



University of Kerala

Discipline	CHEMISTRY				
Course Code	UK4DSCCHE201				
Course Title	ANALYTICAL PRINCIPLES I				
Type of Course	DSC				
Semester	4				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	2 hours	-	4 hours	6
Pre-requisites	1. Higher secondary level chemistry 2. UK1DSCCHE100				
Course Summary	The course covers significant figures, error analysis, and various chromatographic techniques including HPLC, TLC, and paper chromatography, as well as solvent extraction and gravimetric analysis methods. Practical components include inorganic qualitative analysis and gravimetric analysis techniques, providing students with hands-on experience in analytical chemistry methods and preparing them for accurate and precise chemical analysis in research and industry settings.				

Detailed Syllabus:

Module	Unit	Content	Hrs
		ANALYTICAL PRINCIPLES I	90
I		SIGNIFICANT FIGURES & ERRORS IN CHEMICAL ANALYSIS	6
	1	Significant figures and Reporting Data, Rules of Computing.	2
	2	Accuracy & Precision, Classification of errors: Determinate & Indeterminate Errors, Detection & Minimisation of errors, Propagation of Indeterminate Error	4
II		CHROMATOGRAPHY	9
	3	Overview of Analytical Separation, Classification of Chromatographic Methods, General description of chromatography, Principles of chromatographic separations, Classification of chromatography: Adsorption, Partition, Ion exchange and Size exclusion chromatography	2
	4	General Theory of Column Chromatography, Theory of Column Efficiency in Chromatography, Chromatographic Resolution, Capacity Factor, Column Selectivity, Column Efficiency, Optimizing Chromatographic Separations	2



	5	High-Performance Liquid Chromatography, Stationary Phases in HPLC, Chiral Stationary Phases, Equipment for HPLC, Detectors	2
	6	Thin-layer chromatography (TLC), R_f values, TLC stationary phases, TLC mobile phases, TLC sample application, HP TLC development, development tanks, HPTLC gradient elution, HPTLC, spot visualization,	2
	7	Paper chromatography: principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, different development methods-ascending, descending, horizontal, circular spreading	1
III	QUALITATIVE ANALYSIS & SOLVENT EXTRACTION		9
	8	Inorganic qualitative analysis – systematic approach and testing schemes. Importance of qualitative analysis in research, industry, and environmental monitoring. Need for elimination of interfering acid radicals and their elimination methods – oxalate, fluoride, borate, phosphate, chromate, arsenite and arsenate. Common ion effect, solubility product and their application in qualitative analysis.	3
		Solvent Extraction: Principles, Advantages, Separation factor/ Efficiency, Multiple Extraction, Factors Affecting Solvent Extraction, Counter current distribution principle (Craig counter current extraction, Solvent Extraction Methods: Chelate extraction, Extraction by solvation, Ion pair formation, Synergic extraction	4
	9	Techniques of Solvent Extraction: Batch, Continuous & Counter current Extraction, Applications of Solvent Extraction	2
IV	GRAVIMETRIC ANALYSIS		6
	10	Introduction to gravimetric analysis, Types: Precipitation, Volatilization and Particulate Gravimetry Precipitation methods, the colloidal state, Supersaturation and precipitate formation, Factors influencing precipitation, Co-precipitation & post-precipitation Conditions of precipitation, Precipitation from homogeneous solution,	4
	11	Ageing and filtration of precipitate, filter papers, Gooch crucible, Sintered glass crucible, Washing, drying and ignition of precipitates.	1
	12	Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG)	1
V	PRACTICALS: INORGANIC QUALITATIVE ANALYSIS &		60
	I	Qualitative Inorganic Analysis (Micro Analysis)	42
	13	Studies of the reactions of the following basic radicals with a view to their identification and confirmation: Lead, Copper, Bismuth, Cadmium, Tin, Antimony, Ferrous, Ferric ions, Aluminium, Chromium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Magnesium, Potassium and Ammonium ions/radicals	10
	14	Studies of the reactions of the following acid radicals with a view to their identification and confirmation:	10



