St. Xavier's College (Autonomous), Ahmedabad-09

Proposed Syllabus under Autonomous system for M.Sc. Semester I and II for M Sc Analytical Chemistry (Self Finance Course) (2018-2020)

January 30, 2018

(Effective from 2018)

St. Xavier's College- Ahmedabad 09 (Autonomous)
Department of Chemistry
Proposed Syllabus for M Sc Sem I and II Chemistry for
M.Sc. Analytical Chemistry (Self finance)
(To be approved by the board of studies in the Chemistry Department)

M Sc Chemistry Sem I Overview

Sub. code	Course	Instruction Hrs/week	Internal Assessment Marks	Max Marks Semester Exams	Duration of Semester Exam (Hrs)	Credit
THEORY						
PCH 1851	Inorganic Chemistry-I	4	40	60	3	4
PCH 1852	Organic Chemistry-I	4	40	60	3	4
PCH 1853	Physical Chemistry-I	4	40	60	3	4
PCH 1854	Analytical techniques-I	4	40	60	3	4
PRACTICALS						
PCH 1855L	Inorganic Chemistry Lab-I	3	40	60	3	4
	Organic Chemistry Lab-I	3			3	
PCH 1856L	Physical Chemistry Lab-I	3	40	60	3	4
	Analytical Chemistry Lab-I	3			3	
	Total	**28**	**240**	**360**		**24**

Note:- Semester -I and Semester-II syllabus is common for all specializations to be selected by the students for final year i.e. Inorganic, Organic, Physical and Analytical. At present St. Xavier's College offers Organic Chemistry and Analytical Chemistry (Self Finance) as specializations in the final year of M Sc Chemistry.

M Sc Semester I

CORE Paper: Inorganic Chemistry (Theory)
Course Code: PCH 1851
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit IC 01: Quantum theory and Atomic Structure

Unit IC 02: Symmetry and Group Theory

Unit IC 03: Magneto chemistry

Unit IC 04: Bio-inorganic Chemistry

The main objective of the course will be to enhance the understanding and knowledge of Inorganic Chemistry, for students studying, any branch of chemistry.

By the end of the paper, a student will be able to:

(a)Understand the important aspects of Quantum theory and Atomic Structure

(b)Know and study the Symmetry and Group Theory

(c) Understand the important aspects of Magneto chemistry

(d) Know and study Bio-inorganic Chemistry

Thus, the knowledge from the course can help in the following:
(a) Finally, all students, of all branches whether organic or inorganic will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

Unit 1 -Quantum theory and Atomic Structure (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Quantum theory and Atomic Structure]

Postulates of quantum mechanics, setting up of different observables, commutation relations, step-up and step-down operators. Simple harmonic oscillator. Angular momentum of inner quantum number j.

Approximationmethods:VariationmethodandapplicationtoHatom.Perturbation theory (first order and non-degenerate), application to the Heliumatom.

Unit 2- Symmetry and Group Theory (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Symmetry and Group Theory]

Representation of groups –some properties of matrices & vectors, representation of groups, the Great orthogonality theorem and its consequences, character table, wave functions as basis for irreducible representations, direct product, identifying non- zero matrix elements.

Unit 3- Magneto Chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Magneto chemistry]

Magnetic susceptibility and basic derivation of diamagnetic susceptibility, pascal constant and its utility, Curie law and Curie-Weiss law, antiferromagnetism and ferromagnetism. Types of ant ferromagnetism, antiferromagnetic exchange pathway: Direct –metal- metal interaction and Indirect-atom exchange i.e. super exchange mechanism.

Unit 4- Bio-inorganic Chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Bio-inorganic Chemistry]

Metalloporphyrins (enzymes) definition, hemoglobin and myoglobin, cytochrome, vitamin B_{12} (cyanocobalamin), zinc metallo enzymes, nitrogen fixation, essential and trace elements in biological system, biochemistry of non metals K, Na pump (action of bath ions), toxic metals and their toxicity.

Co-ordination compounds in medicine

Chelation therapy, gold compounds and rheumatoid arthritis, anticancer drugs –platinum complexes, gold complexes, metallocenes etc, antimicrobial agents, metal complexes as radio diagnostic agents, magnetic resonance imaging.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester I

IV. Reference Books: PCH 1851: Inorganic Chemistry (Theory)

Core Reference Books:

(1) Introduction to Quantum Chemistry, A. K. Chandra, Tata MacGraw Hill

(2) F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 2nd Edn.1992
(3) Quantum Chemistry by R. K. Prasad, New Age International Publishers (1985)
(4) Elements of Magnetochemistry, Dutta and Syamal, 1993
(5) Bioinorganic Chemistry, I. Bertini, H. B. Gray and S. J. Lippard

IV. Other Reference Books: PCH 1801: Inorganic Chemistry (Theory)

(1) Quantum Chemistry, Ira N. Levine, Prentice Hall
(2) Elementary Quantum Chemistry by D. L. Pilar, McGraw Hill Book Co, New York (1968)
(3) Quantum Mechanics in Chemistry, M. W. Hanna The Benjamin Pub.
(4) Molecular Quantum Mechanics, Third Edition, P. W. Atkins and R.S. Friedman
(5) Group theory and symmetry in chemistry, L. H. Hall (McGraw Hill)
(6) Group theory in Chemistry V. Ramkrishnan & M. S. Gopinadhan Vishal Pub.1996.
(7) Inorganic Chemistry, Alan G. Sharpe Third Edition,
(8) Theoretical Inorganic Chemistry, M. C. Day, J. Shellin
(9) Hermann Dugas, Bioorganic Chemistry, A Chemical Approach to Enzyme Action, Springer International Edition
(10) Inorganic Chemistry, K. F. Purcell and J. C. Kotz.
(11) Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Bers
(12) Bioinorganic Chemistry, I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, University Science Books
(13) Introduction to Magnetochemistry, Alan Earnshaw, 1968

M Sc Semester I

Paper: PCH 1852: Organic Chemistry (Theory)

CORE Paper: Organic Chemistry (Theory)
Course Code: PCH 1852
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit OC 01: (A) Elimination Reaction
(B) Nucleophilic Substitution Reaction
Unit OC 02: Molecular rearrangements:
Unit OC 03: (A) Reactive intermediates
(B) Aromaticity
Unit OC 04: Stereo Chemistry

The main objective of the course will be to enhance the understanding and knowledge of organic chemistry

By the end of the paper, a student will be able to :

(a) understand the details of Elimination Reaction and Nucleophilic Substitution Reaction

(b) the chemistry of various types of Molecular rearrangement reactions.
(c) understand the important aspects of Reactive intermediates and Aromaticity

(d)understand the details of various aspects of Stereo Chemistry.

Thus, the knowledge from the course can help in the following:
This content can help students to increase their conceptual base and understanding in these topics which will be needed by students in their pursuit of research in other allied branches of chemistry.

II. Course Content

Unit-1 **(15L)[14Marks]**

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Elimination Reaction and Nucleophilic Substitution Reaction]

(A) Elimination Reaction

The E1, E2 and E1CB reaction mechanism. reactivity- effects of substrate structures, attacking base, leaving group and medium. Regiochemistry of E1 and E2 elimination reactions.Stereochemistry of E2eliminations in cycloalkane and related systems.Mechanism and

orientation in Pyrolytic eliminations in (1) Acyclic systems (ii) Alicyclic systems (iii) Cope eliminations. Thermal decomposition without rearrangement. - The chugaev reaction.

(B) Nucleophilic Substitution Reaction

Mixed S_N^1, S_N^2 and SET mechanism. Nucleophilic substitution at (i) Allylic carbon (Allylic rearrangements)(ii) An Aliphatic trigonal carbon (the tetrahedral mechanism) and at (iii) A Vinyl carbon. Participation of Neighboring groups in Nucleophilic substitution by (a) Carboxylate anion (b) Halogen atoms (c) Hydroxyl groups (d) Acetoxyl group (e) Phenyl group (f) RS group (g) Participation by π-bond.

