॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Established on 17th September, 1994. Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) M. Sc. II year - Analytical Chemistry (Affiliated College)
2) M. Sc. II year - Biochemistry (Affiliated College)
3) M. Sc. II year - Organic Chemistry (Affiliated College)
4) M. Sc. II year - Physical Chemistry (Affiliated College)
5) M. Sc. II year - Inorganic Chemistry (Affiliated College)
6) M. Sc. II year - Analytical Chemistry (Campus)
7) M. Sc. II year - Industrial Chemistry (Campus)
8) M. Sc. II year - Medicinal Chemistry (Campus)
9) M. Sc. II year - Organic Chemistry (Campus)
10) M. Sc. II year - Physical Chemistry (Campus)
11) M. Sc. II year - Polymer Chemistry (Campus)
12) M. Sc. II year - Computer Management (Affiliated College)
13) M. Sc. II year - Computer Sciene (Affiliated College)
14) M. Sc. II year - Software Engineering (Affiliated College)
15) M. Sc. II year - System Administration & Networking (Affiliated College)
16) M. Sc. II year - Computer Application (Campus)
17) M. Sc. II year - Computer Network (Campus)
18) M. Sc. II year - Computer Science (Campus)
19) M. Sc. II year - Zoology (Campus)
20) M. Sc. II year - Zoology (Affiliated College)
21) M. Sc. II year - Physics (Campus)
22) M. Sc. II year – Physics (Affiliated College)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/993
दिनांक १३.०६.२०२४

डॉ. सरिता लोसरवार
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

Two Years Post Graduate Degree Program in
Analytical Chemistry

(Faculty of Science and Technology)

Revised Syllabi as per NEP-2020 for

M.Sc. Second Year

ANALYTICAL CHEMISTRY

(For Affiliated Colleges)

To be implemented from
Academic year 2024 - 2025

Framed by
BOARD OF STUDIES IN ANALYTICAL CHEMISTRY

Syllabus for M. Sc. Analytical Chemistry, Second Year

Semester – III & IV

As Per National Education Policy- 2020

To be implemented from

Academic Year 2024-2025

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHCT1501

Title of the Course: Advanced Spectroscopic Methods

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- Students are acquainted with various spectroscopic techniques to elucidate the known and unknown organic molecules.
- Students are familiar with the ultra-violet and visible spectroscopy by determining the absorption maximum of various dienes, enones and aromatic organic compounds.
- Student develops the detail knowledge to get the different peaks of functional groups in organic molecules by infra-red spectroscopy.
- Students understand the importance and applications of proton magnetic resonance spectroscopy for determination of structure of unknown organic compounds.
- Students are recognizable with CMR to authenticate the position of carbon atom in organic molecules.
- Students identified the structure of compounds by fragmentation of various classes of organic molecules.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**UV-VIS AND IR SPECTROSCOPY:**	**17**
	1.1	**UV-Vis Spectroscopy:** Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Fieser-Kuhn rules for polyenes. UV spectra of aromatic compounds and heteroaromatic compounds. Calculation of □max for the benzene derivatives (R-C6H4-Co-G) by A. I. Scott emperical rules.	
	1.2	**IR spectroscopy:** Recapitulation, Characteristic vibration frequencies of Alkanes, Alkenes, Alkynes, Aromatic compounds, Alcohols, Ethers, Phenols and Amines. Detailed study of vibrational frequencies of carbonyl compounds Ketones, Aldehydes, Esters, Amides, Acids, Anhydride, Lactose, Lactams and Conjugated Carbonyl compounds. Factors affecting group frequencies: overtones, combination bands and	

		Fermi-resonance. FITR and sampling techniques.	
2.0		**^{1}H NMR AND ^{13}C NMR SPECTROSCOPY:**	**15**
	2.1	General introduction and definitions, Chemical shift, Spin-spin interaction, Shielding mechanism of measurement of chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehyde and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). Factors affecting chemical shift. Deuterium exchange. Spin-spin coupling, factors affecting coupling constant. Complex spin-spin interaction between two and three nuclei. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique. Nuclear Over-Hauser effect (NOE). Resonance of other nuclei; ^{19}Fand ^{31}P.	
	2.2	**^{13}C NMR Spectroscopy:** Resolution and multiplicity of ^{13}C NMR, ^{1}H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE signal enhancement, off-resonance, proton decoupling, Structural applications of CMR.	
3.0		**MASS SPECTROMETRY AND ESR**	**15**
	3.1	**Mass Spectrometry:** Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms- singly and doubly charged ions, metastable peak, base peak, isotropic mass peaks, relative intensity, FTMS, etc.; Recognition of M+ ion peak; General fragmentation rules: Fragmentation of various classes of organic molecules, including compounds containing oxygen, sulfur, nitrogen and halogens; α, β-, allylic and benzylic cleavage; McLafferty rearrangement.	
	3.2	**Electron Spin Resonance Spectroscopy**: Basic principle, Hyperfine Splitting (isotropic systems); the g-value and the factors affecting thereof; interactions affecting electron energies in paramagnetic species (Zero-field splitting and Kramer's degeneracy); Electron-electron interactions, anisotropic effects (the g-value and the hyperfine couplings); Structural applications to carbon, nitrogen and oxygen based organic mono, bi and polyradicals.	
4.0		**Structural Problems:**	**10**
	4.1	Combined problems on UV, IR, NMR and Mass spectral data for structure determination.	
	4.2	Elucidation of structure of organic molecules using spectra (IR, PMR&CMR).	
		Total	**60**

Course outcomes:

1. Know the use electronic spectroscopy to determine absorption maximum in dienes, enones and aromatic compounds.
2. Know the applications of IR spectroscopy for functional group determination.
3. Learn the structure elucidation of organic compounds by PMR spectroscopy.
4. Gathering basic knowledge to know the position of carbon in carbon compounds.
5. Recognize the molecular mass of the organic molecule by fragmentation pattern.
6. Know the complete structure of compounds using UV, IR, PMR, CMR and Mass spectroscopic methods.

