



## UNIVERSITI TEKNOLOGI MARA

### CHM421: ANALYTICAL CHEMISTRY

<b>Course Name (English)</b>	ANALYTICAL CHEMISTRY <b>APPROVED</b>
<b>Course Code</b>	CHM421
<b>MQF Credit</b>	4
<b>Course Description</b>	This course involves theories and techniques in Analytical Chemistry. Students will define concepts, explain principles and applications, solve qualitative and quantitative problems and perform investigations via laboratory exercises. The outcomes shall be assessed through paper examination, tests and quizzes, laboratory technique skills and written laboratory reports.
<b>Transferable Skills</b>	Written report Team work Thinking scientific skill
<b>Teaching Methodologies</b>	Lectures, Blended Learning, Lab Work
<b>CLO</b>	CLO1 Describe the functions of laboratory apparatus, standard laboratory techniques as well as the principles involve in sampling and preparing laboratory samples. CLO2 Explain the principles and applications of volumetric, gravimetric and basic chromatography analyses to solve the reliability of experimental data. CLO3 Demonstrate the theories covered by performing experiments on volumetric titrations, gravimetric analysis and chromatography. CLO4 Report on experimental findings in a scientific manner.
<b>Pre-Requisite Courses</b>	No course recommendations
<b>Topics</b>	
<b>1. Introduction (Definition)</b> 1.1) 1.1 Units for Quantities and Concentration 1.2) 1.2 Mole and millimole 1.3) 1.3 Molarity, normality, stoichiometry 1.4) 1.4 % concentrations (% w/w, w/v, v/v), ppm and ppb for solid and liquid 1.5) 1.5 Density and specific gravity of solution	
<b>2. Apparatus &amp; Techniques</b> 2.1) 2.1 Balances 2.2) 2.1.1 Analytical balances 2.3) 2.1.2 Care & use 2.4) 2.1.3 Error in weighing (buoyancy) 2.5) 2.2 Volumetric glasswares 2.6) 2.2.1 Units of volume 2.7) 2.2.2 Pipettes 2.8) 2.2.3 Burettes 2.9) 2.2.4 Volumetric flask 2.10) 2.3 Water for laboratory use: Deionised and distilled water, different grades of water 2.11) 2.4 Heating apparatus; Burners, hotplates, electric ovens, microwave ovens, furnace 2.12) 2.5 Desiccators 2.13) 2.6 Filtration apparatus & techniques 2.14) 2.7 Titration apparatus & techniques 2.15) 2.8 Reagents (different grades) and purification of substance	

### **3. Sampling & evaluation of experimental data**

- 3.1) 3.1 Sampling
- 3.2) 3.1.1 Methods for sampling solid, liquid, gas
- 3.3) 3.1.2 Reduction to laboratory size sample
- 3.4) 3.1.3 Dissolution of sample; Wet ashing, dry ashing, microwave, fusions
- 3.5) 3.1.4 Elimination of interferences-distillation, masking agent
- 3.6) 3.2 Evaluation of experimental data
- 3.7) 3.2.1 Types and sources of error.
- 3.8) 3.2.2 Mean, median, precision and accuracy
- 3.9) 3.2.3 Standard deviation and pooled standard deviation
- 3.10) 3.2.4 Significant figure and uncertainty
- 3.11) 3.2.5 Confidence limits (when ? is known and when ? is unknown) and significance test.
- 3.12) 3.2.6 Gross Error and Q-test

### **4. Titrimetric analysis**

- 4.1) 4.1 Standards
- 4.2) 4.1.1 Primary and secondary standards
- 4.3) 4.1.2 Standard, stock and working solutions
- 4.4) 4.2 Dilution and standardisation
- 4.5) 4.3 Acid-base titrations
- 4.6) 4.3.1 Principles and applications
- 4.7) 4.3.2 Neutralisation curves (Equivalent point, pH, indicator)
- 4.8) 4.3.2.1 Strong acid versus strong base
- 4.9) 4.3.2.2 Strong acid versus weak base
- 4.10) 4.3.2.3 Weak acid versus strong base
- 4.11) 4.3.2.4 Weak acid versus weak base
- 4.12) 4.3.3 Indicator and choice of indicator
- 4.13) 4.3.4 Quantitative analysis
- 4.14) 4.3.5 Back-titration
- 4.15) 4.4 Complexometric titrations
- 4.16) 4.4.1 Principles and applications (Water hardness)
- 4.17) 4.4.2 EDTA as complexing agent
- 4.18) 4.4.3 Titration curves
- 4.19) 4.4.4 Indicator
- 4.20) 4.4.5 Quantitative analysis
- 4.21) 4.5 Precipitation titrations
- 4.22) 4.5.1 Principles and applications
- 4.23) 4.5.2 Titration curve
- 4.24) 4.5.3 Mohr, Fajans and Volhard method
- 4.25) 4.5.4 Quantitative analysis
- 4.26) 4.6 Redox titration
- 4.27) 4.6.1 Principles and applications (COD)
- 4.28) 4.6.2 Iodimetry and iodometry
- 4.29) 4.6.3 Quantitative analysis

### **5. Gravimetric analysis**

- 5.1) 5.1 Types of gravimetric method
- 5.2) 5.2 Properties of precipitate and precipitating agents
- 5.3) 5.3 Conditions for precipitation
- 5.4) 5.4 Homogenous precipitation
- 5.5) 5.5 Colloid and crystalline precipitate (supersaturation)
- 5.6) 5.6 Filtering, drying and igniting precipitate
- 5.7) 5.7 Quantitative analysis

### **6. Conventional separation techniques**

- 6.1) 6.1 Distillation, precipitation and crystallisation
- 6.2) 6.1.1 Principles and applications
- 6.3) 6.2 Extraction
- 6.4) 6.2.1 Types of extraction; solid-liquid, liquid-liquid
- 6.5) 6.2.2 Principles and applications
- 6.6) 6.3 Chromatography
- 6.7) 6.3.1 Planar chromatography
- 6.8) 6.3.1.1 Paper and thin layer chromatography (TLC).
- 6.9) 6.3.1.2 Principles, techniques and applications
- 6.10) 6.3.2 Column/Elution chromatography
- 6.11) 6.3.2.1 Principles, techniques and applications (ion-exchange )

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Lab Exercise	Lab exercise (Jotter)	5%	CLO3
	Test	Test	40%	CLO1
	Written Report	Written lab report	15%	CLO4

Reading List	Recommended Text	<ul style="list-style-type: none"> <li>Skoog, D.A., West, D.M., Holler, H.J., Crouch 2004, <i>Analytical Chemistry</i>, 8 Ed., Thomson Brooks/Cole</li> </ul>
	Reference Book Resources	<ul style="list-style-type: none"> <li>Mendham, J., Denney, R.C., Barnes, J.D., Thom 2000, <i>Vogels Textbook of Quantitative Chemical A</i>, 6 Ed., UK: Prentice Hall</li> <li>Christian, G.D. 2003, <i>Analytical Chemistry</i>, 6 Ed., U.S: Wiley International Edition</li> <li>Chang, R. 2007, <i>Chemistry</i>, 9 Ed., McGraw-Hill Higher Education, US</li> <li>Harvey, D. 2000, <i>Modern Analytical Chemistry</i>, McGraw-Hill Higher Education, Singapore</li> </ul>

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