Unit-2 Molecular rearrangements (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Molecular rearrangements]

Introduction: Definition and classification.

(I) Rearrangements Induced by Cationic or Electron Deficient Sites

Molecular rearrangements involving electron deficient carbon:

(i) Wagner- Meerwein
(ii) Pinacol- Pinacolone rearrangement
(iii) Tiffeneau-Demjanov Rearrangement

Rearrangements to Electron Deficient Heteroatoms

Electron deficient Nitrogen:

(i) Lossen rearrangement
(ii) Curtius rearrangement
(iii) Schmidt rearrangement

Electron deficient Oxygen:

(i) Baeyer-Villager Rearrangement

(II) Rearrangements Induced by Bases or Electron Rich Sites

(i) The Favorskii Rearrangement
(ii) Wittig and Stevens Rearrangement
(iii) Benzylic acid rearrangement
(iv) The Sommelet-Hauser rearrangement

Unit – 3 (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to reactive intermediates and aromaticity]

(A) Reactive intermediates

Carbocations (classical and non classical), Carbanion, Carbines, Free radicals and Nitrenes: their stability, structure, generation and fate.

(B) Aromaticity

Aromaticity, aromatic character, Frost circle diagram for cyclobutadiene, benzene and others. Resonance and chemical stabilization-aromatic character based on NMR criteria, Huckels molecular orbital(HMO) method, MO of simple organic systems such as ethene, allyl and butadiene. Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes, fulvenes, azulenes, antiaromaticity and homoaromaticity.

Unit –4 Stereo Chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Stereo Chemistry]

Planar and helical Chirality: Configurational nomenclature: Planar chiral ANSA compounds and trans- cyclooctene. Helical chiral compounds. Enantio selective Synthesis – Epoxidation of allyl alcohols (Sharplessep oxidation), Enantio selectivity through Hydroboration-Oxidation, Enantio selectivity through use of Phase transfer catalysts, Reduction of ketones with chiral hydride donors. Asymmetric resolution: Dynamic resolution, Dynamic kinetic resolution and Dynamic Thermodynamic resolution.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester I

IV. Reference Books: PCH 1852: Organic Chemistry:(Theory)

Core Reference Books

(1) Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, 6thEdition, John Wiley.

(2) Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .

(3) Advanced Organic Chemistry Part B: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer

(4) Stereo Chemistry, P.S. Kalsi , New Age Publications.

(5) Organic Reaction mechanism, Third edition, V. K. Ahluwalia, RakeshkumarParashar, Narosa Publishing house New Delhi.

IV. Other Reference Books: PCH 1802: Organic Chemistry:(Theory)

(1) Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.

(2) Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall

(3) Organic Chemistry, Jonathan Clayden, Nick Geeves, Stuart Warren, 1st Edition, Oxford University Press.
(4) Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rd Edition, Blackie Academic and Professional.
(5) Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.
(6) Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen, Wiley-Blackwell.
(7) Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.
(8) Dynamic Stereochemistry of Chiral Compounds: Principles and Applications, Christian Wolf, RSC publishing.
(9) Organic Chemistry Vol 1-2 I.L.Finar 5^{th} edition,ELBS.

M Sc Semester I

CORE Paper: Physical Chemistry (Theory)
Course Code: PCH 1853
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit PC 01- Chemical thermodynamics
Unit PC 02- Chemical Kinetics
Unit PC 03-Solid state chemistry
Unit PC 04- Surface chemistry

The main objective of the course will be to enhance the understanding and knowledge of Physical Chemistry without an obscuring mathematical screen.

By the end of the paper, a student will be able to:

(a) understand the details and utility of the entire topics in physical chemistry, separately as well as in context to one another.

(b) the long major areas of study such as thermodynamics and kinetics are so taught ,such that students are able to move on to more advanced studies.

Thus, the knowledge from the course can help in the following:
The other topics, like Solid State and Surface Chemistry are so decided upon so that students can increase their conceptual base in this subject which will be needed by students in their pursuit of research in other allied branches of chemistry.

II. Course Content

Unit -1 Chemical thermodynamics (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Chemical thermodynamics]

Experimental verification of third law of thermodynamics, entropy correction for real gases, partial molar quantities and their determination, Gibbs-Duhem equation, chemical potential, chemical potential of idea gases and solutions, Raoult's law, real solutions, free energy and solutions, activity and activity coefficients, fugacity of gases and liquids and methods of its determination. Non equilibrium thermodynamics-basic concepts.

Unit -2 Chemical Kinetics (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Chemical Kinetics]

Unimolecular reactions, chain reactions and branched chain reactions, explosion limits, chain reaction between hydrogen and bromine, theory of absolute reaction rates, Kinetics of fast

reaction and some experimental techniques for studying fast reactions like NMR, Mass Spectoscopy, Gas chromatography, Flow method and Flash photolysis method.

Unit -3Solid state chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Solid state chemistry]

Bonding in solids and electronic structure in solids, bond theory-metals, semiconductors and insulators, defects in crystals, calculation of schottly and Frenkel defects using statistical method, non-stoichiometry –FeO (wustite), solid electrolytes, diffusion in solids- Fick's laws, mechanism of diffusion, electrical conductivity in solids, super conductivity, perovskites.

Unit -4 Surface chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Surface chemistry]

Physical and chemical adsorption, BET equation, heat of adsorption and its measurement by Calorimetric and Clausius Clapeyron equation methods, determination of surface area of adsorbents by BET method , surface tension and adsorption from solutions, Gibb's adsorption equation, micellisation and critical micellar concentration (cmc).

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M.Sc. Semester I

IV. Reference books: PCH1853: Physical Chemistry (Theory)

Core Reference books:

(1) Advanced physical chemistry by Gurdeep Raj 35th revised edition, Goel publishing house.

(2) Thermodynamics for chemists by S.Glasstone, Read Books, 2007.

(3) Solid state chemistry ,An introduction : 4th edition CRC press by Smart and Moore

IV. Reference books: PCH 1803: Physical Chemistry (Theory)

(1) Physical chemistry by W.J.Moore, 5th edition, orient longman private ltd.

(2) Textbook of physical chemistry by S. Glasstone, D. Van Nostrand company, inc., 1946.

(3) Textbook of physical chemistry by Peter Atkins Julio de and Paula, 9th edition, oxford press.

(4) Advanced physical chemistry by J.N.Gurtu, A.Gurtu, 11th edition , Pragati prakashan.

(5) Physical chemistry by S. Castellan, 3rd edition, Pearson Custom Publishing.
(6) Thermodynamics of non equilibrium processes- Karapitianeh
(7) Chemical Kinetics by Laidler, 3rd edition, Pearson Education India
(8) Chemical Kinetics – Frost and Pearson
(9) Principles of the Solid State by H.V.Keer, 2nd edition ,New Age Internation (P) Ltd.
(10) Introduction to Solids by L.Azaroff, 1st edition, McGraw Hill Education India Pvt Ltd.
(11) Physical Chemistry of Surfaces by A.W.Adamson,6th edtition, Wiley-Interscience.
(12) Surface chemistry – Osipov
(13) Solid State Chemistry and its Applications by Anthony R West, 2nd edtiton 2014,Wiley.
(14) Chemical Thermodynamics: Classical, Statistical and Irreversible by Rajaram & Kuriakose, S Chand, 2nd edition.

