।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. M.Sc.-II Year-Botany
2. M.Sc.-II Year-Herbal Medicine
3. M.Sc.-II Year-Analytical Chemistry
4. M.Sc.-II Year-Biochemistry
5. M.Sc.-II Year-Organic Chemistry
6. M.Sc.-II Year-Physical Chemistry
7. M.Sc.-II Year-Computer Management
8. M.Sc.-II Year-Computer Science
9. M.Sc.-II Year-Information Technology
10. M.C.A. (Master of Computer Applications)-II Year
11. M.Sc.-II Year-Software Engineering
12. M.Sc.-II Year-System Administration & Networking
13. M.Sc.-II Year-Dairy Science
14. M.Sc.-II Year-Environmental Science
15. M.Sc.-II Year-Applied Mathematics
16. M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.Sc.-II Year-Bioinformatics

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३५**

दिनांक : १६.०७.२०२०.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

A CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Post Graduate (PG) Programme in

Chemistry

(Affiliated Colleges)

w. e. f. Academic year 2020

SYLLABUS

M. Sc. SECOND YEAR [III & IV semester]

ANALYTICAL ACHEMISTRY

Board of Studies in Chemistry

Swami Ramanand Teerth Marathwada University, Nanded

Swami Ramanand Teerth Marathwada University

M. Sc. Chemistry Core and Elective papers

M. Sc. S. Y. (Third Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Core papers				
1.	XV	Advanced Spectroscopic Methods	60	4
2.	XVI	Fundamentals of Analytical Chemistry	60	4
3.	XVII	Chromatography in Chemical analysis -I	60	4
4.	XVIII	Instrumental methods of Chemical analysis – I	60	4
Practical courses				
5.	XXV	Laboratory Course-V	120	4
6.	XXVI	Laboratory Course-VI	120	4
7.	XIX	Seminar	15	1

Elective Paper

1.	XV	Techniques in Forensic Analysis	60	4

M. Sc. S. Y. (Fourth Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Core papers				
1.	XX	Industrial Analytical chemistry	60	4
2.	XXI	Analytical methods	60	4
3.	XXII	chromatography and other Process in Chemical analysis-II	60	4
4.	XXIII	Instrumental methods of Chemical analysis - II	60	4
Practical courses				
6.	XXVII	Laboratory Course-VII	120	4
7.	XXVIII	Laboratory Course-VIII	120	4
8.	XXIV	Seminar	15	1

Elective Paper

1.	XX	Industrial Safety and Hazardous	60	4

Swami Ramanand Teerth Marathwada University

M. Sc. Chemistry Core and Elective papers drafts

M. Sc. S. Y. (Third Semester)

Semester	Paper No.	Course No.	External (ESE)	Internal (CA)	Total
III[rd]	XV	CH-511	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XVI	ACH-512	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XVII	ACH-513	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XVIII	ACH-514	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XV	EACH-511	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	Seminar	SACH-515	-	25 Marks (Credit–1)	25 Marks (Credit–1)

For Internal (CA): (2 tests 15 Marks) + (Assignments – 10 Marks)

M. Sc. S. Y. (Fourth Semester)

Semester	Paper No.	Course No.	External (ESE)	Internal (CA)	Total
IV[th]	XX	ACH-516	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XXI	ACH-517	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XXII	ACH-518	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XXIII	ACH-519	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	XX	EACH- 516	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
	Seminar	SACH-520	-	25 Marks (Credit–1)	25 Marks (Credit–1)

For Internal (CA) : (2 tests 15 Marks) + (Assignments – 10 Marks)

M. Sc. S. Y. (Lab Course)

Paper No.	Course No.	External (ESE)	Internal (CA)	Total
XXV	ALCH-521	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
XXVI	ALCH-522	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
XXVII	ALCH-523	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4
XXVIII	ALCH-524	75 Marks (Credit–3)	25 Marks (Credit–1)	100 Marks Credit–4

Total credit:

Sem. I+	Sem. II+	Lab. Course+	Seminar =	Total
16+	16+	16+	02=	50

M. Sc. Second Year, Semester-III

Paper–XV, [CH-511]

Advanced Spectroscopic Methods

Credits: 04 **Periods: 60**.

