

## **SECOND SEMESTER 2022-2023**

## **Course Handout (Part - II)**

Date:16.01.2023

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CHEM F329
Course Title Analytical Chemistry
Instructor-in-charge : N. RAJESH

- 1. **Course Description:** Data handling, sample preparation, unit operations, volumetric analysis, potentiometry, chromatography, solvent extraction, trace metal separation and estimation in biological and environmental samples with emphasis on green chemistry.
- 2. **Scope & Objective of the Course:** The objective of this course is to provide a comprehensive survey of the basic concepts in analytical chemistry. The topics to be covered include a brief review of classical methods of analysis, data handling, instrumental methods of analysis and their applications. Separation methods in environmental analytical chemistry such as solvent extraction and chromatography will also be dealt with in detail. The course involves considerable classroom participation in the form of analyzing case studies, group discussions etc. Considerable emphasis would be given to **greener methodologies for the detoxification of toxic metal ions, dyes, PCB's etc from industrial effluents. Lab component involving the above methods would form a part of the evaluation scheme.**

**Text Book:** T1. Analytical Chemistry, GARY. D. CHRISTIAN, 6<sup>th</sup> ed. Wiley, 2003.

**Reference Book:** R1. Fundamentals of analytical chemistry, Skoog, West Holler, 7<sup>th</sup> Ed, Harcourt Pub, 2001.

## 3. Course Plan:

Lec.	Topics to be Learning outcome Learning Objectives		Chapter in the Text Book	
No.	Covered			
3	Data handling,	Relevance of statistics	Reliability of data,	Chap. 1,2 (T1)
	sampling in analysis	in handling data	statistical test, sampling	
			of solids, liquids and	
			gases.	
2	Complexometric	Importance of	EDTA method to	Chap. 8 (T1)
	titration's and redox   classical methods in   estimate total hardness			
	titrations	environmental appln	in water , Redox	
			titrations	
3	Chromatography	Separation principles	Principal of all types of	Chap. 17 (T1)
	basic concepts		chromatography and	
			their utility in analysis	
4	Ion exchange and	Relevance in	Cation exchange and	Chap. 17 (T1)
	adsorption	separation science and	anion exchange	
		technology	separations	
			emphasizing green	
			chemistry	
3	GC and HPLC	Sophisticated	Principles and	Chap. 17 (T1)
		instrumental	application of GC and	
		separation in industry	HPLC.	

