Subject: Principles and Techniques of Analytical Chemistry -MSCAC11501

Type of course: Major

Prerequisite: Before studying Principles and Techniques of Analytical Chemistry, students should have basic knowledge of: Fundamental concepts of general chemistry (atoms, molecules, elements, and compounds),Chemical reactions, stoichiometry, and solution preparation,Acids, bases, pH, and buffer solutions,Introduction to chemical equilibrium and oxidation–reduction reactions.

Rationale: The study of Principles and Techniques of Analytical Chemistry provides students with the knowledge and practical skills required to identify and quantify chemical substances accurately. It introduces the principles of qualitative and quantitative analysis, sampling methods, and modern analytical techniques such as titrimetry, gravimetry, chromatography, and spectroscopy. This subject develops critical thinking, problem-solving abilities, and laboratory competence essential for quality control, environmental monitoring, pharmaceutical analysis, food testing, clinical laboratories, and research.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	00	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

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Course Content:

Unit No.	Course content	Hrs	% Weightage
1	**Errors in Analytical Chemistry**: Limitations of analytical methods, Classification of errors, Accuracy, Precision, Minimization of errors, Mean and standard deviation, Distribution of random errors, Reliability of results, Confidence interval, Comparison of results, Comparison of the means of two samples, Paired t-test, Analysis of Variance (ANOVA)	15	25
2	**Tools of Analytical Chemistry:** Chemicals, Apparatus, and Unit Operations of Analytical Chemistry, Selecting and Handling Reagents and Other Chemicals, Cleaning and Marking of Laboratory Ware, Evaporating Liquids, Measuring Mass, Equipment and Manipulations Associated with Weighing, Filtration and Ignition of Solids, Measuring Volume, Calibrating Volumetric Glassware, Safety in the Laboratory	15	25
3	**Gravimetric Methods of Analysis**: Precipitation Gravimetry, Specific Surface Area of Colloids, Calculation of Results from Gravimetric Data, Gravimetric Titrations, Applications of Gravimetric Methods	15	25
4.	**Titrations in Analytical Chemistry:** Volumetric Calculations, Neutralization Titrations, Complexation and Precipitation Reactions and Titrations and related applications	15	25
	Total	60	100

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	**Error Detective:** Find the Mistake:Students identify and correct errors in the given questions, statements, or solutions. This activity enhances observation, critical thinking, and problem-solving skills through individual or group discussion and uploaded the same to the GMIU Web Portal.	10
2.	**Analytical Tools Explorer:** Students identify and explain the uses of common analytical chemistry instruments and techniques. This activity improves their understanding of	

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	laboratory tools and their applications through observation and discussion and uploaded the same to the GMIU Web Portal.	
3.	**Arrange the Gravimetric Steps :** Students arrange the steps of the gravimetric analysis process in the correct sequence, from precipitation to weighing. This activity reinforces their understanding of the procedure and improves analytical thinking through group discussion and uploaded the same to the GMIU Web Portal.	10
4.	**Titration Technique Challenge :** Students match different types of titrations with their indicators, reactions, and applications. This activity enhances their understanding of titration principles and analytical techniques through collaborative learning and uploaded the same to the GMIU Web Portal.	10
5.	Attendance	10
Total		**50**

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	30%	30%	30%	10	00	00

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Explain and classify errors in analytical measurements and evaluate the accuracy, precision, reliability, and statistical significance of analytical results.

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CO2	Apply statistical methods such as mean, standard deviation, confidence interval, *t*-test, and ANOVA for comparison and interpretation of analytical data.
CO3	Demonstrate the proper selection, handling, cleaning, calibration, and use of chemicals, laboratory apparatus, and analytical equipment with appropriate safety practices.
CO4	Apply gravimetric methods for the quantitative determination of analytes, including precipitation, calculation of results, and evaluation of practical applications.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

1. Fundamental of Analytical Chemistry IXth edition by D.A. Skoog, D. M. West, F.J Hooller & S. R. Crouch Brooks /Cole Publication.

2. ANALYTICAL CHEMISTRY BY OPEN LEARNING, A SERIES OF 34 TITLES(SET) by ELIZABETH PRICHARD (Author).

3. Quantitative Analysis by D A Ray and Underwood 4. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G.H. Jeffory, J. Busseff, J.M endliam & R.C. Denny

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