SM-1: UV-Vis Spectroscopy: **09P**

Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Fieser-Kuhn rules for polyenes. UV spectra of aromatic compounds and heteroaromatic compounds. Calculation of λ_{max} for the benzene derivatives (R-C_6H_4-Co-G) by A. I. Scott emperical rules.

SM-2: IR spectroscopy: **09P**

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.

SM-3: ^{1}H NMR Spectroscopy: **12P**

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}F and ^{31}P.

SM-4: ^{13}C NMR: **06P**

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.

SM-5: Mass Spectroscopy: **09P**

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.

SM-6: Structural Problems: **15P**

a) Combined problems on UV, IR, NMR and Mass spectral data for structure determination.

b) Elucidation of structure of organic molecules using spectra (IR, PMR & CMR).

Objective(s)	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.
Course Outcome(s)	
CO -1	Learn the structure determination of organic molecules by spectroscopic methods.Know the use electronic spectroscopy to determine absorption maximum in dienes, enones and aromatic compounds
CO -2	Know the applications of IR spectroscopy for functional group determination.
CO - 3	Learn the structure elucidation of organic compounds by PMR spectroscopy.
CO - 4	Gathering basic knowledge to know the position of carbon in carbon compounds.
CO - 5	Recognize the molecular mass of the organic molecule by fragmentation pattern.

CO- 6	Know the complete structure of compounds using UV, IR, PMR, CMR and Mass spectroscopic methods.

Reference Books:

01. Spectroscopic Identification of Organic Compounds, R. M. Silverstern, G. C. Bassler and T. C. Morril.
02. Introduction to NMR spectroscopy, R. J. Abraham, J. Fisher and P. Loftus.
03. Application of spectroscopy of organic compounds, J. R. Dyer.
04. Spectroscopy of organic compounds, P. S. Kalsi.
05. Organic Spectroscopy, William Kamp.
06. Organic chemistry, R. T. Morrison and R. N. Boyd.
07. Practical NMR spectroscopy, M. L. Martin, J. J. Delpench and G. J. Martin.
08. Spectroscopic methods in organic chemistry, D. H. William, I. Fleming.
09. 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.

M. Sc. Second Year, Semester-III

Paper–XVI, [ACH-512]

Fundamentals of Analytical Chemistry (FAC)

Credits: 04 **Periods: 60**

FAC-1: Introduction
FAC-2: Errors and Evaluation of Analytical Data:
FAC-3: Mole concept and Chemical calculations
FAC-4: General concepts of Chemical Equilibrium:

FAC-1.Introduction: **11P**

Introduction, classification of analytical methods, classical and instrumental types of instrumental analysis, selection of analytical method, Laboratory operations and practices. Analytical balance. Techniques of weighing, weighting errors. Volumetric glassware – cleaning, calibration of glassware, Sampling. Problems.

FAC-2.Errors and Evaluation of Analytical Data: **16P**

Definition of terms, Precision, deviation, mean deviation, standard deviation accuracy, absolute errors, types of errors determinate, indeterminate and gross, sources of errors and their effect on final result, Methods of reporting analytical data., statistical evaluation of data. Indeterminate errors, Linear least squares methods, correlation coefficient. Significant figures, computation rules, Use of scientific calculators. Problems.

FAC-3.Mole concept and Chemical calculations: **17P**

Mole, concentration units, solubility, molarity, molality, formality, percentage concentration, dilution, equivalance, milliequivalents, millimoles, ppm, ppb, titer, calculations of equivalents in acid base, redox, precipitation, complexation, reactions. Calculation of concentration from density and percentage, Problems.

FAC-4.General concepts of Chemical Equilibrium: **16P**

Chemical reaction, rate constant, Gibb's free energy and equilibrium constant. LeChatelier's principle,. Factors affecting chemical equilibrium constant-temperature, pressure, concentration, catalyst, Completeness of reactions, equilibrium constants for

dissociating species, calculations using equilibrium, constants, Common ion effect, activity and activity co-efficient, diverse ion effect, thermodynamic equilibrium constant. Problems.

Objective(s)	To the fundamentals of Analytical Chemistry and to acquire the knowledge of various analytical methods.
Course Outcome(s)	
CO -1	Understand the tools and techniques used in analytical methods.
CO -2	To find errors in analytical data and to Evaluation of analytical data.
CO -3	Learn mole concept and chemical calculations.
CO - 4	Aware general concept of chemical equilibrium.

