, back titration
- 4.6)
- 4.7) Acid-base titration
- 4.8) Types of acid base titrations
- 4.9) Titration (pH) curves and acid-base indicators
- 4.10) Calculation of percent content involving direct and back titration
- 4.11)
- 4.12) Precipitation titration
- 4.13) Principle of Mohr and Volhard methods
- 4.14) Detection of end point of Mohr and Volhard methods
- 4.15) Calculation involving Mohr and Volhard methods
- 4.16)
- 4.17) Complexometric titration
- 4.18) Definition of complex ions, ligands, chelates, chelating agents
- 4.19) Principle and application of EDTA ligand in analysis of metal ions
- 4.20) Definition and determination of Water hardness
- 4.21)
- 4.22) Redox titration
- 4.23) Standard oxidising agents ($K_2Cr_2O_7$, $KMnO_4$, Iodine)
- 4.24) Principle and quantitative analysis of iodometric and iodimetric titration
- 4.25) Chemical Oxygen Demand (COD) and its calculation

5. Electrochemistry

- 5.1) Definition of electrode potential, reference electrode, standard electrode
- 5.2) Electrochemical cell and calculation on electrode potential of the cell
- 5.3) Writing cell notation (IUPAC symbol)
- 5.4) Application of Nernst equation

6. Gravimetric analysis

- 6.1) Principles and process in gravimetric analysis
- 6.2) Types and properties of precipitates and precipitating reagents
- 6.3) Factors affecting precipitation
- 6.4) Determination of % content using gravimetric analysis

7. Chromatography

- 7.1) Principle of chromatography: Stationary and mobile phase, planar and column
- 7.2) Chromatography, mechanism of chromatography: Partition versus adsorption
- 7.3) Principles and techniques of separations
- 7.4) Paper Chromatography
- 7.5) Thin Layer Chromatography (TLC)
- 7.6) Column chromatography
- 7.7) Ion-exchange chromatography (IEC)
- 7.8) Application of IEC in salt water purification ($NaCl$ and $CaCl_2$)

Assessment Breakdown	%
Continuous Assessment	50.00%
Final Assessment	50.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Online Quiz	Topic 1	10%	CLO1
	Presentation	topic 2 & 3	25%	CLO2
	Written Report	Lab report	15%	CLO4

Reading List	Reference Book Resources	<ul style="list-style-type: none"> • Douglas A.Skoog, Donald M. West 2004, <i>Fundamentals of Analytical Chemistry</i>, eighth edition Ed., Thomson Brooks USA • Gary D. Christian 2006, <i>Analytical Chemistry</i>, 6 Ed., John Wiley and Sons New Jersey USA • Daniel, C. Harris 2003, <i>Quantitative Chemical Analysis</i>, sixth edition Ed., W.H. Freeman and Company New York , USA • Harvey, D. 2000, <i>Modern Analytical Chemistry</i>, McGraw-Hill Higher Education Singapore
	Article/Paper List	This Course does not have any article/paper resources
Other References	This Course does not have any other resources	