Reference Books:

1. Spectroscopic Identification of Organic Compounds, R. M. Silverstern, G. C.Bassler and T. C. Morril.
2. Introduction to NMR spectroscopy, R. J. Abraham, J. Fisher and P. Loftus.
3. Application of spectroscopy of organic compounds, J. R. Dyer.
4. Spectroscopy of organic compounds, P. S. Kalsi.
5. Organic Spectroscopy, William Kamp.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd.
7. Practical NMR spectroscopy, M. L. Martin, J. J. Delpench and G. J. Martin.
8. Spectroscopic methods in organic Chemistry, D. H. William, I. Fleming.
9. Fundamentals of Molecular spectroscopy, C.N.Banwel.
10. A Handbook of Spectroscopic Data of Chemistry, B. D. Mistry.
11. Elementary Organic Spectroscopy, Y. R. Sharma.
12. Organic Radicals by Chuanyi Wang, Abdelkader Labidi and Eric Lichtfouse
13. https://pubs.acs.org/doi/abs/10.1021/cr400056a

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHCT1502

Title of the Course: Fundamentals of Analytical Chemistry (FAC)

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- To the fundamentals of Analytical Chemistry and to acquire the knowledge of various analytical methods.
- To cover important basic concept of analytical chemistry like errors and evaluation of analytical data.
- Discuss mole concept, various concentrations units of solutions and Chemical calculations General concepts of Chemical Equilibrium Factors affecting chemical equilibrium constant-temperature, pressure.

3	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**BASIC CONCEPTS OF ANALYTICAL CHEMISTRY**	**15**
	1	Role of analytical chemistry, Type of analysis, classification of analytical methods, selection an analytical method, cleanliness and neatness in analytical laboratory, Laboratory notebook, safety in the analytical laboratory, laboratory operations and practices, sample preparation for analysis types of sampling, sampling of solid, liquid and gas. Weighing the sample dissolving the sample, sample decomposition, analytical balance, electronic balance, single pan mechanical balance semi micro and micro balance care and use of analytical balance, Techniques of weighing, weighting errors. Volumetric glassware cleaning, calibration of glassware.	
2.0		**ERRORS AND EVALUATION OF ANALYTICAL DATA**	**16**
	2	Mean, median, range, precision, accuracy and standard deviation. Types and source of errors, determinant error, indeterminant error, minimization of errors, Confidence of limits significance figure and computation rules, Methods for reporting the analytical data statistical evaluation of the data reliability and rejections of the results, Linear least squares methods, correlation coefficient. Use of scientific calculators. Problems	

3.0		**MOLE CONCEPT AND CHEMICAL CALCULATIONS**	**16**
	3	Mole Concept, molecular weight, formula weight, and equivalent weight. compounds for Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, dilution, equivalence, milliequivalents, millimoles, pH, pOH calculations of equivalents in acid base, redox, precipitation, complexation, reactions. Calculation of concentration from density and percentage, Problems, Numerical.	
4.0		**GENERAL CONCEPTS OF CHEMICAL EQUILIBRIUM:**	**14**
	4	Chemical reaction, rate concept, type of equilibria, Gibbs free energy and equilibrium constant it equilibrium constant Le Chatelier's principle, temperature effect on equilibrium constant, pressure, concentration, catalysis, completeness of reaction on equilibria. Equilibrium constant for dissociating or combining species weak electrolytes and precipitate the common ion effect shifting the equilibrium, calculations using equilibrium, constants, Common ion effect, activity and activity co-efficient, diverse ion effect, thermodynamic equilibrium constant and activity coefficient Problems.	
		Total	**60**

COURSE OUTCOMES:

1. Understand the basic concepts and techniques used in analytical methods.
2. To find different types of errors in analytical data and to evaluation of analytical data.
3. Learn mole concept, various concentrations units of solutions and chemical calculations.
4. Aware general concept of chemical equilibrium and factor affecting on it

Reference Books:

1. L.Erdey, gravimetric analysis. Oxford: Pergamon, 1965
2. J.s.Fritz, Acid-Base Titration in Non-aqueous Solvents, Boston : Allyn and Bacon, 1973
3. W.F.Hillebrand, G.E.F. Lundell, H.A.Bright and J.I.Hoffman, applied Inorganioc Analysis 2nd ed. New York: Wikky, 1953
4. I.M.Kolthoff, V.a.Stenger and R.Bekher, Volumetric Analysis, New York: Inter Science 1942-57, Three volumes.
5. R.Bock, Decomposition Methods in analytical Chemistry, New York, Wiley 1979
6. R.A.Day, Jr.A.L.Underwood,, Quantitative Analysis, Sixth ediction 1991, Preutict Hall, INC, Engle Wood Clits, N.J.U.S.A.
7. J.H.Kenndy, Analytical Chemistry: Principles, 2nd ed. Saunders College Publishing,

New York, 1990
8. D.A.Skoog, D.M.West and F.J.Holler. Fundamentals of Analytical Chemistry. 6th ed.Saunders College Publishing, New York 1992
9. F.W.Fifield and D.Kealey. Principles and Practice of Analytical Chemistry. 3rd ed. Blackie Glasgopw and Lonmdon (1990)
10. J.H.Jeffery et.al., Vogel's Text book of Quantitative Chemical Analysis, 5th ed. ELND Longman (1989)