Books Suggested:

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)

M. Sc. Second Year, Semester-III

Paper–XVII, [ACH-513]

Chromatography in Chemical Analysis I (CCA-I)

Credits: 04 **Periods: 60**

CCA-1 General principles of chromatography
CCA-2 Paper Chromatography
CCA-3 Thin layer Chromatography
CCA-4 Column chromatography
CCA-5 Ion Exchange chromatography
CCA-6 Gas-liquid chromatography

CCA-1.General principles of chromatography: 17P

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.

CCA-2.Paper Chromatography 08P

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.

CCA-3.Thin layer Chromatography 08P

Preparation of chromatoplates, chromatosheets and ready-prepared chromatroplates, choice of medium, selection of solvent, development of chromatogram. Location of substances on chromatogram, applications.

CCA-4.Column chromatography 08P

Prepartion of column. Types of adsorbents. Selection of solvents and eluents. Column resolution. Applications.

CCA-5. Ion Exchange chromatography **07P**

Ion exchangers, ion exchange resins, action of ion exchange equilibria, selectivity coefficient, seperation factor, ion exchange capacity, cation and anion exchanger, applications. Problems.

CCA 6.Gas-liquid chromatography **12P**

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.

Objective(s)	To familiarize student with various chromatographic techniques used for separation and analysis of sample.
Course Outcome(s)	
CO - 1	Know fundamentals of Chromatography.
CO - 2	Understand Paper Chromatography method of analysis.
CO - 3	To know the TLC technique used to check purity of sample.
CO - 4	Study the simple and widely used separation technique
CO - 5	Learn the advance separation techniques.
CO - 6	Aware the modern separation techniques.

Books Suggested

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

M. Sc. Second Year, Semester-III

Paper XVIII, [ACH-514]

Instrumental Methods of Chemical Analysis – I (IMCA-I)

Credits: 04 **Periods: 60**

IMCA-1 Introduction to Absorption and Emission Spectroscopy
IMCA-2 Flame Emission and Atomic Absorption Spectrophotometry
IMCA-3 Optical methods
IMCA-4 Thermal analysis:

IMCA-1.Introduction to Absorption and Emission Spectroscopy: 08P

Nature of electromagnetic radiation, electromagnetic spectrum, atomic energy levels, molecular electronic levels, vibrational energy levels, absorption spectra, emission spectra. Problems.

IMCA-2.Flame Emission and Atomic Absorption Spectrophotometry: 19P

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.

IMCA- 3 Optical methods: 19P

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.

IMCA-4.Thermal analysis: 14P

Differential, thermal analysis and differential scanning calorimetry, thermogravimetry, methodology of DSC, DTA and TG, thermo mechanical analysis, thermometric titrations and applications. Problems.

Objective(s)	To familiarize the students with Absorption Spectroscopy, Emission Spectroscopy and various Optical & Thermal analysis methods for qualitative and quantitative analysis of sample.
Course Outcome(s)	
CO-I	Understand the basic Fundamentals of Absorption and Emission Spectroscopy
CO-II	Learn the Structural construction (Instrumentation), working and application of Flame Emission and Atomic Absorption Spectrophotometry.
CO-III	Know the various Optical methods used to do analysis of optically active compounds
CO-IV	Aware the Thermal methods and its application.

Books Suggested:

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 Methods of Analysis, Mc.Graw Hilll, New York, 1975.

6. 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.
7. 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.
8. F.J.Welcher, Ed., standard Methods of Chemical Analysis, 6th ed., Vol.3 Part A. Van Nostrand Rein hold. New York, 1966.

M. Sc. Second Year, Semester-III.

Paper–XV, [EACH-511]

Techniques in Forensic Analysis (TFA)

Credits: 04 Periods: 60

TFA- 1.Forensic Analysis Overview
TFA- 2.Body fluid and hair analysis
TFA- 3.Systematic Drug Identification
TFA- 4.Materials of interest for Forensic studies
TFA- 5.Forensic analysis of Fibre, paints and varnishes

TFA- 1.Forensic Analysis Overview: 07 P

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.

TFA- 2.Body fluid and hair analysis: 18 P

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.

TFA- 3.Systematic Drug Identification: 11 P

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.