hydrometallurgy and nuclear industry  3 UV-visible and IR spectroscopy  Beer's Law, Photometric estimation, selection rules in IR, interpretation of IR spectra  2 Atomic absorption spectroscopy and ppb analysis in diverse applications  2 Automation in analysis  2 Automation in analysis  4 Potentiometry  Polarography  Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  4 Environmental analysis  A Radioanalytical methods or toxic contaminants  Relevance of analysis of methods for toxic contaminants  Relevance of analysis of toxic metal in environment  Relevance of analysis of analytical techniques in ruce analysis of anal	3	Solvent Extraction	Importance in	Extraction of metal	Chap. 16 (T1)
association complexes, applications emphasizing green chemistry  3 UV-visible and IR spectroscopy spectrophotometric principles in trace analysis in diverse applications of in diverse applications analysis in allysis in electroanalytical techniques in trace analysis  4 Potentiometry Importance of electroanalytical techniques in trace analysis  2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations (Estimations) Especiations (Estimations) Especiation and sub ppb level analysis of toxic metal ions  4 Environmental analysis (Estimations) Especiation and sub ppb level analysis of toxic contaminants (Estimations) Esticides and other trace metals in environment  1 Radioanalytical muclear chemistry (Estimations) Estective estimations (Estimations) Esticides and other trace metals in environment (Estimations) Esticides and other trace metals in environment (Estimations) Estimations (Estimations) Estimations (Estimations) (Estim	3	Solvelit Extraction	Importance in	1	Cliap. 10 (11)
applications emphasizing green chemistry  3 UV-visible and IR spectroscopy spectroscopy analysis in diverse applications automations in industry and its relevance today  4 Potentiometry Importance of electroanalytical techniques in trace analysis			5	1	
a UV-visible and IR spectroscopy spectrophotometric principles in trace analysis and ppb analysis in diverse applications analysis analysi			nuclear maustry		
Chemistry   Chap. 14 (T1)					
3 UV-visible and IR spectroscopy   Sectrophotometric principles in trace analysis   Sectroscopy   Sectrophotometric principles in trace analysis   Sectroscopy   Sectros					
spectroscopy  spectrophotometric principles in trace analysis  2 Atomic absorption spectroscopy  and ppb analysis in diverse applications  2 Automation in analysis  analysis  4 Potentiometry  Description spectroscopy  Importance of electroanalytical techniques in trace analysis  Trace metal estimations  4 Environmental analysis  A Environmental analysis  Relevance of analytical enemistry  Relevance of toxic contaminants  Relevance of electroanalytical techniques in race analysis  A Environmental analysis  Relevance of analytical techniques in unclear chemistry  Redox titrations, pHmetry, ion-selective electrodes and applications  DC polarography and its utility in chemical analysis  Selected methods for trace metal ons  Analysis of air, water, pesticides and other trace metals in environment  Relevance of analytical techniques in nuclear chemistry  Redox titrations, pHmetry, ion-selective and applications  DC polarography and its utility in chemical analysis  DC polarography and its utility in chemical analysis  Selected methods for trace metal ons  Analysis of air, water, pesticides and other trace metals in environment  Relevance of analytical techniques in nuclear chemistry in nuclear chemistry  Byb level analysis of toxic metal in environment  Relevance of analytical techniques in nuclear chemistry gamma spectrometry beta counters isotope beta counters isotope		1177 : :11	TT 1 . 1		
principles in trace analysis  Importance in ppm and ppb analysis in diverse applications  Automation in analysis  Automation in analysis  Potentiometry  Importance of electroanalytical techniques in trace analysis  Polarography  Importance of electroanalytical techniques in trace analysis  A Trace metal  Environmental analysis  Principles in trace analysis  Principles in trace analysis  Importance in ppm and ppb analysis in diverse applications  Process control automation on line analyzers, computers in analytical chemistry  Redox titrations, Phmetry, ion-selective electrodes and applications  DC polarography and its utility in chemical analysis  DC polarography and its utility in chemical analysis  Felected methods for trace metal estimations  P. 681-753 (T1)  Analysis of air, water, pesticides and other trace metals in environment  Relevance of analytical techniques in trace analysis of toxic contaminants  Relevance of analytical techniques in trace metals in environment  Relevance of analytical techniques in trace analysis of toxic metal in environment  Relevance of analytical techniques in trace metals in environment spectrometry beta counters isotope beta counters isotope	3			1	Chap. 14 (11)