M Sc Semester I

CORE Paper: Analytical Chemistry (Theory)
Course Code: PCH 1854
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit -AC 01 Analytical objectives, sampling and calibration methods
Unit-AC 02 Fundamentals of spectrophotometry
Unit-AC 03 Applications of spectrophotometry
Unit-AC 04 Thermal methods of analysis

The main objective of the course will be to enhance the understanding and knowledge of Analytical Chemistry, for students studying , any branch of chemistry .

By the end of the paper, a student will be able to:

(a) Understand the very important role of an analytical chemist in all branches of chemistry.

(b) Know and study the work-up required by all samples before they can be subjected to analysis and also learn about the various types of analysis.

(c) will study about the most widely employed technique i.e. spectrophotometry and its application.in analytical chemistry and other branches of chemistry.

(d) will study about thermal methods of analysis which is able to provide valuable analytical data.Thus, the knowledge from the course can help in the following:

All students, of all branches whether organic or inorganic will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

Unit -1Analytical objectives, sampling and calibration methods (15L)[14 Marks]
[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Analytical objectives, sampling and calibration methods]

Scope of analytical science and its literature, sampling and sample preparation, general steps in chemical analysis, calibration and classification of glassware, validation of analytical methods, finding the best straight line-least square regression ,correlation coefficient, calibration curves, standard addition technique internal standard method. Numericals based on chemical concentrations.

Unit-2 Fundamentals of spectrophotometry (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Fundamentals of spectrophotometry]

Properties of light, absorption of light, interaction of light with matter and origin of spectra, spectrophotometer-instrumentation of single and double beam, Beers Law-its use, limitation and numericals, photometric accuracy.

Unit-3 Applications of spectrophotometry (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Applications of spectrophotometry]

Analysis of mixture, measurement of equilibrium constant, Scatchard Plot, Stoichiometry determination-method of continuous variation-Jobbs Plot , Photometric titrations.

Unit-4 Thermal methods of analysis (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Thermal methods of analysis]

Principle, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential thermal analysis(DTA) and Differential Scanning Calorimetry (DSC).

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester I

IV. Reference books: PCH1854: Analytical Chemistry (Theory)

Core Reference books:

(1) Principles of Instrumental Analysis, by Douglas A. Skoog, 3rd Edition, Holt- Saunders International Edition.

(2) Quantitative Chemical Analysis, by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York.

(3) Fundamentals of Analytical Chemistry by Crouch, West and Skoog,9th edition , Brooks/Cole (2013)

IV. Other Reference books: PCH1804: Analytical Chemistry (Theory)

(1) Analytical Chemistry, by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.

(2) Instrumental Methods of Chemical Analysis, by Galen W. Ewing, 4thEdition, International Student Edition.

M Sc Semester I

Paper: Inorganic Chemistry and Organic Chemistry (Practicals)
Course Code: PCH 1855L
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course: PCH 1855L (A) Advanced Inorganic Chemistry (Practicals)
II. Course Content

(1) Solid phase synthesis of trans-bis glycinato copper (II)
(2) Non-metal complex: Synthesis and characterization of bispyridine iodide nitrate.
(3) Nano-chemistry: Preparation of manganese dioxide nanoparticles.
(4) Synthesis of hexaammine cobalt (III) chloride.
(5) Determine the presence of F, As, Zn, Cd, Pb, Cu in drinking water and heavy metal in food samples.
(6) Determination of the half wave-potential for Cd (II) or Cu (II) or Zn (II) ion in 0.1 M KCl solution.
(7) Study the kinetics of dissociation of tris-O-phenanthroline Fe (II), Ni (II) complex by spectrophotometric method.
(8) Catalytic reduction activity of silver nano particle for p-nitrophenol and other derivatives.

Projects:

(1) Just like heavy metal detection in waste water, in chocolate and toys with the help of nano-particles.
(2) Bio chemical sensing with nano-particles.

III. Teaching methodologies: Practical work, problem solving, and group discussion etc.

M. Sc. Semester I

IV. References books: PCH1855L (A): Advanced Inorganic Chemistry (Practicals)

(1) Vogel's Qualitative Inorganic Analysis, Revised by G Svehla, Sixth Edition, Longman, 1987.
(2) Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST.

I. Course: PCH 1855L (B) Organic Chemistry (Practicals)

II. Course Content

(a)Preparation of organic compounds: Single Stage Preparations:

(1) Preparation of 1-Phenyl-3-methyl-5 pyrazolone from acetoacetic ester.

(2) Preparation of Dibenzylidene acetone from Benzaldehyde.

(3) Preparation of o-Chlorobenzoic acid from o-amino benzoic acid.

(4) Preparation of 2,4-Dinitroanisole from Anisole

(5) Preparation of Phthalimide from phthalic acid.

(6) Preparation of Para Red

(7) Preparation of methyl Orange.

(8) Preparation of Benzo triazole from o-Phenylene diamine

(9) Preparation of 1,2,3,4 tetrahydrocarbazole from phenyl hydrazine. (Fisher Indole synthesis)

(10) Preparation of p-Bromo acetanilide from acetanilide (Green route)

(b) Quantitative Estimations:

(1) Estimation of ester + acid

(2) Estimation of Formaldehyde

(3) Estimation of glycine

(4) Estimation of amide + acid

III. Teaching methodologies: Practical work, problem solving, and group discussion etc.

M. Sc. Semester I

IV. References books: PCH1855L (B): Organic Chemistry (Practicals)

(1) A text book of practical organic chemistry – A. I. Vogel

(2) Practical organic Chemistry – Mann and Saunders

(3) A handbook of quantitative and qualitative analysis – H. T. Clarke

(4) Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia& S. Dhingra.

(5) Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press.

(6) An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

M. Sc. Semester I

Paper: Physical Chemistry and Analytical Chemistry (Practicals)
Course Code: PCH 1856L
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course: PCH 1856L (A) Physical Chemistry (Practicals)
II. Course Content

(1). Conductometry

(a) To determine of centration of HCl and NH_4Cl in a given solution conductometrically (requirements: 0.05N HCl, 0.5 N NH_4Cl, 0.5 N NaOH)

(b) Estimate the concentration of H_2SO_4, CH_3COOH and C_USO_4 5 H_2O in a given solution conductometrically. (0.005M all against 0.05N NaOH)

(2) Potentiometry

(a) To construct the calibration curve for quinhydrone electrode and hence the standard oxidation potential of quinhydrone electrode. (0.2N CH_3COONa, 0.2NCH_3COOH)

(b) Solubility product of silver halides.

(3) pH metry

(a) To determine the amount of Aspirin in a given solution.(aspirin,0.1N alcoholic KOH, glass and calomel electrodes)

(b) Titration of mixture of bases (Na_2CO_3& $NaHCO_3$) with standard HCl and find the concentration of bases.

(4) Adsorption and kinetics

(a) To study the rate of acid catalysed ionization of acetone in presence of excess acid and acetone at room temp. (requirement: acetone, iodine, sulfuric acid sodium acetate, 0.01sodium thiosulphate, starch)

(b) To determine the autocatalytic reaction between $KMnO_4$ and oxalic acid. (Requirements:0.1M $H_2C_2O_4$, 10%KI , 0.01M $Na_2S_2O_3$, 0.02M $KMnO_4$,0.2M $MnSO_4$, 1% starch, 1.0 M H_2SO_4)

(5) Distribution method

(a) Distribution of HAC between H_2O and $CHCl_3$ / CCl_4.

(b) Distribution of I_2 between H_2O and CCl_4.

III. Teaching methodologies: Practical work, problem solving, and group discussion etc.

M. Sc. Semester I

IV. References books: PCH 1856 L (A): Physical Chemistry (Practicals)

(1) Advanced Practical Physical Chemisty By J. B. Yadav, 32nd edtion Krishna publication**.**

(2) Practicals in physical chemistry by P. S. Sindhu, Macmillan 2005.