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHCT1503

Title of the Course: Chromatography in Chemical Analysis I

[No. of Credits: 2 Credit] **[Total 30 Lectures]**

Course objectives:

- To familiarize student with various chromatographic techniques used for separation and analysis of sample.
- To study the general principal of chromatography.
- To study the separation of different compounds of paper, Than layer, column chromatography.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**GENERAL PRINCIPLES OF CHROMATOGRAPHY**	**08**
	1	Definition of terms, migration rates of solutes, partition ratio, retention time, dead time, relation between retention time and partition ratio, rate of solute migration (The capacity factor), differential migration rates (The selectivity factor), efficiency of chromatographic columns, rate theory of chromatography, column efficiency, plate height, number of theoretical plates, definition of plate height, experimental evaluation of H & N	
2.0		**PAPER CHROMATOGRAPHY**	
	2	Sample solution, application of sample solution to the paper, choice of solvent, development of chromatogram, drying of the paper, location of spots on paper chromatogram. Limits of detection on chromatograms, concept of R values, applications.	**08**
3.0		**THIN LAYER CHROMATOGRAPHY**	
	3	Preparation of chromatoplates, chromatosheets and ready-prepared chromatroplates, choice of medium, selection of solvent, development of chromatogram. Location of substances on chromatogram, applications.	**08**
4.0		**COLUMN CHROMATOGRAPHY**	**06**

	4	Prepartion of column. Types of adsorbents. Selection of solvents and eluents. Column resolution. Applications.	
		Total	**30**

COURSE OUTCOMES:

The students will understand different of chromatography such as

1.Know fundamentals of Chromatography.

2.Understand Paper Chromatography method of analysis.

3.To know the TLC technique used to check purity of sample.

4.Study the simple and widely used separation technique

Reference Books:

1.B.L.Karger, L.R.Snyder and C.Horvath. An Introduction to Separation Science, New York: Wiley 1973

2.J.M.Miller, Separation Methods in Chemical Analysis, New York: Wiley 1975

3.W.Rieman andH.F. Walton, Ion Exchange in Analytical Chemistry. Oxford Pergamon 1970

4.W.J.Williams, Handbook of anion Determination. London. Butter Worths, 1979

5. Synder and Kirkland, Introduction to Modern Liquid Chromatography, 2nd ed. (1973)

6.R.b.Fisher and D.G.Peters, Quantitative Chemical Analysis, 3rd 1968

7.G.D.Christian, Analytical Chemistry, 4th Ed. John Wiley and sons. New York, 1986

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Elective Theory Course

Course Code – SACHET1504

Title of the Course: Instrumental Methods of Chemical Analysis – I (IMCA-I)

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- To familiarize the students with Absorption Spectroscopy, Emission Spectroscopy and various Optical & Thermal analysis methods for qualitative and quantitative analysis of sample.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**INTRODUCTION TO ABSORPTION AND EMISSION SPECTROSCOPY**	**08**
	1	Nature of electromagnetic radiation, electromagnetic spectrum, atomic energy levels, molecular electronic levels, vibrational energy levels, absorption spectra, emission spectra. Problems	
2.0		**FLAME EMISSION AND ATOMIC ABSORPTION SPECTROPHOTOMETRY**	**19**
	2	Atomization, sample atomization, continuous atomizers, discrete atomizers, types and sources of atomic spectra, atomic emission spectra, atomic absorption spectra, atomic fluorescence spectra, atomic line widths, line broadening from uncertainty effects. Doppler shift, pressure broadening effect of temperature on atomic spectra, interference buy molecular spectra during atomization. Flame atomization types of flames, Flame structure, flame atomizers, electrothermal atomizers. Atomic absorption, radiation sources. Single beam and double beam spectrophotometers. Spectral interference, chemical interferences, analytical techniques, in AAS, application of AAS. Flame photometry instrumentation, interferences, analytical techniques, application of flame photometry. Problems.	
3.0		**OPTICAL METHODS**	**19**

	3	**A. 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. Problems. **B. Polarimetry:** Theory, optical rotator dispersion and circular dichroism theory, measurement of optical rotation, faraday effect, multicomponent analysis, calculations of polarimetry and saccharimetry, applications of optical rotatory, dispersion and circular dichrosim, polarimeter, automatic recording spectro polarimeters, applications. Problems. **C. Nephelometry and Turidimetry:** Theory, standards (NTU), instrumentation, applications.	
4.0		**THERMAL ANALYSIS**	
	4	Differential, thermal analysis and differential scanning calorimetry, thermogravimetry, methodology of DSC, DTA and TG, thermo mechanical analysis, thermometric titrations and applications. Problems.	**14**
		Total	**60**

COURSE OUTCOMES:

1.Understand the basic Fundamentals of Absorption and Emission Spectroscopy
2. Learn the Structural construction (Instrumentation), working and application of Flame Emission and Atomic Absorption Spectrophotometry.
3. Know the various Optical methods used to do analysis of optically active compounds
4. To aware the thermal methods and its application.

Reference Books:

1. F.W.Fifield and D.K.Kealey, Principles and Practice of Analytical Chemistry, 3rd ed. Blackie Ghsgow and London (1990)
2. D.P.Shoemaker, C.W.Garland, and J.W.Nibler, Expeiments in Physical Chemistry, 5th ed. McGrtaw Hill international Ediution (1989)
3. H.H.Willard, L.L.Merritt, J.A.Dean and F.a.Settle, Instrumental Methods of Analysis.Wadsworth Publishing Company U.S.A.
4. .D.A.Skoog, J.J.Leary, Principles of Instrumental analysis. Salanrdes college publishing foundation Edn. New York.
5. E,J.Bair. Introduction to Chemical Instrumentation. Mc Graw-Hill, New York, 1962.
6. E.D.Olsen, Modern Optical Metho1ds of Analysis, Mc.Graw Hilll, New York, 1975.
7. J.A.Dean and T.C.Rains, Eds., Flame Emission and Atomic Absorption spectrometry: thoery Vol I, 1969, components and Techniques Vol II, 1971: Elements and Matrics Vol III 1975, Marcel-Dekkar, New York.