analysis rules in IR, interpretation of IR spectroscopy  Atomic absorption spectroscopy  and ppb analysis in diverse applications  Automation in analysis  Potentiometry  Potentiometry  Polarography  Trace metal estimations  Trace metal analysis  Process control automation on line analyzers, computers in analyzers, computers in analytical techniques in trace analysis  Polarography  Trace metal estimations  Process control automation on line analyzers, computers in analyzers, computers in analytical chemistry  Redox titrations, pHmetry, ion-selective electrodes and applications  PC polarography and its utility in chemical analysis  PC polarography and its utility in chemical analysis  PC polarography and its utility in chemical analysis of toxic metal ions  PC polarography and its utility in chemical analysis of toxic metal ions  Analysis of toxic metal estimations  PC polarography and its utility in chemical analysis of toxic metal ions  Analysis of toxic metal ions  PC polarography and its utility in chemical analysis of toxic metal ions  Analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Redioanalytical methods  Relevance of analytical techniques in nuclear chemistry  In Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry  PC polarography and its utility in chemical analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Lecture notes		spectroscopy			
Importance in ppm and ppb analysis in diverse applications   Flame AAS, graphite furnace AAS, applications				1	
2 Atomic absorption spectroscopy			analysis	, ,	
Atomic absorption spectroscopy  Automation in analysis  2 Automation in analysis  2 Automation in analysis  3 Potentiometry  4 Potentiometry  4 Potentiometry  Importance of electroanalytical techniques in trace analysis  2 Polarography  Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  A Environmental analysis  Relevance of electroanalytical techniques in trace methods  A Relevance of electroanalytical techniques in trace analysis  A Environmental analysis  Relevance of estimations  Relevance of analytical techniques in trace methods  A Relevance of analytical techniques in trace methods  A Relevance of analytical techniques in moulear chemistry  A Radioanalytical methods  Relevance of analytical techniques in muclear chemistry  A Radiochemistry, gamma spectrometry beta counters isotope  AAS, applications  Process control automation on line analyzers, computers in				_	
spectroscopy and ppb analysis in diverse applications  2 Automation in analysis  2 Automation in analysis  3 Automation in analysis  4 Potentiometry  4 Potentiometry  Importance of electroanalytical techniques in trace analysis  2 Polarography  Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  A Environmental analysis  Relevance of analytical techniques in trace methods  Relevance of analytical transplant in trace analysis  Relevance of analytical transplant in trace analysis  A Environmental analysis  Relevance of analytical techniques in trace methods  Relevance of analytical techniques in trace metal estimations  Relevance of analytical techniques in trace metals in environment  Relevance of analytical techniques in trace methods  Relevance of analytical techniques in trace methods  Relevance of analytical techniques in trace methods  Relevance of analytical techniques in trace metals in environment  Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry beta counters isotope					
diverse applications applications  Automation in analysis automations in industry and its relevance today analytical techniques in trace analysis  Polarography  Polarography  Importance of electroanalytical techniques in trace analysis  Trace metal estimations  Environmental analysis  Relevance of methods  Relevance of analytical trace metals in environment  Radioanalytical analytical electronanalytical standards in nuclear chemistry beta counters in analysis control automation on line analyzers, computers in analyzers, computer	2	_			Chap. 15 (T1)
Automation in analysis  Analysis, computers in analyzical tensity, phlmetry, ion-selective electrodes and applications  Automation in automation on line analyzical tensity in analyzics of control automation on line analyziers, computers in analyziers, computers i		spectroscopy		,	
analysis automations in industry and its relevance today  4 Potentiometry Importance of electroanalytical techniques in trace analysis  2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations Emirations  4 Environmental analysis  4 Environmental analysis  A Environmental analysis  A Relevance of methods  B Relevance of electrodes and applications  B DC polarography and electrodes and applications  Chap. 21  (T1)  (R1)  (R1)  A Potentiometry Importance of electroanalytical its utility in chemical analysis  Selected methods for analysis of toxic metal ions  A P. 681-753 (T1)  A Radioanalytical methods  R Relevance of analytical techniques in nuclear chemistry  B Redox titrations, pHmetry, ion-selective electrodes and applications  DC polarography and (T1)  (R1)  (R1)  A P. 681-753 (T1)  A Radiochemistry, pesticides and other trace metals in environment  R Radiochemistry, gamma spectrometry beta counters isotope				<del>  ^ ^</del>	