(3) Experimental physical chemistry by R. C. Das, B. BeheraTata McGraw-Hill, 1983.

(4) Experimental Physical Chemistry by Athwale , Mathur and Parul, 1st edition reprint 2011,New Age International (P) Ltd.

M. Sc. Semester I

I. Course: PCH 1856L (B) Analytical Chemistry (Practicals)

II. Course Content

(1) Calibration of glass wares and balance.

(2) Determination of %age purity of given sample of Isoniacid.

(3) Determination of %age of Asprin in the given tablet.

(4) Determination of available chlorine in bleaching powder.

(5) Determination of vitamin C in orange juice/amla.

(6) Determination of acetic acid in vinegar.

(7) Determination of sodium carbonate and sodium bicarbonate in washing soda.

(8) Determination of ascorbic acid in vitamin C tablets.

(9) Determination of %age purity of given sample of Analgin tablet.

(10) Determination of calcium and magnesium in water sample.

(11) Determination of sulphate in water sample.

(12) Determination of chloride in water sample.

III. Teaching methodologies: Practical work, problem solving, and group discussion etc.

M. Sc. Semester I

IV. References books:PCH1856L (B): Analytical Chemistry (Practicals)

(1) Analytical Chemistry Practice, John H. Kennedy, Saunders College Publishing, Second Edition 1990.

(2) Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.

M Sc Chemistry Sem II Overview

Sub. code	Course	Instruction Hrs/week	Internal Assessment Marks	Max Marks Semester Exams	Duration of Semester Exam (Hrs)	Credit
THEORY						
PCH 2851	Inorganic Chemistry-II	4	40	60	3	4
PCH 2852	Organic Chemistry-II	4	40	60	3	4
PCH 2853	Physical Chemistry-II	4	40	60	3	4
PCH 2854	Analytical techniques-II	4	40	60	3	4
PRACTICALS						
PCH 2855L	Inorganic Chemistry Lab-II	3	40	60	3	4
	Organic Chemistry Lab-II	3			3	
PCH 2856L	Physical Chemistry Lab-II	3	40	60	3	4
	Analytical Chemistry Lab-II	3			3	
	Total	**28**	**240**	**360**		**24**

Note:- Semester -I and Semester-II syllabus is common for all specializations to be selected by the students for final year i.e. Inorganic, Organic, Physical and Analytical. At present St. Xavier's College offers Organic Chemistry and Analytical Chemistry (Self Finance) as specializations in the final year of M Sc Chemistry.

M. Sc. Semester II

CORE Paper: Inorganic Chemistry (Theory)
Course Code: PCH 2851
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit IC 01- Chemical Bonding

Unit IC 02- Application of symmetry

Unit IC 03- Organometallic Compounds

Unit IC 04 – Reaction Mechanism

The main objective of the course will be to enhance the understanding and knowledge of Inorganic Chemistry, for students studying, any branch of chemistry.
By the end of the paper, a student will be able to:

(a) understand the important aspects of Chemical Bonding and Atomic Structure

(b) know and study the applications Symmetry and Group Theory

(c) understand the important aspects of Organometallic Compounds

(d) know and study Reaction Mechanism in inorganic chemistry

Thus, the knowledge from the course can help in the following:
(a) Finally, all students, of all branches whether organic or inorganic will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

Unit 1- Chemical Bonding **(15L)[14Marks]**

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to VSEPR theory and Chemical Bonding]
VSEPR, Walsh diagrams(tri atomic molecules), Bent rule and Simple Huckel theory of linear conjugated systems, simple Huckel theory of the cyclic conjugated system and aromaticity, self-consistent filed method, valence state ionization potentials,-Band theory of solids, Fermi level, electrical properties, insulators, semiconductors and superconductors (properties).

Unit 2- Application of symmetry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to symmetry and IR and Raman spectra]

Application of symmetry to hybrid orbital, molecular orbitals, hybridization schemes for σorbitals, π bonding and molecular orbital for ABn type of molecules.

Application of symmetry to molecular vibrations, interpretation of IR and Raman spectral data.

Unit 3-Organometallic Compounds (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Organometallic Compounds]

Organometallic compounds of transition elements, stability of metal carbon bond in complexes. Synthesis, uses and structure of organometallic compounds of π bonding organic ligands, 2-electron ligands, olifinic and acetylinic complexes, compound with 3 electron ligand – allylic complexes, compounds. With 4- electron ligands butadiene complexes, n4 complexes of cyclopentadiene, compounds with 5 electron ligands – cyclopantadionyl, compounds with 6 electron ligands, n6 complexes of benzene and its derivatives. Role of organometallic compounds in catalytic reaction.

Unit 4 – Reaction Mechanism (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Inorganic Reaction Mechanism]

Mechanism of substitution reaction in square planar complexes. Kinetics of substitution reaction of platinum (II) complexes.

Effect of leaving group, effect of charge, steric effect, solvent effect, effect of nucleophile, effect of temperature and other effects.

Oxidation-Reduction reaction, electron transfer, tunneling effect, Marcus –Hush theory, one and two electron transfer inner sphere and outer sphere, effect of ions on rate, electron transfer through extended bridges, unstable oxidation states, hydrated electron.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M. Sc. Semester –II

IV. References books: PCH2851: Inorganic Chemistry(Theory)

Core Reference books:

(1) Mechanism of Inorganic Reactions, F. Basolo and R. G. Persons, Wiley Pub
(2) Electrons and Chemical Bonding by H B Gray
(3) Symmetry and group theory by B S Garg

IV. Other References books: PCH2801: Inorganic Chemistry (Theory)

(1) Lectures on Chemical Bonding and Quantum Chemistry, S. N. Datta, A Prism Book
(2) Group theory and symmetry in chemistry, L. H. Hall(McGraw Hill) Coulson's Valence, R. McWeeny, ELBS
(3) F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 2nd Edn.1992
(4) V. Ramkrishnan& M. S. Gopinadhan, Group theory in Chemistry Vishal Pub.1996
(5) Inorganic Chemistry, Third Edition, Alan G. Sharpe
(6) Theoretical Inorganic Chemistry, M. C. Day, J. Shellin
(7) Chemistry, Fifth Edition, John E. McMurry, Robert C. Fay
(8) An Introduction to Theoretical Chemistry, Jack Simons, Cambridge
(9) Progress in inorganic Chemistry, Vols 18 and 38 ed. J. J. Lippard, Wiley
(10) Reaction Mechanism of Coordination Compounds, C. H. Langford and H. B. Gray
(11) Inorganic Reaction Mechanisms, M. L. Tobe, Nelson Pub
(12) Inorganic Chemistry, K. F. Purcell and J. C. Kotz.
(13) Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Bers
(14) Mehrotra R. C. and Singh A. Organo Metallic Chemistry, Willey Eastern Ltd., New Delhi
(15) Coates G. E. Green MIH Wade, K and Aylett B. J. Organo Metallic Comounds Chapman and Hall, London

M. Sc. Semester –II

CORE Paper: Organic Chemistry (Theory)
Course Code: PCH 2852
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit OC 01: Application Redox and reagents in organic synthesis.
Unit OC 02:(A)Photochemistry
(B)Chemistry of Heterocycles
Unit OC 03: Organic Name reactions
Unit OC 04: Reagents in organic synthesis
The main objective of the course will be to enhance the understanding and knowledge of organic chemistry

By the end of the paper, a student will be able to:

(a) understand the details of Application Redox and reagents in organic synthesis
(b) the chemistry of Photochemistry and Heterocyclic compounds
(c) understand the importance of Organic Name reactions
(d) understand the details of various aspects of Reagents in organic synthesis.

Thus, the knowledge from the course can help in the following:
This content can help students to increase their conceptual base and understanding in these topics which will be needed by students in their pursuit of research in other allied branches of chemistry.