8. Kolthoff,I.M. and P.J.Elving, Eds., Trease on analytical Chemistry, Chap, 11-14 and 16, Vol I Part I Wiley – Interscience, New York, 1984.
9. .F.J.Welcher, Ed., standard Methods of Chemical Analysis, 6th ed., Vol.3 Part A. Van Nostrand Rein hold. New York, 1966.

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Elective Theory Course

Course Code – SACHET1505

Title of the Course: Techniques in Forensic Analysis

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- This course reviews the various modern analytical techniquers to be employed in the forensic science.
- The main emphasis will on the importance of sound scientific knowledge and ethics in collecting the forensic evidence and in the reporting of the findings of such analyses..

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**FORENSIC ANALYSIS OVERVIEW AND SYSTEMATIC DRUG IDENTIFICATION**	**08**
	1	Overview, historical forensic science, Analisis of Arsenic and nicotine, Destructive and Nondestructive techniques, Data interpretation. Destructive techniques: Mass spectroscopy, Thermal Analysis, Ion Chomatography, etc. Nondestructive techniques: SEM, TEM, XRF, IR, etc. **Systematic Drug Identification:** Classification and categories of compounds involved, analytical strategy-EMIT, FPIA, TLC, LC, GC-MS, etc., requirements for identification, possibilities & limitations of selected techniques, isotope detection method with numericals, new drug groups.	
2.0		**BODY FLUID AND HAIR ANALYSIS**	

	2	Blood Analysis: Blood preservation and ageing effects, Analysis of blood components and exogenic substances, blood stain analysis., DNA Profiling : DNA and its polymorphism, DNA typing procedures-RFLP, PCR, MVR-PCR, Dot-blot, AMP-FLP, STR, other methods, paternity testing, applications, interpretation and practical use. Hair analysis: Structure and composition of hair, morphological examination, Chemical analysis of hair components and components remaining on or in hair. Determination of alcohol: Legal background, Sampling and sample preservation, analysis-GC, IR, enzymatic and other methods. Fingerprint analysis: Latent fingerprints; optical, physical, physico-chemical & chemical detection methods; fingerprints in blood, fingerprint detection sequences.	**19**
3.0		**MATERIALS OF INTEREST FOR FORENSIC STUDIES**:	
	3	Arson Residues : nature of arson evidence, chemical evidence, properties of liquid accelerants, sampling and sample pre-treatment, laboratory examination of suspect arson evidence, evidential value. Explosives: Types, analytical methods for identification of low and high explosives in post-blast debris. Gunshot Residues : Composition of sources, detection on hands & its limitations, determination of muzzle- to-target distance, elemental & inorganic analysis, numericals on estimation of energy released by combustion reactions, etc.	**19**
4.0		**FORENSIC ANALYSIS OF FIBRE, PAINTS AND VARNISHES:**	
	4	Fibres: Fibres encountered at crime scene, identification of types, dye extraction and analysis, colour matching, analysis for metals, additives and contaminants-SEMEDX, XRD, XRF. Paints, Varnishes and Lacquers : Formulation of paints, types of sample, Sample pre-treatment prior to analysis, colour measurements, Analysis by SEM, SEM- SPMA, TEM, TLC/HPTLC, PyrGC, IR, Raman, UV-Vis-Flu, XRF, AES, TG-DTA. Glass: As forensic evidence, measurement of physical properties, elemental analysis-XRD, NAA, etc., interpretation of results, casework examples	**14**
		Total	**60**

COURSE OUTCOMES:

1. Understand the basic principle and operation of commonly employed techniques in forensic laboratory.
2. Educate about Body fluid and hair analysis though biotechnology techniques and advanced analytical techniques
3. Learn about Systematic Drug Identification through various analytical strategies.
4. Aware about Materials of interest for Forensic studies
5. Know the advanced analytical techniques for analysis of Fibre, paints and varnishes.

Reference Books:

1. Instrumental Methods of Analysis-G-Chatwal and S. Anand (Himalaya Publication;1988)
2. Thermal Analysis-Wendland
3. Physical Methods for Chemists-R.S.Drago.
4. 'Forensic Chemistry' by Suzanne Bell, Pearson Prentice Hall Publishers, 2006
5. Allan Cury, Irvins Sunshine, Forensic Analysis, Academic Press Publications.
6. E.G.J.Clarics, Isolation and Identification of drugs, Pharmaceutical Press.
7. C.J.Creswell, C.A.Runquist and M.M.Campbell, Spectral Analysis of Organic Compounds.
8. F.J.Welcher, Robert E,Standard Methods of Chemical Analysis, A series of volumes.
9. Hawk's Physiological Chemistry.
10. W.G. Eckert, Introduction to Forensic Sciences, Second Edition, Elsevier, New York, 1992.
11. R. Saferstein, Criminalistics: An Introduction to Forensic Science, Seventh Edition, Prentice-Hall, Upper Saddle River, 2001.

