UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2023-2024

<table>
<tr><td colspan="2">Title of theCourse</td><td colspan="7">Advanced Analytical Chemistry-II</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">424C2A</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of analytical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To interpret and analyze data acquired during testing of samples.
To understand the principle of absorption and emission using flame techniques
Selection of the chromatographic technique to separate and identify molecules and ions.
To understand the role of surface analytical techniques in qualitative and quantitative analysis.
To understand basic theory & instrumentation involved with analytical techniques for characterization and imaging</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: Errors and Sampling techniques: Nature of quantitative measurements and treatment of data. Basic statistical concepts – Errors random and systematic, mean, median, precision and accuracy, significant figures, Gaussian distribution curves, Null Hypothesis, Confidence interval of mean, Rejection of data (Q test), Student’s t, F tests. Reliability of results, Regression and correlation. Quality control and controlchart.
Analytical Chemical standards, types and traceability, Evaluation of Analytical process, Analytical Method Calibration. Chemical Measurement Process (CMP) – concept and steps.
Principles of sampling methods for solid, liquids and gases. Gross sampling, Sampler’s responsibility and pitfalls, hazards of sampling.</td></tr>
<tr><td colspan="8">UNIT-II: Emission Techniques: Flame Photometry – Theory, Instrumentation and a few important applications.
Emission Techniques – Theory, techniques of excitation, electrodes and their shapes, flame and plasma emission spectrometry – instrumentation and application.
Atomic Absorption Spectrometry – Theory, instrumentation (flame and flameless atomization), ICP and their applications.
Types of interfaces, background correction and applications.</td></tr>
<tr><td colspan="8">UNIT-III: Gas and HPLC : GC-Types, nature and selection of stationary and mobile phases, solid supports and their choice, columns – packed, open and capillary, sampling methods, instrumentation, detectors – types, sensitivity, limit of detection, operative principles of TCD, FID and ECD, comparison of detectors, temperature programming, derivative chromatography, hyphenated techniques qualitative and quantitative applications GC-MS and GC-IR
HPLC - Theory and equipments, types of pumps and their choice, types of columns and choice of column materials, detectors and applications.
Size exclusion chromatography – Theory, gel filtration and gel permeation
Supercritical fluid
chromatography.</td></tr>
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	UNIT-IV: XPS: Electron spectroscopy for Chemical Analysis (ESCA) – Principle, Instrumentation – X-ray source, detectors, magnetic shielding and its applications – Quantitative analysis, chemical shifts, oxidation state and structure. XRF – principle and applications. Auger electron spectroscopy – Theory, Principle, instrumentation and general applications –qualitative analysis and depth profiling of solid surfaces.
	UNIT-V: Spectroscopy and Thermal techniques: Mossbauer spectroscopy: Introduction, principle, instrumentation, recoil energy, Doppler effect, number of MB signals, isomer shift, quadrupole splitting, magnetic hyperfine splitting applications to 57Fe, 119Sn and 129I compounds Raman Spectroscopy: SERS, SERRS. ATR techniques – UV, IR, Raman. Principle & application of ORD and CD in the identification of complexes. 3D, 4D & 5D NMR imaging techniques Thermal methods of analysis – TGA, DTA and DSC – Principle and applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Fundamentals of Analytical Chemistry - Skoog, West and Holler, Saunders College Publishing, VI Edition, 1991, and VII Edition, 1996. 2. 2. Text Book of Quantitative Inorganic Analysis – A.I. Vogel, ELBS, III Edition, 1976, and IV Edition, 1985 3. Vogel's Text Book of Quantitative Chemical Analysis – A.I. Vogel, Pearson Education Ltd, VIEdition, 2001 4. Skoog, D. A; Holler, F.; Crouch, S (2017); Principles of Instrumental Analysis, 7th Ed, Brooks/Cole publisher.

Reference Books	1. Analytical Chemistry – Gary D. Christian, John Wiley & Sons, INC, V Edition, 2001 2. Statistics for Analytical Chemistry – J.C. Miller and J.N. Miller, Ellis Harwood, Chichester,1984. 3. Willard, H. H.; Merritt, L.L. Jr.; Dean, J.A.; Settle, F. A. Jr. (2004); Instrumental methods of analysis CBS Publishers & Distributors; 7th Ed, ISBN 13: 9780534081423 4. Macomber, R. S (1998); A complete introduction to Modern NMR Spectroscopy, John Wiley,ISBN: 0-471-15736-8. 5. Physico – Chemical Techniques of Analysis – P.B. Janardhan, Vol. I & II.
Website and e-learning source	1. https://www.youtube.com/watch?v=iHrKsfw827c-Chromatographic Techniques 2. https://www.youtube.com/watch?v=jozx6dOoyxA-XPS

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:
CO1: To calculate errors by applying the correct concept and collect a sample for analysis.
CO2: To understand the mechanism of functioning of emission techniques
CO3: To understand the role of GC and HPLC in separation of compounds.
CO4: To qualitatively and quantitatively determine the composition of a surface
CO5: To study the fundamental properties of materials using various sophisticated techniques

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low