II. Course Content

Unit - 1: Application Redox and reagents in organic synthesis. (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Oxidation and reduction]

(A) Oxidizing agents, Reducing agents and Mechanistic explanation of oxidation and reduction with example.
Oxidation with Manganese, $KMnO_4$,Chromium, Peracid, Peroxide, Dimethyl dioxarane SeO_2,NBS,DDQ,Chloranil and Oppenauer oxidation.

(B) Reduction:
(i) Reduction with Hydride transfer reagents like $LiAlH_4$,$NaBH_4$,Diborane.
(ii) Reduction by Dissolving metals Zn, Li, Na.
(iii) Birch reduction and catalytic reduction.

Unit – 2 **(15L)[14Marks]**

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Photochemistry and Heterocyclic compounds]

(A) Photochemistry:

(1) Photochemical reactions: Principles of energy transfer, electronic excitation and molecular orbital view of excitation, excited states and excitation and molecular orbital view of excitation, excited states and fate of excited molecules (modified Jablonski diagram), Photosensitization.

(2) Photochemistry of carbonyl compounds: Representation of excited states of ketones, photo reduction Norrish type I & Π reactions, Reactions of cyclic Ketone, oxetane formation (Paterno-Buchi reaction)

(3) Di-π methane rearrangement, Dienone photochemistry, cis-trans isomerisation and photochemistry of conjugated olefins.

(B) Chemistry of Heterocycles

(1) Nomenclature of heterocycles: Few examples of systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.
General chemical behavior of following aromatic heterocycles: their synthesis and important applications. (Three examples each)
(2) Five-membered and benzo fused five member heterocycles : Oxazole, Isoxazole, Thiazole, Pyrazole, Imidazole, Benzothiazole and Benzimidazole.
(3) Six membered and benzofused six membered heterocycles :Pyrazine, Pyridazine, Pyrimidine, Cinnoline, Quinazoline, Quinoxaline, Phenoxaline.

Unit – 3 Name reactions: **(15L)[14Marks]**

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Name reactions]

General nature, method, mechanism and synthetic applications of thefollowing named organic reactions:

(i)	Suzuki reaction	(ii)	Buchwald Hartwing reaction (cross coupling)
(iii)	Sonogarshira coupling	(iv)	Vilsmeier-Haack reaction
(iv)	Mitsunobu reaction	(vi)	Stobbe condensation
(vii)	Jones oxidation	(viii)	Swern oxidation reaction
(ix)	Michael addition	(x)	Dickmann reaction
(xi)	Knoevanagel reaction	(xii)	Darzen'sglycidic ester synthesis
(xi)	Mannich reaction	(xiv)	Witting reaction

Unit-4 Reagents in organic synthesis: (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Reagents in organic synthesis]

Mechanism selectivity and utility of following reagents:

(i) Gilman's reagent-Lithium dimethylcuprate (ii) Lithium diisopropylamide (LDA)

(iii) Dicyclohexylcarbodiimide (DCC) (iv) 1,3 – Dithiane (Umpolung reagent)

(v) Dess- Martin periodinane (vi) Bakers yeast

(vii) Diisobutylauminiumhydride(DIBAL –H)

(viii) Sodium cyanoborohydride($NaBH_3(CN)$) (ix) Grignard reagents

(x) Sodium borohydride (xi) DDQ (xii) n-Butyl lithium

(xiii) Phase transfer catalysis : Quaternary ammonium and phosphonium salts, crown ethers.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M. Sc. Semester –II

IV. References books: PCH2852: Organic Chemistry (Theory)

Core Reference books:

(1) Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons
(2) Advance organic chemistry by Jerry March
(3) Photochemistry and Pericyclic Reactions by Jagdamba singh and Jaya singh NEW AGE; 3rd edition (1 January 2012)
(4) Organic Chemistry Vol 1-2 I.L.Finar 5th edition, ELBS.

IV. Other References books: PCH2802: Organic Chemistry (Theory)

(1) Modern Synthetic Reactions, H.O.House, W.A. Benjamin.
(2) Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rd Edition, Blackie Academic and Proffessional.
(3) Introductory Photochemistry, A.Cox and T.Camp, McGraw Hill.
(4) Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.

(5) Organic Photochemistry, J. Coxon and B. Halton, 2nd Edition , Cambridge University Press.
(6) Strategic Applications of Named Reactions in Organic Synthesis, Laszlo Kurti and Barbara Czak, 1st Edition, Acedemic Press.
(7) Name Reactions and Reagents in Organic Synthesis, Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro, 2nd Edition, Wiley – Interscience.
(8) Name Reactions. A Collection of Detailed Reaction Mechanisms., Jie Jack Li, 3rd Edition Springer.
(9) Heterocyclic Chemistry, volume 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer-Verlag.
(10) Heterocyclic Chemistry, J.A. Joule, K.Mills, and G.F. Smith, 3rd Edition, Chapman and Hall.
(11) Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
(12) Contemporary Heterocyclic Chemistry, G.R. Nikome and W.W. Poudler, Wiley.
(13) Comprehensive Heterocyclic Chemistry, A.R. Kartizky, and C.W. Rees.
(14) Encyclopedia of Reagents for Organic Synthesis, Leo A. Paquette, David Crich and Phillip L. Fuchs, John Wiley and Sons Inc. .
(17) Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall.
(18) Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .
(21) Advance organic chemistry by Carey and Sundberg,
(22) Advance organic chemistry by Francis A. Carey.

M. Sc. Semester –II

CORE Paper: Physical Chemistry (Theory)
Course Code: PCH 2853
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit-PC 01 Statistical thermodynamics

Unit-PC 02 Nuclear chemistry

Unit-PC 03 Polymer chemistry

Unit-PC 04 Electrochemistry

The main objective of the course will be to enhance the understanding and knowledge of Physical Chemistry without an obscuring mathematical screen.

By the end of the paper, a student will be able to :

(a) understand the details and utility of the entire topics in physical chemistry, separately as well as in context to one another.

(b) The long major areas of study such as Statistical thermodynamics and Nuclear chemistry are so taught, such that students are able to move on to more advanced studies.

Thus, the knowledge from the course can help in the following:
The other topics, like Polymer chemistry and Electrochemistry are so decided upon so that students can increase their conceptual base in this subject which will be needed by students in their pursuit of research in other allied branches of chemistry.

II. Course Content

Unit-1 Statistical thermodynamics (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Statistical thermodynamics]

Concepts of distribution of molecules, microstate and macrostate. Ensemble averaging, Canonical, grand canonical and microcanonical ensembles, Maxwell-Boltzman distribution laws (using Lagrange's method of undetermined multipliers). Fermi-Dirac statistics – distribution law and Bose-Einstein statistics – distribution law.

Partition functions – translational, rotational, vibrational and electronic partition

Unit-2 Nuclear chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Nuclear chemistry]

Nuclear properties-nuclear radius, coulombic and nuclear potential radius, nuclear spin and angular momentum, magnetic moment, nuclear binding energy, nuclear models-shell model, liquid drop model, Fermi gas model, collective model, radioactive decay, nuclear reactions, evaporation, spallation, fragmentation, fission and fusion reactions, accelerators, reaction cross section, use of radioisotopes as tracers.

Unit-3 Polymer chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Polymer chemistry]

Kinetics and mechanism of polymer processes, criteria of polymer solubility, thermodynamics of polymer solutions, polymer characterization, molecular weight of polymer (number average and weight average), methods of molecular weight determination, properties of polymers and applications.