TFA- 4.Materials of interest for Forensic studies: 11 P

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.

TFA- 5.Forensic analysis of Fibre, paints and varnishes: 13 P

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.

Objective(s)	1 This course reviews the various modern analytical techniquers to be employed in the forensic science. 2 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.
Course Outcome(s)	
CO-I	Understand the basic principle and operation of commonly employed techniques in forensic laboratory.
CO-II	Educate about Body fluid and hair analysis though biotechnology techniques and advanced analytical techniques
CO-III	Learn about Systematic Drug Identification through various analytical strategies.
CO - IV	Aware about Materials of interest for Forensic studies
CO-V	Know the advanced analytical techniques for analysis of Fibre, paints and varnishes

Books Suggested:

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.

M. Sc. Second Year, Semester-IV

Paper–XX, [ACH-516]

Industrial Analytical Chemistry (IAC)

Credits: 04 **Periods: 60**

IAC-1.Analysis of Oils and fats
IAC-2.Introduction to Pharmacopeia
IAC-3.Analysis of Plastics and Synthetic fibers
IAC-4.Process and Analysis of sugar and fermentation industries
IAC-5 Analysis of Fuels
IAC-6.Rubber Analysis
IAC-7.Analysis of Paints and Pigments
IAC-8.Analysis of Cement

IAC-1.Analysis of Oils and fats **08P**

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.

IAC-2.Introduction to Pharmacopeia **07P**

Introduction, different assay of drug: Loss on drying, storage, assay by chromatographic method and spectral technique.

IAC-3.Analysis of Plastics and Synthetic fibers **07P**

Plastics: Definitions, classification of Plastics, thermo plastics, properties and uses Synthetic fibers Classification of synthetic fibers, Rayon or Artificial Silk properties and uses.

IAC-4.Process and Analysis of sugar and fermentation industries **09P**

Sugar Industries Manufacture of White crystalline sugar Two steps method, extraction of Juice, classification of Juice ,evaporation 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.

IAC-5.Analysis of Fuels **08P**

Introduction, color and consistency, origin, composition, classification, distillation, Matural gasoline, Aviation Gasoline, Cracking process, Octane number, cetaen number, Antiknocking compounds.

IAC-6.Rubber Analysis **08P**

Natural Rubber, coagulation of latex, chemical and physical properties of rubber, properties of synthetic rubber and uses.

IAC-7.Analysis of Paints and Pigments **07P**

Types of paints, smoke point, flash point, characteristics of a good paint, paint failure, zinc white manufacture, properties and uses, manufacturing of red lead.

IAC-8.Analysis of Cement **06P**

Introduction, Composition of cement, Analysis of cement: Analysis of Silica, Calcium etc by gravimetric process and volumetric process.

Objective(s)	To study various Industrial analytical methods and identify the chemical composition of various industrial substances.
Course Outcome(s)	
CO - 1	Understand analysis of Oils and Fats.
CO - 2	Learn about Pharmacopeia
CO - 3	Know Analysis of Plastics and Synthetic fibers
CO - 4	Aware Process and Analysis of sugar and fermentation industries
CO - 5	Learn aspects of Fuel Analysis
CO - 6	Know about Rubber Analysis
CO - 7	Aware about Analysis of Paints and Pigments
CO - 8	Know Modern methods ofAnalysis of Cement

Books Suggested

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.

M. Sc. Second Year, Semester-IV

Paper–XXI, [ACH-517]

Analytical Methods (AM)

Credits: 04 **Periods: 60**

AM-1 Classical Methods of Chemical analysis
AM-2 Analysis of water and Soil:
AM-3 Analysis of body Fluids and Drugs
AM-4 Analysis of Food

AM-1.Classical Methods of Chemical analysis: 18P

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

AM-2.Analysis of water and Soil: 14P

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.

AM-3.Analysis of body Fluids and Drugs: 14P

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 phosphates.

B) Drug Analysis:

Classification of drugs, narcotics and dangerous drugs, screening by gas and thin layer chromatography and Spectrophotometric measurement.

AM 4. Analysis of Food: 14P

Moisture, ash, crude protein, fat, crude fiber, carbohydrates, Ca, K, Na and PO4-3.

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.

