

UNIVERSITY OF MADRAS
B.Sc. DEGREE PROGRAMME IN CHEMISTRY
SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Course	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS						
Paper No.	SEC 6 (Discipline specific)						
Category	Skill Enhancement Course	Year Semester	II IV	Credits	2	Course Code	224S4A
Instructional hours per week	Lecture	Tutorial	Lab Practice		Total		
	2	-	-		2		
Prerequisites	General Chemistry						
Objectives of the course	<p>The course aims at providing an overall view of the</p> <ul style="list-style-type: none"> • operation and troubleshooting of chemical instruments • fundamentals of analytical techniques and its application in the characterization of compounds • theory of chromatographic separation and • theory of thermo / electro analytical techniques • stoichiometry and the related concentration terms 						
Course Outline	<p>UNIT-I Qualitative and Quantitative Aspects of Analysis S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Density and Specific Gravity of Liquids. Stoichiometry Calculations Sampling, evaluation of analytical data, Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Coefficient of Variation, Confidence Limits, Q- test, F-test, T-test. The Least Square Method for Deriving Calibration plots.</p> <p>UNIT II Atomic Absorption Spectroscopy: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.</p>						

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	<p>UNIT III UV-Visible and IR Spectroscopy Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.</p> <p>UV-Visible Spectrometry: Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Infrared Spectroscopy: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.</p> <p>UNIT IV Thermal and Electro-analytical Methods of Analysis TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of silver nitrate, calcium oxalate and calcium acetate DSC- Principle, Instrumentation and applications.</p> <p>Electroanalytical methods: polarography - principle, instrumentation and applications. Derivative polarography- Cyclic Voltammetry - principle.</p>
	<p>UNIT V Separation and purification techniques</p> <p>Classification, principle, Factors affecting - Solvent Extraction – Liquid - Liquid Extraction, Chromatography: Column, TLC, Paper, Gas, HPLC and Electrophoresis, Principle, Classification, Choice of Adsorbents, Solvents, Preparation of Column, Elution Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms and R_f value.</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</p>

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Recommended Text	<ol style="list-style-type: none"> 1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman. 2. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007 3. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017). 4. R. Speyer, Thermal Analysis of Materials, CRC Press, 1993. 5. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th edn., Prentice Hall of India Private Ltd., New Delhi, 1993
Reference Books	<ol style="list-style-type: none"> 1. D. A. Skoog, D. M. West and F. J. Holler, Analytical Chemistry: An Introduction, 5th edn., Saunders college publishing, Philadelphia, 1998. 2. Dash U N, Analytical Chemistry; Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011. 3. Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004. 4. Mikes, O. & Chalmes, R.A. Laboratory Handbook of Chromatographic & Allied Methods, EllesHarwood Ltd. London 5. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, sixth edition Pearson Education, 2000
Website and e-learning sources	<ol style="list-style-type: none"> 1. http://www.epa.gov/rpdweb00/docs/marlap/402-b-04-001b-14-final.pdf 2. http://eric.ed.gov/?id=EJ386287 3. http://www.sjsu.edu/faculty/watkins/diagram.htm 4. http://www.britannica.com/EBchecked/topic/108875/separation-and-purification 5. http://www.chemistry.co.nz/stoichiometry.htm
<p>Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to</p> <p>CO1: apply error analysis in the calibration and use of analytical instruments, explain theory, instrumentation and application of flame photometry and Atomic Absorption spectrometry</p> <p>CO2: explain theory, instrumentation and application of UV visible and Infrared spectroscopy.</p> <p>CO3: able to discuss instrumentation, theory and applications of thermal and electrochemical techniques</p> <p>CO4: explain the use of chromatographic techniques in the separation and identification of mixtures</p> <p>CO5: explain preparation of solutions, stoichiometric calculations</p>	

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	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

Level of Correlation between PSO's and CO's