



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3163610

Semester – VI

Subject Name: Analytical Techniques

Type of course: Chemical Technology

Prerequisite: Needs basic knowledge of Chemistry

Rationale: The main objective of this subject is to develop sufficient knowledge about the major instrumental methods of chemical analysis and instrumental techniques so that they can determine what technique should be used to solve a particular problem.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Fundamentals of Analytical Chemistry: Concept of quality: Definition of quality, Quality control & assurance, TQM. Correlation between quality & analysis, steps & types of chemical analysis, Stoichiometry & expression of concentration.	04	10
2.	Theory of errors: Sources & classification of errors. Statistical treatment of analytical data & presentation of result. Sampling of solids, liquids & gases. Evaluation & validation of analytical methods. Good laboratory practices.	04	10
3.	Chromatographic methods: Introduction & classification of chromatography. Theory, instrumentation & applications of the following chromatographic techniques: (i) Column chromatography (ii) TLC (iii) Paper chromatography (iv) GC (v) HPLC	15	30
4.	UV-Visible Spectroscopy: Introduction, Theory of UV-Visible Spectroscopy & colourimetry, Beer Lambert law, Deviation from Beer Lambert law. Infrared Spectroscopy: Introduction, Infrared radiation & its interaction with organic molecules, vibrational mode of bonds, instrumentation & applications, interpretation of IR spectra. Nuclear magnetic resonance spectroscopy: Introduction, Theory & Instrumentation, chemical shift concept, spin spin coupling, isotopic nuclei, reference standards & solvents, applications. Mass spectrometry: Basic principles & brief outline of	18	25



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	instrumentation. Ion formation, molecular ion, meta stable ion, fragmentation process in relation to molecular structure & functional groups.		
5.	Volumetric analysis: Acid base titrations: Indicators; Oxidation-reduction titrations; Complexation using ligands, complexometric titration with EDTA, metal ion indicators; simple calculations; analysis of Na_2CO_3 , Fe_2O_3 , Brass, Solder etc.	04	10
6.	Quantitative analysis. Precipitation, types of precipitates, impurities, co precipitation, post-precipitation, conditions for precipitation, precipitation from homogeneous solution. Gravimetric determination of Fe, Ni & Cu, calculations. TGA	05	15

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	15	15	10	5	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Course Outcomes:

Sr. No.	CO statement	Marks weightage	%
CO-1	To describe the theoretical principles and important applications of classical analytical methods within titration.	10	
CO-2	To distinguishes various separation techniques in chromatography and typical applications of chromatographic techniques.	30	
CO-3	To interpret assurance of quality, safety and efficacy of drugs, pharmaceuticals and of any Compound.	10	
CO-4	To identify the different types of errors and its significance	10	
CO-5	To explain Gravimetric estimation of different alloys and its importance.	15	
CO-6	To design the structure of unknown compound using different spectroscopy and interpret the data.	25	



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List of Experiments:

1	Gravimetric Estimation of nickel (II) as nickel- dimethylglyoxime.
2	Volumetric Analysis of given sample of steel alloy.
3	Volumetric Analysis of given sample of brass alloy.
4	To determine the Rf value of amino acids in the given mixture by paper chromatography
5	To separate different components using Thin Layer Chromatography (TLC).
6	To determine λ_{\max} and concentration of unknown solution of KMnO_4 using Colorimeter.
7	To find out amount of Ca^{+2} in tap and RO water by EDTA titration.
8	To separate different components using Column Chromatography.
9	To find out Refractive Index using Refractometer.
10	To Determine the turbidity of given sample in NTU unit by turbidity meter.

Reference Books:

1. Instrumental Methods of Chemical Analysis, E. W. Ewing, McGraw Hill, New York. 4th Ed, 1975
2. Instrumental Methods of Analysis, B. K. Sharma, Goel Publishing house.
3. Elementary Organic Spectroscopy, Y.R. Sharma, S.Chand & company Ltd. New Delhi 2008
4. Principles of Instrumental Analysis by Douglas Skoog, 2nd Edition, 1980.
5. Fundamentals of Molecular Spectroscopy by Colin N Banwell and Elaine M McCash , McGraw Hill, 4th edition, 2016.
6. Instrumental Methods of Analysis 7th Edition by Willard, CBS PUBLICATION, 7th Edition, 2004
7. Spectroscopy of Organic Compounds by P S Kalsi, New Age International Publishers, 6th Edition, 2004.

List of Open Source Software/learning website:

1. NPTEL
2. MIT Open course lecture available on Internet etc
3. Delnet