Objective(s)	To Learn various classical and advanced analytical methods
Course Outcome(s)	
CO-I	Study the classical analytical methods
CO-II	Know about water and soil analysis
CO-III	Acquire knowledge about Analysis of body Fluids and Drugs by using the aspect of clinical chemistry and drug analysis.
CO-IV	Aware about Analysis of Food

Books Suggested:

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)

M. Sc. Second Year, Semester-IV

Paper–XXII, [ACH-518]

Chromatography and Other Process in Chemical Analysis-II (CCA-II)

Credits: 04 **Periods: 60**

CCA-1 High performance liquid chromatography
CCA-2 Liquid-Liquid Extraction
CCA-3 Process Instruments and Automatic Analysis

CCA-1.High performance liquid chromatography: 20P

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

CCA-2.Liquid-Liquid Extraction: 20P

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.

CCA-3.Process Instruments and Automatic Analysis: 20P

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.

Objective(s)	To familiarize student with various advanced chromatographic techniques used for separation and analysis of sample.
Course Outcome(s)	
CO-I	Understand the Instrumentation and working of HPLC
CO-II	Learn the Principle and applications of Liquid-Liquid Extraction:
CO-III	Aware about automatic analysis

Books Suggested

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.
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; Marcel Dekker, Inc, 1977

M. Sc. Second Year, Semester-IV

Paper–XXIII, [ACH-519]

Instrumental Methods of Chemical Analysis – II (IMCA-II)

Credits: 04 **Periods: 60**

IMCA-1.UV & Visible Spectrophotometry
IMCA-2.Infra red Spectrophotometry
IMCA-3.Mass Spectrophotometry
IMCA-4.Electroanalytical Methods
IMCA-5.Radio analytical Chemistry

IMCA-1.UV & Visible Spectrophotometry: 13P

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.

IMCA-2.Infra red Spectrophotometry: 09P

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.

IMCA-3.Mass Spectrophotometry: 10P

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,

IMCA-4.Electroanalytical Methods: **15P**

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.

IMCA 5.Radio analytical Chemistry: **13P**

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.

Objective(s)	To familiarize the students with various Instrumental methods of chemical analysis to indentify an unknown substance or compound.
Course Outcome(s)	
CO - 1	Study the various aspects of UV & Visible Spectrophotometry
CO - 2	Learn Infra-red Spectrophotometry
CO - 3	Know about Mass spectrophotometry
CO - 4	Learn Potentiometry, Polarometry and Conductometry.
CO - 5	Study about Radio analytical chemistry

Books Suggested:

1. F.W.Fifield and D.K.Kealey, Principles and Practice of Analytical Chemistry, 3rd
1. 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
4. Analysis.Wadsworth Publishing Company U.S.A.
5. D.A.Skoog, J.J.Leary, Principles of Instrumental analysis. Salanrdes college publishing foundation Edn. New York.
6. E,J.Bair. Introduction to Chemical Instrumentation. Mc Graw-Hill, New York, 1962.
7. Middleditch, B.S.Ed., Practical Mass Spectrometry, Plenum, New York 1979
8. J.J.Lingane Electronanalytical Chemistry, Iind ed. Wiley – Inter science, New York, 1958
9. 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.
10. F.J.Welcher, Ed., standard Methods of Chemical Analysis, 6th ed., Vol.3 Part A. Van Nostrand Rein hold. New York, 1966.

M. Sc. Second Year, Semester-IV

Paper–XX, [EACH-516]

INDUSTRIAL SAFETY AND HAZARDOUS (ISH)

Credits: 04 **Periods: 60**

ISH-1.Industrial safety
ISH-2.Industrial hygiene in chemical industry
ISH-3.Fire and explosions
ISH-4.Hazards identification

ISH-1.Industrial safety **14 P**

Introduction: Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions, Nature of the Accident Process, Inherent Safety, Seven Significant Disasters. Toxicology: Effect of Toxicants on Biological Organisms, Toxicological Studies, Dose versus Response, Models for Dose and Response Curves, Relative Toxicity, Threshold Limit Values, National Fire Protection Association (NFPA) Diamond