industry and its relevance today  4 Potentiometry  Importance of electroanalytical techniques in trace analysis  2 Polarography  Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  4 Environmental analysis  A Relevance of electroanalytical toxic contaminants  Final provided its utility in chemical analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Relevance of electroaes and applications  DC polarography and its utility in chemical analysis  Selected methods for analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry  Bradox titrations, pHmetry, ion-selective electrodes and applications  DC polarography and its utility in chemical analysis of toxic methods for analysis of toxic metal ions  Analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Rectox titrations, pHmetry, ion-selective electrodes and applications  Chap. 21  (T1)  (R1)  Relevance of analysis of air, water, pesticides and other trace metals in environment  Rector itrace metal in environment  Lecture notes	2		<u> </u>	1	Chap. 19 (T1)
relevance today A Potentiometry Importance of electroanalytical techniques in trace analysis  Polarography Importance of electrodes and applications  Polarography Importance of electrodes and applications  DC polarography and its utility in chemical analysis  Trace metal estimations  Utility of distinct methods for trace metal analysis  Environmental analysis  P. 681-753 (T1)  Environmental analysis of toxic metal ions  P. 681-753 (T1)  A Environmental analysis of toxic contaminants  P. 681-753 (T1)  A Environmental analysis of air, water, pesticides and other trace metals in environment  Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry  Bradioanalytical techniques in nuclear chemistry  DC polarography and its utility in chemical analysis of toxic methods for analysis of toxic methods for analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Radiochemistry, gamma spectrometry beta counters isotope		analysis		1	
4 Potentiometry Importance of electroanalytical techniques in trace analysis  2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations Entironmental analysis  4 Environmental analysis  4 Environmental analysis  7 Radioanalytical methods  8 Redox titrations, pHmetry, ion-selective electrodes and applications  9 DC polarography and its utility in chemical analysis  8 Selected methods for analysis of toxic metal ions  9 P. 681-753 (T1)  8 Analysis of air, water, pesticides and other trace metals in environment  1 Radioanalytical methods  1					
electroanalytical techniques in trace analysis  Polarography Importance of electroanalytical techniques in trace analysis  Trace metal estimations  Utility of distinct methods for trace metal analysis  Environmental analysis  Environmental analysis  Relevance of toxic contaminants  Radioanalytical methods methods  Relevance of analytical techniques in nuclear chemistry methods  Relevance of analytical techniques in unclear chemistry methods  Relevance of analytical techniques in unclear chemistry methods  P. 681-753 (T1)  Chap. 21 (T1) (R1)  Rhaptical techniques analysis of toxic metal ions  P. 681-753 (T1)  Lecture notes  Lecture notes				, , ,	
techniques in trace analysis applications  2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations Environmental analysis  4 Environmental analysis ppb level analysis of toxic contaminants  Takedioanalytical methods  Trace metal electrodes and applications  DC polarography and its utility in chemical attainity in chemical analysis  Selected methods for analysis of toxic metal ions  Analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry beta counters isotope  Take Chap. 21  (T1)  (R1)  P. 681-753 (T1)  Lecture notes	4	Potentiometry			Chap.11,12 (T1)
analysis applications  2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations Environmental analysis  5 Environmental analysis  A Environmental analysis					
2 Polarography Importance of electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  5 Speciation and sub ppb level analysis of toxic contaminants  1 Radioanalytical methods  Relevance of methods  1 Radioanalytical techniques in nuclear chemistry  1 Speciation and sub ppb level analysis of toxic metal ions  2 P. 681-753 (T1)  3 P. 681-753 (T1)  4 Lecture notes  4 Lecture notes  4 Lecture notes  5 P. 681-753 (T1)  6 P. 681-753 (T1)  7 P. 681-753 (T1)  8 P. 681-753 (T1)  8 P. 681-753 (T1)  9 P. 681-753 (T1)  9 P. 681-753 (T1)  1 Lecture notes			techniques in trace	electrodes and	
electroanalytical techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  5 Selected methods for methods for trace metal analysis  4 Environmental analysis  5 Selected methods for analysis of toxic metal ions  4 Analysis of air, water, pesticides and other trace metals in environment  1 Radioanalytical methods  Takedioanalytical methods  Relevance of analytical techniques in nuclear chemistry  1 Radioanalytical methods  Trace metal methods for analysis of toxic metal ions  Analysis of air, water, pesticides and other trace metals in environment  Radiochemistry, gamma spectrometry beta counters isotope			analysis	applications	