National Education Policy 2020

M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHCT1551

Title of the Course: INDUSTRIAL ANALYTICAL CHEMISTRY (IAC)

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- To study various Industrial analytical methods and identify the chemical composition of various industrial substances

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**INTRODUCTION TO PHARMACOPEIA & ANALYSIS OF OILS AND FATS**	**15**
	1	**Introduction to Pharmacopeia** Introduction, different assay of drug: Loss on drying, storage, assay by chromatographicmethod and spectral technique. **Analysis of Oils and fats** Formulae of fatty acids, composition of some common oils and fats, composition of some drying oils, composition of peanut oil, sesame oil, caster oil, jute seed oil, butter fat, animal fat. Classification of oil, drying oils, semi-drying oils, non-drying oils, waxes Tests of oils, fats and waxes, saponification value, acid value, Iodine value uses of oils and fats.	
2.0		**ANALYSIS OF PLASTICS, SYNTHETIC FIBERS, SUGAR AND FERMENTATION INDUSTRIE**	**16**
	2	**Analysis of Plastics and Synthetic fibers** Plastics: Definitions, classification of Plastics, thermo plastics, properties and uses Synthetic fibers Classification of synthetic fibers, Rayon or Artificial Silk properties and uses. **Process and Analysis of sugar and fermentation industries** Sugar Industries Manufacture of White crystalline sugar Two steps method, extraction of Juice, classification of Juice ,evapo1ration of juice to make syrup, treatment of molasses, testing and estimation of sugar Fermentation Industries Introduction, Enzymes, yeast, brewery yeast, distillery yeast, wine yeast, preparation of culture east on a large scale, pure culture of distillery yeast, Manufacture of Vinegar , Uses of Vinegar	
3.0		**ANALYSIS OF FUELS AND RUBBER**	**16**

	3	**Analysis of Fuels** Introduction, color and consistency, origin, composition, classification, distillation, Matural gasoline, Aviation Gasoline, Cracking process, Octane number, cetaen number, Antiknocking compounds. **Rubber Analysis** Natural Rubber, coagulation of latex, chemical and physical properties of rubber, properties of synthetic rubber and uses.	
4.0		**ANALYSIS OF PAINTS AND PIGMENTS AND CEMENT**	**13**
	4	**Analysis of Paints and Pigments** Types of paints, smoke point, flash point, characteristics of a good paint, paint failure, zinc white manufacture, properties and uses, manufacturing of red lead. **Analysis of Cement** Introduction, Composition of cement, Analysis of cement: Analysis of Silica, Calcium etc by gravimetric process and volumetric process.	
		Total	**60**

Course outcomes:

1) Understand analysis of Oils and Fats.
2) Learn about Pharmacopeia
3) Know Analysis of Plastics and Synthetic fibers
4) Aware Process and Analysis of sugar and fermentation industries
5) Learn aspects of Fuel Analysis
6) Know about Rubber Analysis
7) Aware about Analysis of Paints and Pigments
8) Know Modern methods ofAnalysis of Cement.

References books

1. Analysis and characterization of oils, fats and fat products. Vol. 2 H. A. Boekenoogen
2. Lipid Analysis in Oils and Fats R.J. Hamilton
3. Analysis of Oils and Fats 1st Edition by R. J. Hamilton J. B. Rossell
4. Martindale: The Complete Drug Reference, 38th Edition
5. Martindale: The Complete Drug Reference on MedicinesComplete
6. van Tellingen "Pliny's pharmacopoeia or the Roman treat". Netherlands heart journal 15(3): 118–
7. Philip K. Hitti (cf. Kasem Ajram (1992), Miracle of Islamic Science
8. Kohan, Melvin (1995). Nylon Plastics Handbook. Munich: Carl Hanser Verlag
9. J. Robinson (ed) "The Oxford Companion to Wine" Third Edition pg 267-269
10. H. Johnson Vintage: The Story of Wine pg 16 Simon and Schuster 1989 ISBN 0-671-68702-
11. Guide to Combustion Analysis and Fuel Efficiency Paperback – August 1, 2007 by Erik Rasmussen
12. Medium and High Efficiency Gas Furnaces Paperback, Richard Jazwin
13. Analysis of Rubber and Rubber-like Polymers, : Loadman, M.J.
14. Rubber Analysis - Polymers, Compounds and Products Paperback –by M. J. Forrest
15. Application of Differential Thermal Analysis in Cement Chemistry by V.S. Ramachandran
16. Cement Chemistry and Physics for Civil Engineers by Wolfgang Czernin

17. Textbook of analytical chemistry by Y. R. Sharma
18. A textbook of analytical chemistry by Alka Gupta.
19. Analytical chemistry by H. Kaur
20. Textbook of industrial chemistry & metallurgical analysis by S. K. Jain.
21. University practical chemistry by Solamn
22. J. D. Christian, Analytical chemistry , 4th edition John Wiley and sons. New York , 1986.
23. Quantitative and qualitative analysis by Vogel.
24. Analytical chemistry by S. M. Khopkar
25. Fundamentals of analytical chemistry by Skoog and West.
26. Principles of analytical chemistry by J. H. Kennedy.
27. Quantities analysis by R. A. Day And A. L. Underwood.

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M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHCT1552

Title of the Course: Chromatography and Other Process in Chemical Analysis-II

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- To familiarize student with various advanced chromatographic techniques used for separation and analysis of sample.