ISH-2.Industrial hygiene in chemical industry **18 P**

Industrial Hygiene: Government Laws and Regulations, OSHA: Process Safety Management, EPA: Risk Management Plan, DHS: Chemical Facility Anti-Terrorism Standards (CFATS) Industrial Hygiene: Anticipation and Identification, Evaluation, Control. Source Models: Introduction to Source Models, Flow of Liquid through Holes, and Pipes, Flow of Gases or Vapors through Holes and Pipes, Flashing Liquids, Liquid Pool Evaporation or Boiling, Conservative Analysis

ISH-3.Fire and explosions **18 P**

Fires and Explosions: The Fire Triangle, Distinction between Fires and Explosions, Definitions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram, Ignition Energy , Autoignition , Auto-Oxidation , Adiabatic Compression, Ignition Sources, Sprays and Mists, Explosions Concepts to Prevent Fires and Explosions: Inerting, Static Electricity and its Control,

Explosion-Proof Equipment and Instruments, Ventilation, Sprinkler Systems, Miscellaneous Concepts for Preventing Fires and Explosions.

ISH-4.Hazards identification **10 P**

Hazards Identification: Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews, Other Methods, Risk Assessment: Review of Probability Theory, Event Trees, Fault Trees, QRA and LOPA

Objective(s)	1 To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models 2 To understand about fire and explosion, preventive methods, relief and its sizing methods 3 To analyze industrial hazards and its risk assessment
Course Outcome(s)	
CO - 1	Understand the industrial laws, regulations and source models.
CO - 2	How to Apply the methods of prevention of fire and explosions?
CO - 3	Understand the relief and its sizing methods.
CO - 4	Understand the methods of hazard identification and preventive measures

Books Suggested:

1 Occupational health and safety law: text and materials by Brenda Barrett, Richard Howells Second edition first published in Great Britain 2000 by Cavendish Publishing Limited, The Glass House, Wharton Street, London WC1X 9PX, United Kingdom.

2 Practical guide to industrial safety methods for process safety professionals Nicholas cheremisinoff 2001 Marcel Dekker, Inc. ISBN:0-8247-0476-2.

3 Essentials of health and safety at work Crown 2006

4 KlING'S SAFETY IN THE PROCESS INDUSTRIES Second Edition Ralph King, Ronald Hirst and Glynne Evans Wuerz Publishing Ltd, Canada second edition ISBN 0 340 67786 4 ISBN 0 920063 75 6 (Wuerz) 1996.

5 Managing Health and Safety by Jacqueline Jeynes, 2007 Elsevier Ltd. All rights reserved

6 Health and Safety at Work: Key Terms by Jeremy Stranks, An imprint of Elsevier Science, 2002.

7 Workplace Safety Volume 4 of the Safety at Work Series Edited by John Ridley and John Channing,1999.

8 Environmental and health &safety management guide to compliance by Nicholas cheremisinoff, Madelyn l. graffa, 1955.

9 Health Safety Fifth Edition Introduction to Work by Phil Hughes,2011.

10 A Quick Guide to Health and Safety by Ray glibort, 2008.
11 D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall, 2011.
12 R.K. Sinnott, Coulson & Richardson's, Chemical Engineering, Vol. 6, Elsevier India, 2006.
13 Fawcett H.H. and W.S.Wood, Safety and accident prevention in Chemical operations 2nd edition John Wiley and Sons Inc. (1982).

M. Sc. Second Year

Laboratory Course-V, Paper– XXV, ALCH-521

Credits: 04 **Periods: 144**

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

Objective(s)	To familiarize the students with the determination/ estimation of analyte in consumable and non-consumable materials.
Course Outcome(s)	
	Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials.

M. Sc. Second Year

Laboratory Course-VI, Paper– XXVI, ALCH-522

Credits: 04 **Periods: 144**

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 of barium 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 HCO3 (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 liquid at 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.

Objective(s)	To familiarize the students with the various instrumental and non-instruments analytical methods for separation/ determination/ estimation of analyte in the sample.
Course Outcome(s)	
	Students become aware of preparation of sample, Standardization of solution, separation/ determination / estimation of analyte in the sample.