Unit-4 Electro chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electrochemistry]

Sign convention-American, European and IUPAC; Polarization ,demonstration of polarization , elimination of polarization ,Decomposition Potential-Factors ,applications and measurement of Decomposition potential and Overvoltage and factors affecting overvoltage, basic principle of polarography, origin of different types of current; Ilkovic equation. polarographic wave equation, Importance of E1/2 in polarography ,Dependence of E1/2 on pH and complexing agents(derivation),Pilot ion method and standard addition method to determine concentration.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M. Sc. Semester –II

IV. Reference books: PCH2853: Physical Chemistry (Theory)

Core Reference books

(1) Statistical thermodynamics by M.C.Gupta ,revised 2nd edition, New Age International publishers

(2) Nuclear and radioactive chemistry by B K Sharma, Krishan Prakashan (2014)

(3) Advanced physical chemistry by Gurdeep Raj 35th revised edition, Goel publishing house
(4) Polymer science by Gowariker, New Age International, reprint 1986.

IV. Other Reference books: PCH2803: Physical Chemistry (Theory)

(1) Physical chemistry by W.J.Moore, 5th edition, orient longman private ltd.
(2) Textbook of physical chemistry by S. Glasstone, D. Van Nostrand company, inc., 1946.
(3) Textbook of physical chemistry by Peter Atkins Julio de and Paula, 9th edition, oxford press.
(4) Advanced physical chemistry by J.N.Gurtu, A.Gurtu, 11th edition , Pragati prakashan.
(5) Thermodynamics,statistical thermodynamics and kinetics by T.Engle and P.Reid, Pearson India.
(6) Statistical Thermodynamics - Fundamentals and Applications by NORMAND M. LAURENDEAU , Cambridge University Press 2005
(7) Polymer science by Gowariker, New Age International, reprint 1986.
(8) Textbook of Polymer Science By 3rd Edition edition (2 May 1984), Wiley-Blackwell.
(9) Principles of Polymer Science, 2nd edition by Bahadur&Sastry, Alpha Science.
(10) Polymer science & technology by Fried, 3rd edition, Printece-Hall.
(11) Polymer Chemistry: An Introductionby Malcolm P. Stevens, 3rd edition,Addison-Wesley Publishing Company.
(12) Essentials of Nuclear Chemistryby Arnikar, New Age Internation
(13) Nuclear and radio chemistry by J.W. Kannedy, G.Friedlander, 3rd edition, Wiley.
(14) Modern Electrochemistry by Bockris and Reddy

M. Sc. Semester –II

CORE Paper: Analytical Chemistry (Theory)
Course Code: PCH 2854
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

I. Course Overview & Course Objectives

Unit-AC 01 Sample Preparation Techniques

Unit-AC 02 Basic Principles of chromatography

Unit-AC 03 Specialized chromatographic techniques

Unit-AC 04 Electro-Analytical Chemistry

The main objective of the course will be to enhance the understanding and knowledge of Analytical Chemistry, for students studying, any branch of chemistry.
By the end of the paper, a student will be able to:

(a) understand the very important role of an analytical chemist in all branches of chemistry.
(b) know and study the work-up required by all samples before they can be subjected to analysis and also learn about the various types of analysis.
(c) will study about the most widely employed technique i.e. Principles of chromatography and its applicationin analytical chemistry and other branches of chemistry.
(d) will study about Electro-Analytical methods of analysis which is able to provide valuable analytical data. Thus, the knowledge from the course can help in the following:

All students, of all branches whether organic or inorganic will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

Unit-1 Sample Preparation Techniques (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Sample Preparation Techniques]

Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE).

Unit -2 Basic Principles of chromatography (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Basic Principles of chromatography]

Chromatographic Methods Principles of chromatography, classification of chromatographic techniques based on mechanism of retention, configuration, mobile and stationary phase. Importance and meaning of terms –Partition Ratio, Retention Time and Dead Time, Capacity Factor and Selectivity Factor, Efficiency of separation- plate theory (theoretical plate concept) and rate theory (Van Deemter equation).

Unit -3 Specialized chromatographic techniques (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Basic Principles of chromatography and Specialized chromatographic]

Principles, instrumentation and applications of Gas Chromatography, HPLC, HPTLC and Ion exchange chromatography .

Unit -4 Electro-Analytical Chemistry (15L)[14Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electro-Analytical Chemistry]

pH measurement with glass electrode, working of glass electrode, mechanism of pH measurement, calibration of glass electrode, errors in pH measurement. Classification, principle, properties and design of ion selective membrane electrodes- Glass electrodes for ions other than H^+, Solid precipitate electrode and single crystal electrode, Liquid ion exchange electrode, ion molecular sieve electrodes. Ion, Gas-sensing probes and enzyme substrate electrodes.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M. Sc. Semester –II

IV. Reference books: PCH2854: Analytical Chemistry (Theory)

Core Reference Books:

(1) Analytical Chemistry, by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.

(2) Quantitative Chemical Analysis, by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York.

(3) Fundamentals of Analytical Chemistry by Crouch, West and Skoog,9th edition , Brooks/Cole (2013)

IV. Other Reference books: PCH2804: Analytical Chemistry (Theory)

(1) A Practical handbook of preparative HPLC by Donald Wellings, Elsevier, 2006.

(2) Ion-pair chromatography: Theory and Biological and Pharmaceutical Applications (Chromatographic Science), Milton Hearn (editor), Marcel and Dekker Inc. (1985).

(3) Practical Aspects of Gas Chromatography/Mass Spectroscopy by Gordon M. Message, John Wiley & Sons, 1984.

(4) Modern Practice of Gas Chromatography by Robert L. Grob and Eugene F. Barry, 3rd edition, Wiley-Interscience, 1995.

(5) Basic Gas Chromatography by Harold M. McNair, James M. Miller, John Wiley and Sons, 2008.

(6) Analytical gas Chromatography by Walter Jennings, Eric Mittlefehldt and Philip Stremple, second edition, Elsevier Science, 1997.

(7) Modern HPLC for practicing scientists by Michael W. Dong, Wiley Interscience, 2006.

M. Sc. Semester II

Paper: Inorganic Chemistry and Organic Chemistry (Practicals)
Course Code: PCH 2855L
No. of Credits: 04
Learning Hours: 60 (70 Marks)
I. Course: PCH 2855L (A) Inorganic Chemistry (practicals)
II. Course Content

(1) Preparation and determination of purity of double and complex salts. At least seven preparations should be done.

(2) Colourimetric estimation of any four out of Cu, Mn, NO_2, Ni, P, Fe, V, Ti, Cr, Co.

III. Teaching methodologies: Practical work, problem solving and group discussion etc.

M. Sc. Semester II

IV. References books: PCH2805L (A) : Inorganic Chemistry(Practicals)

(1) Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.

(2) Advanced Practical Inorganic Chemistry, Gurdeepraj, Goel Publishing House, 2001.

(3) An Advanced Course in Practical Chemistry, A.K. Nad, B. Mahapatra, A. Ghosal, New Central Book Agency, 2004

M. Sc. Semester II

I. Course: PCH 2855L (B) Organic Chemistry (practicals)
II. Course Content

Mixture analysis: ternary mixture to be given. (S+S+S)or (L+L+L). Type determination. Separation by physical and chemical methods. (both permitted in case of liquids).

III. Teaching methodologies: Practical work, problem solving and group discussion etc.

M. Sc. Semester II

IV. References books: PCH2855L(B): Organic Chemistry (Practicals)

(1) A text book of practical organic chemistry – A. I. Vogel

(2) Practical organic Chemistry – Mann and Saunders

(3) A handbook of quantitative and qualitative analysis – H. T. Clarke

(4) Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia& S. Dhingra.

(5) Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis, V K Ahluwalia & R. Aggarwal Universities Press.