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**ION EXCHANGE AND GAS-LIQUID CHROMATOGRAPHY**	**15**
	1	**Ion Exchange chromatography** Ion exchangers, ion exchange resins, action of ion exchange equilibria, selectivity coefficient, seperation factor, ion exchange capacity, cation and anion exchanger, applications. Problems. **Gas-liquid chromatography** Principles of GLC, instruments for GLC, carrier gas supply, sample injection system, column, column thermostating, detectors, liquid phases for GLC, applications of GLC – qualitative and quantitative.	
2.0		**HIGH PERFORMANCE LIQUID CHROMATOGRAPHY:**	**15**
	2	Instruments for HPLC, mobile phase reservoirs and solvent treatment systems, pumping systems, sample injection systems, columns for HPLC, detectors, high performance partition chromatography, banded phase packing, normal and reverse phase packing, choice of mobile and stationary phases, applications, stationary and mobile phases, applications, HPTLC . Problems	
3.0		**LIQUID-LIQUID EXTRACTION**	**15**
	3	Nernst's distribution law, distribution coefficient, distribution ratio, factors affecting Ld and d, efficiency of extraction, selectivity of extraction, extraction systems, multiple extractions, types of extraction procedure – simple, exhaustive extraction, counter current extractions. Applications : Extractive separation of metal ions as chelates, effect of PH and reagent concentration ion distribution ratios, extractions with diphenylthiocarbazone, extraction with 8-hydroxyquinoline, the extraction of metal chlorides, extraction of nitrates, crown ethers and their applications.	
4.0		**PROCESS INSTRUMENTS AND AUTOMATIC ANALYSIS**	**15**
	4	Introduction, industrial process analyzers, method based on bulk properties, infrared process analyzers,, oxygen analyzers, on-line potentiometric	

		analyzers, continuous on- line process control, automatic chemical analyzers, automatic elemental analyzers applications.	
		Total	**60**

Course outcomes:

1. Learn the advance separation techniques.
2. Aware the modern separation techniques.
3. Understand the Instrumentation and working of HPLC
4. Learn the Principle and applications of Liquid-Liquid Extraction:
5. Aware about automatic analysis

References books

1. B.L.Karger, L.R.Snyder and C.Horvath. An Introduction to Separation Science, NewYork: Wiley 1973
2. J.M.Miller, Separation Methods in Chemical Analysis, New York: Wiley 1975
3. W.Rieman andH.F. Walton, Ion Exchange in Analytical Chemistry. OxfordPergamon 1970
4. W.J.Williams, Handbook of anion Determination. London. Butter Worths, 1979
5. Synder and Kirkland, Introduction to Modern Liquid Chromatography, 2nd ed.
6. R.b.Fisher and D.G.Peters, Quantitative Chemical Analysis, 3rd 1968
7. Morrison, G.H. and H.Frieser : Solvent Extraction in analytical Chemistry. New Yoprk: John Wileyand sons. Inc.1957.
8. De, A.K.., S.M.Khopkar and R.A.Chalmers. Solvent Extraction of Metals. New York : VanNostrand Reinholdeo, 1970
9. Sekine, T and Y.Gasegawa. Solvent Extraction Chemistry, New York; MarcelDekker, Inc, 1977

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M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHET1553

Title of the Course: Instrumental Methods of Chemical Analysis – II (IMCA-II)

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

- To familiarize the students with various Instrumental methods of chemical analysis to identify an unknown substance or compound

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**UV, VISIBLE AND INFRA RED SPECTROPHOTOMETRY**	**20**
	1	**UV and Visible Spectrophotometry** Fundamental laws, Spectrophotometry accuracy, photometric precision, quantitative methodology, instrumentation – radiation sources, filters, monochromators, grating monochromator systems, detectors, read out modules, instruments for UV and visible Spectrophotometry, correlation of electronic absorption spectra with molecular structure, applications of UV and visible spectrophometry for single, multicomponent analysis, complex study, photometric titrations. Problems. **Infra-red Spectrophotometry** Theory, instrumentation – radiation sources, detectors, thermal detectors, photon detectors, spectrophotometers, sample handling, gases, liquids solutions, films, mulls, palate technique, cell thickness, multiple internal reflectance, quantitative analysis. Problems.	
2.0		**MASS SPECTROPHOTOMETRY**	**10**
	2	Main components of mass spectrometers, sample inlet system, ion sources, ion collection system (Ion donor), mass analyses, vacuum system and pumping system. Electrostatic accelerating system, resolution in mass spectrometer, mass spectrometers, interfacing chromatography and mass spectrometry (GC/MS), GC/MS) instruments, quantitative analysis of mixtures	
3.0		**ELECTROANALYTICAL METHODS**	**17**
	3	**A) Potentiometry**: Electrochemical cells, electrode potentials, reference electrodes, glass-membrane electrodes, liquid membrane electrodes, gas sensing electrodes, electrometric measurements of PH and PI, potentiometric titrations, indicator electrodes, location of the equivalence point, types of potentiometric titrations, acid- base titrations in non-aqueous solvents, applications, Problems. **B) 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, polarographs, applications Problems. **C) Conductometry**: Electrolytic conductivity, conductance, conductivity, equivalent conductance, measurement of electrolytic conductance, conductance cells, conductometric titrations, types of conductometric titrations, neutralization, precipitation and complexometric, applications. Problems.	
4.0		**RADIO ANALYTICAL CHEMISTRY**	
	4	Detection and measurement of radioactive radiation. Elementary working and principles of GM and scintillations counter and gamma ray spectrometer, neutron radiation sources ,neutron activation analysis – applications.	**13**
		Total	**60**

COURSE OUTCOMES:

1. Study the various aspects of UV & Visible Spectrophotometry
2. Learn Infra-red Spectrophotometry
3. Know about Mass spectrophotometry
4. Learn Potentiometry, Polarometry and Conductometry.
5. Study about Radio analytical chemistry