M. Sc. Second Year

Laboratory Course-VII, Paper– XXVII, ALCH-523

Credits: 04 **Periods: 144**

(Any one from each section)

1 LFT

1. Indicate the splitting of the d-levels and the number of electrons in each level for each of the following complexes.

a) Ni $(NH_3)_6^{+2}$ (Paramagnetic).

b) Trans-Ni$(CH_3)_4Cl_2$ (Paramagnetic, tetragonal, Δ for NH3 > C1$^-$).

c) Cu $(NH_3)_4^{+2}$

d) Trans-Ni $(CN)_4$ $(H_2O)_2^{-2}$

e) Ni Cl_4^{-2} (tetrahedral)

f) Mn (acac)3 (acac = acetylacetonate)

g) Cr $(CN)_6^{-3}$

h) FeO4 $^{-2}$ (tetrahedral)

i) Cu Cl_4^{-2} (tetrahedral)

j) Co $(NH_3)_6^{+2}$

2. Of the complexes in a, e, f, g, h, i and j above, which would you expect to be distorted?

3. Compare the CFSE in $Co(NH_3)_6^{+2}$ and $Co(NH_3)_6^{+3}$

4. a) Calculate the relative energies as a function of Dq and P for both the high spin (HS) and low spin (LS) octahedral and HS tetrahedral aquo complexes of Co(II) and Fe(II). On the basis of these calculations state which configuration is the most energetically favorable for each of these ions.

b) On the basis of the CFSE's alone, predict which ion should show the greater tendency form tetrahedral complexes.

c) Is this prediction upheld by the calculations made above and if not, why?

2 Applications Of Infrared And Raman Spectroscopy (Any One)

The spectrum of $Co(NH_3)_6(ClO_4)^3$ has absorption bands at 3320 cm^{-1}, 3240 cm^{-1},1630 cm^{-1}, 1352 cm^{-1}, and 803 cm^{-1}. For purposes of assignment the molecule can be Treated as a C 3v molecule. Use the Vn, symbolism to label the bands and also describe them as bends, stretches etc.

3 Magnetic Chemistry

1. (a) Co $(N_2H_4)_2Cl_2$ has a magnetic moment of 3.9 BM. Is hydrazine bidentate?

Propose a structure.

(b) How could electronic spectroscopy be employed to support the conclusion in a.

2. In which of the following tetrahedral complexes would you expect contributions from spin orbit coupling? V^{+3} , Cr^{+3} , Cu^{+3}, Co^{+2} , Fe^{+2} , Mn^{+2}
3. In which of the following spin-paired square planar complexes would you expect contributions? d^2, d^3, d^4. d^5, d^6
4. Why is $Fe_2(CO)_9$ with three bridging and six terminal carbonyl is diamagnetic?
5. Explain why mixing of a D 4th, component in with Td ground state lowers the Moment nickel (II) complexes.
6. What is expected magnetic moment for Er^{+3} ?

4 Mossbauer Spectroscopy Problems 7.1 to 7.6.

5 Vibrational Spectroscopy Problems 5.9 to 5.15

6 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 at Different concentration of strong acid.
4. Determination of ionic product of water.

7 Conductometry (any Two)

1. Determination of λo of HCl, NaCl, CH_3COONa hence find out λo 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-propionic acid

8 Solvent extraction (any four)

1. Determination of distribution coefficient of iodine between carbon tetra chloride and 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 by chloride extraction.

9 Non-aqueous titrations (any Two)

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

Objective(s)	To familiarize the students with LFT (Ligand Field Theroy) and various instrumental and non-instrumental analytical methodologies.
Course Outcome(s)	
	Aware of spectroscopic study of metal complexes, 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

M. Sc. Second Year

Laboratory Course-VIII,

Paper– XXVIII, ALCH-524(Project + Seminar)

Credits: 04 (Project: 75 + Seminar 25) **Periods: 144**

The students will develop utilities such as analytical spectra, simulation programmes that will supplement laboratory exercises in their subject of specialization. For this, variety of small research project designed by the teacher based on the interest of the student and capabilities should be worked out.

The students will have to give at least one seminar in each semester in their subject of specialization. For this, submission of synopsis of seminar delivered by every student is compulsory which is to be produced before examiner of practical examination. The project work carried out during the year should be presented in power point presentation in presence of University Examiners.

Important Notes:

1. In house laboratory training of a week / fortnight in industry / research institute is compulsory.
2. Visit to the National research Institutes for example NCL, NPL, IICT, BARC, SIC etc is compulsory
3. Educational tour is compulsory
4. Aims and objectives of all the experiments are well defined.