(6) An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

M. Sc. Semester II

Paper: Physical Chemistry and Analytical Chemistry (Practicals)
Course Code: PCH 2856L
No. of Credits: 04
Learning Hours: 60 (70 Marks)

I. Course: PCH 2856L (A) Physical Chemistry (practicals)
II. Course Content

(1) Conductometry

(a) Test of validity of Ostwald's dilution law and determination of dissociation constant of weak electrolyte like CH_3COOH & $ClCH_2COOH$
(b) Verification of Debye-Huckel-Onsager's equation in case of strong electrolytes like HCl, KCl, NaCl.

(2) Potentiometry

(a) Titration of dibasic acid like malonic, oxalic, succinic acid with NaOH and find the dissociation constant of acid.
(b) Precipitation titration → Titration of halids with $AgNO_3$.
(c) Redox titration Ferrous ammonium sulfate –$KMnO_4$, $K_2Cr_2O_7$.

(3) pH metry

(a) Determination of dissociation constant of weak acid like acetic and monochloroaceticacid
(b) To titrate phosphoric acid solution against alkali and to calculate the first, second and thirdioniozation constant of it.(0.05M phosphoric acid, 10% neutral $CaCl_2$, 0.5N NaOH)

(4) Kinetics

(a) Determination of the effect of (a) Change of temperature (b) Change ofconcentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of an acid hydrolysis of an ester.
(b) Determination of order of reaction between $K_2S_2O_8$ and KI by a fractional change method

(5) Distribution method

(a) Determination of the formula of the complex formed between cupric ion and ammonia by distribution method.

III. Teaching methodologies: Practical work, problem solving and group discussion etc.

M. Sc. Semester II

IV. References books: PCH2856L (A): Physical Chemistry (Practicals)

(1) Practical physical chemistry –J. B. Yadav
(2) Practicals in physical chemistry – P. S. Sindhu
(3) Experimental physical chemistry – R. C. Das, B.Behera
(4) Experiments in physical chemistry- P. H. Parsania, F. Karia

M. Sc. Semester II

I. Course: PCH 2856L (B): Analytical Chemistry (practicals)

II. Course Content

(1) Determination of saponification value of oil.
(2) Determination of iodine value of oil.
(3) Determination of iron by chloride extraction by solvent extraction process.
(4) Determination of dissolved oxygen.
(5) Determination of chemical oxygen demand.
(6) Determination of iron in iron tablets.
(7) Simultaneous estimation of chromium (III) and iron (III) by EDTA titration.
(8) Simultaneous estimation of calcium (II) and zinc (II) by EDTA titration.
(9) Simultaneous estimation of lead (II) and magnesium (II) by EDTA titration.
(10) Separation of aminoacids/ dyes/ drugs by TLC.
(11) Determination of cation content in hard water by ion exchange chromatography.

III. Teaching methodologies: Practical work, problem solving and group discussion etc.

M. Sc. Semester II

IV. References books: PCH2856L (B): Analytical Chemistry (Practicals)

(1) Analytical Chemistry Practice, John H. Kennedy, Saunders College Publishing, Second Edition 1990.
(2) Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, **2**002.

St. Xavier's College (Autonomous), Ahmedbad-09

Proposed Syllabus: M Sc Analytical Chemistry Semester III

Effective from Dec 2019

M. Sc. Semester III (Analytical Chemistry)Overview

Sub. code	Course	Instruction Hrs/week	Internal Assessment Marks	Max Marks Semester Exams	Duration of Semester Exam (Hrs)	Credit
THEORY						
PCH 3851	Analytical spectroscopy – I	4	40	60	3	4
PCH 3852	Electroanalytical Methods	4	40	60	3	4
PCH 3853	Advanced Analytical Instrumentation	4	40	60	3	4
PCH 3854	Forensic Sciences	4	40	60	3	4
PRACTICALS						
PCH 3855L	Analytical Chemistry Lab-I	3	40	60	3	4
	Analytical Instrumental techniques	3			3	
PCH 3856L	Analytical Chemistry Lab-II	3	40	60	3	4
	Industrial applications and titrimetric methods	3			3	
	Total	**28**	**240**	**360**		**24**

Note:- Semester -I and Semester-II syllabus is common for all specializations to be selected by the students for final year i.e. Inorganic, Organic, Physical and Analytical. At present St. Xavier's College (Autonomous) offers Organic as well as Analytical Chemistry as a specialization in the final year of M Sc Chemistry.

St. Xavier's College Ahmedbad-09(Autonomous)
Proposed Syllabus: M Sc Analytical Chemistry Semester III
Effective from June 2019

M Sc Semester III

CORE Paper: Analytical Spectroscopy – I (Theory)
Course Code: PCH 3851
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes

CO1: To apply the fundamentals of various types of spectroscopic techniques like IR, Raman, NMR and x-ray and applications of these techniques to interpret data.

CO2: To describe the advancement in spectroscopic methods like FT-IR and Fluorescence and can recognize necessity of these techniques in the field of analytical science.

CO3: To perform quantitative and qualitative measurements of samples by IR.

I. Course Overview & Course Objectives
Unit AC 01: Infrared Spectroscopy
Unit AC 02: Raman Spectroscopy
Unit AC 03: Nuclear Magnetic Resonance Spectroscopy
Unit AC 04: (i) X – Ray Diffraction, (ii) X – Ray Fluorescence Spectroscopy

The main objective of the course will be to enhance the understanding and knowledge of Qualitative Optical Spectroscopic Methods

By the end of the paper, a student will be able to:

(a)Understand the important aspects Infrared Spectroscopy
(b) Learn the various aspects of Raman Spectroscopy.
(c)Understand the important aspects of Nuclear Magnetic Resonance Spectroscopy
(d) Learn the Chemistry of X – Ray Diffraction and X – Ray Fluorescence Spectroscopy

Thus, the knowledge from the course can help in the following:
(a) Finally, all students, of all branches whether organic or inorganic or analytical will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

Unit – I Infrared Spectroscopy (15L) [14 Marks]
[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Infrared Spectroscopy]
Introduction, IR Frequency Range and Spectrum Presentation, Theory of Infrared Absorption, Mechanical Model of Stretching Vibrations, Quantum Treatment of Vibration, Sampling

process, Dispersive Spectrometers, Fourier Transform Spectrometers, Hyphenated Method, Analytical Information: Qualitative and Quantitative, Applications.

Unit – 2 Raman Spectroscopy (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Raman Spectroscopy]

Introduction, Dispersive Spectrophotometers: Normal Raman, Fourier Transform Spectrometers: FT – Raman, Resonance Raman spectroscopy, Surface – enhanced Raman Spectroscopy (SERS), Raman Microprobe, Remote Raman Analysis, Raman Depolarization Ratios, Analytical Information: Qualitative and Quantitative, Applications.

Unit – 3 Nuclear Magnetic Resonance Spectroscopy (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Nuclear Magnetic Resonance Spectroscopy]

Introduction, Physical and Chemical Principles, Instrumentation, Quantum description, Energy levels in magnetic field, Classical description, Relaxation process, High resolution, Analytical Information: Qualitative and Quantitative, Applications.

Unit – 4 (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to X – Ray Diffraction and X – Ray Fluorescence Spectroscopy]

(i) X – Ray Diffraction

Introduction, Single – Crystal Diffraction, Powder Diffraction, Analytical Information: Qualitative and Quantitative, Applications.

(ii)X – Ray Fluorescence Spectroscopy

Introduction, Instrumentation, Analytical Information: Qualitative and Quantitative, Applications

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester III

Core Reference Books

1. "Principles of Instrumental Analysis" by Skoog, Holler Crouch, 6th edition, Cengage Learning, 2014.
2. "Handbook of Instrumental Techniques for Analytical Chemistry", by Frank Settle, Prentice Hall PTR, New Jersey, 1997.