References books

1. D.P.Shoemaker, C.W.Garland, and J.W.Nibler, Expeiments in Physical Chemistry,5th ed. McGrtaw Hill international Ediution (1989)
2. H.H.Willard, L.L.Merritt, J.A.Dean and F.a.Settle, Instrumental Methods of
3. Analysis.Wadsworth Publishing Company U.S.A.
4. D.A.Skoog, J.J.Leary, Principles of Instrumental analysis. Salanrdes collegepublishing foundation Edn. New York.
5. E,J.Bair. Introduction to Chemical Instrumentation. Mc Graw-Hill, New York, 1962.
6. Middleditch, B.S.Ed., Practical Mass Spectrometry, Plenum, New York 1979
7. J.J.Lingane Electronanalytical Chemistry, Iind ed. Wiley – Inter science, New York, 1958
8. Kolthoff,I.M. and P.J.Elving, Eds., Trease on analytical Chemistry, Chap, 11-14 and16, Vol I Part I Wiley – Interscience, New York, 1984.
9. .F.J.Welcher, Ed., standard Methods of Chemical Analysis, 6th ed., Vol.3 Part A. Van Nostrand Rein hold. New York, 1966.
10. F.W.Fifield and D.K.Kealey, Principles and Practice of Analytical Chemistry, 3rd ed. Blackie Ghsgow and London (1990)

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M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHET1554

Title of the Course: Analytical Methods (AM)

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course objectives:

To Learn various classical and advanced analytical methods

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**CLASSICAL METHODS OF CHEMICAL ANALYSIS**	
	1	A). Definition of terms. Primary and secondary standards used in neutralization, redox precipitations and complexations titrations, theory of acid-base, redox, precipitation. Complexometric titrations, indicators in titrimetric analysis, theory of indicators, non- aqueous titrations. **B). Gravimetric analysis:** Unit operations in gravimetric analysis, preparation of sample solution, precipitation, types of precipitates, filtration,. Washing of precipitation, drying, ignition, weighing, and gravimetric factor. Use of organic precipitants. Problems	**15**
2.0		**ANALYSIS OF WATER AND SOIL**	
	2	**A) Analysis of water**: Water pollution, water pollutant and their sources, determination of physicochemical parameters, acidity, alkalinity, hardness, chloride, sulphate, nitrate, fluoride, nitrogen in various forms, water pollution. **B) Analysis of soil** Moisture, Ph, total nitrogen, phosphorous, silica, lime, magnesia, manganese, sulpher, and alkali salts.	**15**
3.0		**ANALYSIS OF BODY FLUIDS AND DRUGS:**	
	3	**A) Clinical Chemistry:** Composition of blood, collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acid and alkaline phosphat2es. **B) Drug Analysis**: Classification of drugs, narcotics and dangerous drugs, screening by gas and thin layer chromatography and Spectrophotometric measurement.	**16**
4.0		**ANALYSIS OF FOOD:**	
	4	Moisture, ash, crude protein, fat, crude fiber, carbohydrates, Ca, K, Na and PO_4 Food adulteration- Common adulteration in food, contamination of food stuff. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purification of sample.	**14**
		Total	**60**

COURSE OUTCOMES:

The students will understand

1. Study the classical analytical methods
2. Know about water and soil analysis
3. Acquire knowledge about Analysis of body Fluids and Drugs by using the aspect of clinical chemistry and drug analysis.
4. Aware about Analysis of Food

References books

1. L.Erdey, gravimetric analysis. Oxford: Pergamon, 1965
2. J.s.Fritz, Acid-Base Titration in Non-aqueous Solvents, Boston : Allyn and Bacon, 1973
3. W.F.Hillebrand, G.E.F. Lundell, H.A.Bright and J.I.Hoffman, applied Inorganioc Analysis 2nd ed. NewYork:
4. I.M.Kolthoff, V.a.Stenger and R.Bekher, Volumetric Analysis, New York: Inter Science 1942-57,
5. R.Bock, Decomposition Methods in analytical Chemistry, New York, Wiley 1979
6. R.A.Day, Jr.A.L.Underwood,, Quantitative Analysis, Sixth ediction 1991, Preutict Hall, INC, Engle Wood
7. J.H.Kenndy, Analytical Chemistry: Principles, 2nd ed. Saunders College Publishing, New York, 1990
8. D.A.Skoog, D.M.West and F.J.Holler. fundamentals of Analytical Chemistry. 6th ed.Saunders College Publishing, New York 1992
9. F.W.Fifield and D.Kealey. Principles and Practice of Analytical Chemistry. 3rd ed. Blackie Glasgopw and Lonmdon (1990)
10. J.H.Jeffery et.al., Vogel's Text book of Quantitative Chemical Analysis, 5th ed. ELND Longman (1989)

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M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHCR1506

Title of the Course: Research project

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

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M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHCP1507

Title of the Course: Laboratory Course-V

[No. of Credits: 2 Credit] **[Total 30 Lectures]**

Course objectives:

To familiarize the students with the determination/ estimation ofanalyte in consumable and non-consumable materials.

Curriculum Details: SCHECT1551: Laboratory Course-V

1	To determine the amount of vitamin c in the given tablet using statistical method of analysis
2	To separate Fe and Mg by solvent extraction method
3	Analysis of Brass Alloy
4	Analysis of Dolomite ore
5	To determine the acidity of given urine sample titermetrically
6	To determine the amount of ascorbic acid from the given sample of Lemon juice
7	To determine the rancidity of oil
8	To estimate the amount of cholesterol in blood sample by calorimetrically
9	To determine assay of aspirin tablet
10	To estimate amount of sulphanilamide group in given sample of sulpha drug using std $AgNO_3$
11	To estimate the amount of glucose in Honey
12	Analysis of Wheat flour
13	Determine the specific gravity of an oil sample
14	Analysis of egg sample
15	To estimate the amount of Tannin in tea sample
16	To estimate the amount of Coffin in coffee sample
17	To estimate the amount of Casein in milk sample
18	To estimate the amount of Ca and Mg in face powder
19	Analysis of Portland cement
20	Analysis of Paints
21	Assay of Amoxicilin Tablet

COURSE OUTCOMES:

Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials

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M.Sc. Analytical Chemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SACHEP1508

Title of the Course: Laboratory Course-VI

[No. of Credits: 2 Credit] **[Total 30 Lectures]**

Course objectives:

To familiarize the students with the various instrumental and non-instruments analytical methods for separation/ determination/ estimation of analyte in the sample.