techniques in trace analysis  4 Trace metal estimations  4 Environmental analysis  5 Environmental analysis  4 Environmental analysis  5 Environmental analysis  6 Environmental analysis  7 Environmental analysis  8 Environmental analysis  9 Environmental pb level analysis of toxic metal ions  8 Analysis of air, water, pesticides and other trace metals in environment  1 Radioanalytical methods  1 Radioanalytical analytical techniques in nuclear chemistry  1 Environment metals in environment  1 Radioanalytical methods  1 Radioanalytical spectrometry beta counters isotope  1 Environmental spectrometry beta counters isotope  1 Environmental spectrometry beta counters isotope	2	Polarography			Chap. 21
analysis  4 Trace metal estimations  4 Environmental analysis  5 Environmental analysis  Analysis of toxic metal ions  Analysis of air, water, pesticides and other toxic contaminants  Trace metal ions  Analysis of air, water, pesticides and other toxic contaminants  Trace metals in environment  1 Radioanalytical methods  Relevance of analytical techniques in nuclear chemistry beta counters isotope  P. 681-753 (T1)  Lecture notes  Lecture notes				its utility in chemical	(T1)
4 Trace metal estimations  4 Environmental analysis  5 Elected methods for analysis of toxic metal ions  4 Environmental analysis  5 Environmental analysis  4 Environmental analysis  5 Environmental analysis  5 Environmental analysis  6 Environmental analysis  7 Environmental analysis  8 Environmental analysis of pesticides and other trace metals in environment  1 Radioanalytical methods  7 Relevance of analytical techniques in nuclear chemistry  8 Environmental analysis  9 Environmental analysis  Analysis of air, water, pesticides and other trace metals in environment  1 Radioanalytical gamma spectrometry beta counters isotope			techniques in trace	analysis	(R1)
estimations methods for trace metal analysis of toxic metal ions  4 Environmental analysis of ppb level analysis of ppb level analysis of toxic contaminants analysis of air, water, pesticides and other trace metals in environment  1 Radioanalytical methods analytical techniques in nuclear chemistry beta counters isotope    Radioanalytical methods   Radiochemistry, gamma spectrometry beta counters isotope   Lecture notes			analysis		
metal analysis ions  4 Environmental Speciation and sub ppb level analysis of toxic contaminants methods  1 Radioanalytical methods  metal analysis ions  Analysis of air, water, pesticides and other trace metals in environment  Radiochemistry, gamma spectrometry in nuclear chemistry beta counters isotope  Lecture notes  Lecture notes	4	Trace metal		Selected methods for	P. 681-753 (T1)
4 Environmental analysis Speciation and sub ppb level analysis of pesticides and other trace metals in environment  1 Radioanalytical methods Relevance of analytical techniques in nuclear chemistry beta counters isotope  Analysis of air, water, pesticides and other trace metals in environment  Lecture notes  Lecture notes		estimations	methods for trace	analysis of toxic metal	
analysis ppb level analysis of toxic contaminants pesticides and other trace metals in environment  1 Radioanalytical Relevance of methods analytical techniques in nuclear chemistry beta counters isotope  pesticides and other trace metals in environment  Radiochemistry, Lecture notes  analytical techniques gamma spectrometry beta counters isotope			metal analysis		
toxic contaminants trace metals in environment  Radioanalytical Relevance of methods analytical techniques in nuclear chemistry beta counters isotope  toxic contaminants trace metals in environment  Radiochemistry, Lecture notes  gamma spectrometry beta counters isotope	4	Environmental	Speciation and sub	Analysis of air, water,	Lecture notes
environment  Radioanalytical Relevance of Radiochemistry, Lecture notes methods analytical techniques gamma spectrometry in nuclear chemistry beta counters isotope		analysis	ppb level analysis of	pesticides and other	
1 Radioanalytical Relevance of analytical techniques gamma spectrometry in nuclear chemistry beta counters isotope			toxic contaminants	trace metals in	
methods analytical techniques gamma spectrometry in nuclear chemistry beta counters isotope				environment	
methods analytical techniques gamma spectrometry in nuclear chemistry beta counters isotope	1	Radioanalytical	Relevance of	Radiochemistry,	Lecture notes
in nuclear chemistry   beta counters isotope		_	analytical techniques	· ·	
				1 0	
				dilution analysis	

## 4. Evaluation scheme

S No.	Component	Duration	Weightage (%)	Date and Time	Nature of component
1	Mid semester test	90 min.	35	18/03 4.00 - 5.30PM	Closed book
2	Lab experiments		15	Continuous	Open
*3	Assignments/Quiz		10	Take home	Open
4.	Comprehensive. Exam.	3 hr	40	20/05 AN	Closed book

<sup>\*</sup>Home assignment topics would be given and each student is expected to submit a report on the assigned topic which will be evaluated.

- **5**. **Make-up Policy:** Make-up will be granted for only very genuine and deserving cases.
- **6 Chamber Consultation hours:** To be announced in the class.

- **7 Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.
- 8. **Notices:** Relevant notices regarding the course will be displayed on Chemistry Notice Board/CMS.

Instructor-In charge N. RAJESH