		Carbonate, Sulphide, Nitrite, Nitrate, Fluoride, Chloride, Bromide, Iodide, Borate, Acetate, Oxalate, Chromate, Phosphate and Sulphate anions.	
	15	Systematic qualitative analysis by microscale methods of salt mixtures containing two acidic and two basic radicals from the above list (more than one interfering radical should be avoided). (Minimum 8 mixtures are to be analysed)	22
	II	Inorganic Preparations (Open ended – Minimum 4 preparations) Preparations of <ol style="list-style-type: none"> 1. Potash alum 2. Hexamine cobalt Chloride 3. Tetramine copper Sulphate 4. Mohr’s salt 5. Microcosmic salt 6. Sodium cobalt nitrate 7. Sodium nitroprusside 8. vii) Manganese phthalocyanin 9. Potassium trioxalatochromate 10. Potassium trioxalatoferrate 	18

References

1. Vogel, *A Text Book of Quantitative Inorganic Analysis*, Longman, 5th edition, 1989.
2. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, Saunders College Publishing, 7th edition, 1996.
3. J. Holme and H. Perk, *Analytical Biochemistry*, 3rd edition, Prentice Hall, 1998.
4. K. Sharma, *Analytical Chemistry by PDF*, Krishna Prakashan Media(P) Ltd., 2nd Edition, 2006
5. Gary D. Christian, Purnendu K. Dasgupta, Kevin A. Schug, *Analytical Chemistry –*, Wiley, 7th edition, 2013.
6. Skoog and D. M. West, *Principles of Instrumental Analysis*, Saunders College Publishing, 5th edition, 1998.
7. V.V.Ramanujam, “*Semi micro–Qualitative Analysis*”
8. E.S.Gilreath “*Qualitative Analysis using semi micro method*” Mc Graw Hill.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Apply principles of significant figures, computational rules,	Ap	PSO-1,2,3



	accuracy, precision, and error analysis to perform reliable quantitative calculations and report analytical data with minimized and properly evaluated uncertainty.		
CO-2	Analyse and interpret chromatographic separation processes by evaluating principles, mechanisms, efficiency parameters and optimization strategies across column chromatography, HPLC, TLC and paper chromatography.	An	PSO-1,2,3
CO-3	Evaluate the effectiveness and reliability of inorganic qualitative analysis and solvent extraction techniques in achieving accurate separation and identification of chemical species in analytical and industrial contexts.	E	PSO-1,2,3,5
CO-4	Design and optimise gravimetric analytical procedures by selecting appropriate precipitation conditions, reagents, filtration systems and post-treatment steps to achieve accurate and reliable quantitative determination of analytes.	C	PSO-1,2,3,5
CO-5	To design and implement systematic microscale qualitative schemes to accurately identify and confirm basic and acidic radicals in complex inorganic salt mixtures.	C	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ANALYTICAL PRINCIPLES I

Credits: 2:0:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO- 1,6 PSO-1,2,3	Ap	F, C	L	-
2	CO-2	PO- 1,3,6 PSO-1,2,3	An	C, P	L	-
3	CO-3	PO- 1,2,3,6 PSO-1,2,3,5	E	P, M	L	-
4	CO-4	PO- 1,2,6	C	P, M	L	-



		PSO-1,2,3,5				
5	CO-5	PO- 1,2,6 PSO-1,2,3	C	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 2	3	2	3	-	-	1	-	1	-	-	2	-	-
CO 3	3	3	3	-	2	1	1	1	-	-	2	-	-
CO 4	2	3	2	-	2	1	2	-	-	-	2	-	-
CO 5	2	3	3	-	-	1	1	-	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓		✓	✓
CO 4	✓	✓	✓	✓
CO 5	✓			✓