Curriculum Details: SCHECT1551: Laboratory Course-VI

1 General

1. Calibrations of volumetric apparatus. Burette, pipettes, volumetric flask
2. Calibration of mercury thermometers.

2 Titrimetric analysis

1. Preparation of standard potassium hydrogen phthalate solution and standardization ofbarium hydroxide solution.
2. Preparation of constant boiling point HCl and standardization of NaOH solution.
3. Determination of replaceable hydrogen in given unknown acid.
4. Determination of HCO_3 (Bicarbonate) in blood using back titration
5. Determination of total nitrogen content of fertilizer.
6. Determination of iron in iron pills
7. Determination of “volume strength” of hydrogen peroxide

3 Gravimetric analysis

1. Determination of aluminium in alum (turti).
2. Determination of magnesium in a given sample of milk of magnesia.
3. Determination of sulpher content of a coal sample.
4. Determination of thiamine hydrochloride as thiamine silico tungstate.

4 Paper Chromatography

1. Separation of metal ions by paper chromatography.
2. Separation of indicators by paper chromatography.

5 Thin layer chromatography

1. Separation of dye stuffs on activated silica gel.
2. Separation of amino acids on deactivated silica gel.

6 Ion exchange chromatography (any two)

1. Determination of ion exchange capacity of cation / anion exchanger.
2. Separation and determination of zinc and magnesium in a given mixture solution.
3. Separation and determination of nickel and cobalt in a given mixture solution.
4. Determination of sodium with the aid of cation exchanger.
5. Determination f fluoride with the aid of cation exchanger.
6. Determination of total cation concentration in water

7 Gas chromatography

1. Construction of simple apparatus for gas chromatography and separation of chloromethane.
2. Determination of aluminium and chromium as their acetyl acetonates

8 Flame Photometry

1. Determination of calcium in blood serum / calcium bills.
2. Determination of Na / K / Li/ Ca in sample solution

9 Refractometry (any two)

1. Determination of refractive index, specific refractivity, molar refractivity of given liquidat a given temperature.
2. Determination of molecular refractivity of solid substance.
3. Determination of composition of an unknown mixture of two liquids.
4. Determination of atomic refractivity of C, H and O from methyl acetate, ethyl acetate and n-hexane.

10 Polorimetry (any two)

1. Determination of percentage of D-glucose, in given sample.
2. Determination of two optically active compounds in the given mixture solution.
3. Determination of specific, molecular and intrinsic rotation of an optically active compound.
4. Determination of percentage purity of d-tartaric acid / cane sugar.

COURSE OUTCOMES:

Students become aware of preparation of sample, Standardization of solution, separation/ determination / estimation of analyte in the sample.

M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHCR1555

Title of the Course: Research project

[No. of Credits: 6 Credit] **[Total 180Lectures]**

Course objectives

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M.Sc. Analytical Chemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SACHEP1556

Title of the Course: Laboratory Course-VII

[No. of Credits: 2 Credit] **[Total 30 Lectures]**

Course objectives:

To familiarize various instrumental and non-instrumental analytical methodologies

Curriculum Details: SCHECT1551: Laboratory Course-VII

1 Potentiometry (any Two)

1. Determination of strong acid in a given solution, Titrating with strong base using hydrogen electrode.
2. Determination of standard electrode potential of quinhydrone electrode.
3. Determination of formal redox potential of Fe^{2+}/Fe^{3+}, Ce^{3+}/Ce^{4+}systems atDifferent concentration of strong acid.
4. Determination of ionic product of water.

2 Conductometry (any Two)

1. Determination of □o of HCl, NaCl, CH_3COONa hence find out □o of $CH_3COOH$by Kolharaush law.
2. Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride / sodium acetate / ammonium chloride.
3. Determination of titration error of acid-base titration.
4. Determination of dissociation constant of benzoic acid / lactic acid / n-propionicacid

3 Solvent extraction (any SIX)

1. Determination of distribution coefficient of iodine between carbon tetra chlorideand water.
2. Determination of Kd of succinic acid between diethyl ether and water.
3. To study the distribution of benzoic acid between benzene and water.
4. Determination of formula of cuprammonium complex.
5. Determination of percentage of fatty acids in soft soaps.
6. Determination of morphine in a given sample of morphine sulphate tablets..
7. Determination of iron, in iron and aluminium ion mixture solution, by chloride extraction.
8. Determination of lead by doithiozone method.
9. Determination beryllium as acetyl acetone complex.
10. Determination of silver by extractions as its ion association complex with 1:10 phenolthroline and bromo pyrogallol red.
11. Determination of nickel by synergistic extraction.

12. To study effect of contraction of hydrochloric acid on extraction of iron bychloride extraction.

4 Non-aqueous titrations (any Two)

1. Preparation of acetous perchloric acid and its standardization.
2. Determination of percentage purity of amine using standard acetous perchloricacid solution.
3. Determination of ephedrine hydrochloride in given drug sample.

COURSE OUTCOMES

Aware of, Potentiometry, Conductometry, Solvent extraction and Non-aqueous titration

Books Suggested:

1. Structural methods in Inorganic Chemistry by E.A.V. Ebsworth.
2. Physico chemical methods in Inorganic Chemistry by Drago