Subject: Instrumental Methods of Analytical Chemistry -MSCAC11504

Type of course: Major

Prerequisite: Students should have basic knowledge of general, organic, and physical chemistry, including the mole concept, solution preparation, concentration calculations, acid–base chemistry, chemical equilibrium, and basic laboratory techniques. Elementary mathematical and statistical skills will help students understand the working principles, measurements, and interpretation of instrumental analytical methods.

Rationale: Instrumental Methods of Analytical Chemistry provides students with basic knowledge of modern instruments used for the identification, determination, and analysis of chemical substances. It connects fundamental chemical principles with instrumental techniques, data interpretation, and practical laboratory applications. The course builds a foundation for advanced analytical methods, research, quality control, and industrial applications.

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	% Weight age
1	**Volumetric analysis:** Acid base titrations: Indicators; Oxidation-reduction titrations; Complexation using ligands, complexometric titration with EDTA, metal ion indicators; simple calculations; analysis of Na2CO3,Fe2O3 , Brass, Solder etc	12	25
2	**Thermo analytical technique** Differential, thermal analysis and differential scanning calorimetry, thermogravimetry, methodology of DSC, DTA and TG, thermo mechanical analysis, thermometric titrations and applications. Problems	16	25
3	**Refractometry:** Refractive index nair, nvac, conversion of nair to nvac, principle of working of Abbe's refractometer, immersion refractometer, Pulfrich refractometer, Hilger-Chance, recording refractometers, application of Abbe's refractometer. **Nephelometry and Turidimetry:** Theory, standards (NTU), instrumentation, applications. **Polarimetry**: Theory of optical rotator dispersion, circular dichroism theory and applications, multicomponent analysis.	16	25
4.	**Conductometry:** Electrolytic conductivity, conductance, conductivity, equivalent conductance, measurement of electrolytic conductance, conductance cells, conductometric titrations, types of conductometric titrations, applications. **Polarography**: Theoretical principles, residual current, migration current, diffusion current, half wave potential, quantitative techniques, wave height, internal standard method, method of standard addition, measurement of wave height from polarographs, applications.	16	25
	Total	60	100

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Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	**Indicator Selection Activity** Students are given different acid–base titration examples and identify the suitable indicator (e.g., methyl orange or phenolphthalein.	10
2.	**Match the Technique** Students match TGA, DTA and DSC with their principles, measured properties and applications using simple cards.	10
3.	**Concept Identification Quiz** Students identify the correct principle/application from short questions related to refractive index, turbidity and NTU.	10
4.	**Simple Problem-Solving Activity** Students calculate specific rotation from given experimental values and discuss factors affecting optical rotation.	10
5.	**Technique Comparison Activity** Students prepare a simple comparison table showing principle, measurement, instrument and applications of conductometry and polarography.	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%	20%	20%	00	00

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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 the basic principles, instrumentation, and working of major instrumental methods used in chemical analysis.
CO2	Describe the principles and applications of spectroscopic, electroanalytical, and separation techniques used for qualitative and quantitative analysis.
CO3	Apply suitable instrumental analytical techniques for the identification, separation, and quantitative determination of chemical substances.
CO4	Interpret and evaluate instrumental data, spectra, and analytical results to determine the composition and concentration of samples.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher in addition to conventional teaching methods by black board, may also use any 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 the laboratory.

Reference Books:

[1] Instrumental Methods of Analysis, B. K. Sharma, Goel Publishing hous

[2] E,J.Bair. Introduction to Chemical Instrumentation. Mc Graw-Hill, New York, 1962.

[3] E.D.Olsen, Modern Optical Metho1ds of Analysis, Mc.Graw Hilll, New York, 1975.

[4] Spectroscopic Methods in Organic Chemistry by Dudley H. WIR NOVADVE Hill Publishin

[5] F.J.Welcher, Ed., standard Methods of Chemical Analysis, 6th ed., Vol.3 Part A. Van Nostrand Rein hold. New York, 1966.

[6] J.J.Lingane Electronanalytical Chemistry, Iind ed. Wiley – Inter science, New York, 1958.