Other Reference Books: PCH 3851: Analytical Spectroscopy – I (Theory)

1. "Instrumental methods of analysis", by Sivasanker B., Oxford University Press, 2012.
2. "Instrumental Methods of Chemical Analysis", by Sharma B. K., 24th edition, Goel Publishing House, Meerut, 2005.

3. "Modern Spectroscopy", by Hollas J. M., 4th edition, John Wiley & Sons, Ltd.,Chichester, 2004.
4. "Quantitative Chemical Analysis", by Daniel C. Harris, 7th edition, W.H. Freeman and Company, New York, 2007.
5. "Analytical chemistry principles", by Kenedey John H., 2nd edition, Saunders college publishing, 1992.
6. "Handbook of Instrumental Techniques for Analytical Chemistry", by Frank Settle, Prentice Hall PTR, New Jersey, 1997.
7. "Applied Infrared Spectroscopy", by Smith A L, Wiley, New York, 1979.
8. "Instrumental Methods of Analysis", by Willard H H, 7th edition, Belmont, CA: Wadsworth, 1987.
9. "Raman Spectroscopy", by Long D A, McGraw – Hill, New York, 1977.
10. "Laboratory Raman Spectroscopy", by Strommen D P, Nakamoto N, Wiley, New York, 1984.
11. "Spectrometric Identification of Organic Compounds", by Silverstein R M, Bassler G C, Morrill T C, 5th edition, Wiley, New York, 1991.
12. "Introduction to NMR Spectroscopy", by Abraham R J, Fisher J, Loftus P, Wiley, New York, 1988.
13. "Principle of Fluorescence Spectroscopy", by Lakowicz L. R., 3rd edition,Springer, 2011.
14. "Elements of X – Ray Crystallography", by Azaroff L V, McGraw – Hill, New York, 1968.
15. "X – Ray Structure Determination: A Practical Guide", by Stout G H, Jensen L H, 2nd edition, Wiley, New York, 1989.
16. "Principles and Practice of X – Ray Spectrometric Analysis", by Bertin, Eugene, 2nd edition, Plenum Press, New York, 1975.
17. "An Introduction to X –Ray Spectrometry", by Jenkins, Ron, Heyden& Sons, London, 1974.
18. "Principles of Quantitative X – Ray Fluorescence", by Tertian R, Claisse F, Heyden, London, 1982.

M Sc Semester III(Analytical Chemistry -Theory)
PCH – 3852Electroanalytical Methods

CORE Paper: Electroanalytical Methods (Theory)
Course Code: PCH 3852
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes

CO1: To describe and differentiate various techniques based on electro-analytical principle like Voltammetry, Coulometry and polarography.

CO2: To identify and recognize composition and working of potentiometric, amperometric, conductometric chemical as well as biosensors, and to know applications of field-effect transistors sensors.

I. Course Overview & Course Objectives
Unit AC 01: Electroanalytical Measurements
Unit AC 02: Voltammetry
Unit AC 03: Electrodeposition and Coulometry
Unit AC 04: Electrochemical sensors and Biosensors

The main objective of the course will be to enhance the understanding and knowledge of Electroanalytical Techniques

By the end of the paper, a student will be able to:
(a) Understand the important aspects of Electroanalytical Measurements.
(b) Learn the various aspects of Voltammetry.
(c) Understand the important aspects of Electrodeposition and Coulometry.
(d) Learn the Chemistry of Electrochemical and Bio-sensors.

Thus, the knowledge from the course can help in the following:

(a) Finally, all students, of all branches whether organic or inorganic or analytical will be able to incorporate this knowledge, in their pursuit of research in their different fields.

II. Course Content

UNIT-1 Electroanalytical Measurements (15L) [14 Marks]
[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electroanalytical Measurements]
Voltage and it's measurements, Impedance and it's measurements, Electric double layer, Electrocapillarity, Current, Diffusion transport.

UNIT-2 Voltammetry (15L) [14 Marks]
[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Voltammetry]

Differential pulse polarography, Square wave polarography, Alternating current polarography, Stripping analysis, Cycling voltametry, Amperometric titration.

UNIT-3 Electrodeposition and Coulometry (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electrodeposition and Coulometry]

Electrolysis, Current-Voltage relation, Coulometric analysis, Electrogravimetric analysis at constant current, constant potential and controlled potential

UNIT-4 Electrochemical Sensors and Biosensors (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electrochemical sensors and Biosensors]

Potentiometric sensors and biosensors, Amperometric sensors: three generations of Biosensors with their examples, Conductometric sensors and biosensors, Applications of Field-Effect Transistor sensors.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester III

Core Reference Books

1. "Electrochemical Methods: Fundamentals and Applications", by Allen J. Bard and Larry R. Faulkner, wiley, 2000.
2. "Chemical Sensors and Biosensors", by Brian R. Eggins, John Wiley & Sons, New York, 2002.
3. "Principles of Instrumental Analysis" by Skoog, Holler Crouch, 6th edition, Cengage Learning, 2014.

Reference Books: PCH 3852:Electroanalytical Methods (Theory)

1. "Vogel's Text Book of quantitative analysis", by Mendham, Denney et. al.,6th edition, Prentice Hall, 2009.
2. "Laboratory Techniques in Electroanalytical Chemistry", by Kissinger P. T. and Heineman W. R., CRC press, 1996.
3. "Laboratory Techniques in Electroanalytical Chemistry", by Peter T. Kissinger, William R. Heineman, 2nd edition, CRC press, 1996.
4. "Electroanalytical Chemistry", by Galen W. Ewing,Basil H. Vassos, John Wiley & Sons, New York, 1983.
5. "Quantitative Chemical Analysis", by Daniel C. Harris, 7th edition, W.H. Freeman and Company, New York, 2007.
6. "Treatise on Analytical Chemistry", by I.M. Kolthoff, and P.J. Elving, Wiley-Interscience, New York, 1965.

M Sc Semester III (Analytical Chemistry -Theory)
PCH – 3853Industrial Analytical Chemistry

CORE Paper: Industrial Analytical Chemistry(Theory)
Course Code: PCH 3853
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes

CO1: Remember the principle and process control of automated devices as well as the principles and factors affecting flow injection analysis and to know its applications

CO2: To remember the food regulations and international standards as well as nutritional labeling and to perform various compositional analysis of foods, characterization of fats and oils as well as adulteration of milk and milk products.

CO3: To perform the instrumental and titrimetric assays for various drugs, Karl-Fischer titration and to apply it for Moisture/water content determination

CO4:To classify pesticides, fertilizers, soaps and detergents as well as apply the theoretical aspects for their analysis

I. Course Overview & Course Objectives

Unit AC 01: Automationin Measurements
Unit AC 02: Food Analysis
Unit AC 03: Pharmaceutical Analysis
Unit AC 04: Analysis of pesticides, fertilizers, soaps and detergents

The main objective of the course will be to enhance the understanding and knowledge of Industrial Analytical Chemistry, for students studying, any branch of chemistry.

By the end of the paper, a student will be able to:
(a)Understand the important aspects of Automationin Measurements.
(b)Learn the various aspects of Food Analysis.
(c) Understand the important aspects of Pharmaceutical Analysis.
(d) Learn the Chemistry of Analysis of pesticides, fertilizers, soaps and detergents.

Thus, the knowledge from the course can help in the following:

(a) Finally, all students, of all branches whether organic or inorganic or analytical will be able to incorporate this knowledge, in their pursuit of research in their different fields.

UNIT-1 Automation in Measurements (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Automationin Measurements]

Principles of automation, automatic and automated devices, Process control: off-line, at-line and on-line analysis. Continuous and discrete analyzers, feed back mechanism. Flow injection analysis, principles, dispersion coefficient, factors affecting peak height-sample volume, channel length, flow rate and channel geometry.l Applications of FIA, stopped flow measurements and gradient FIA.

UNIT-2 Food Analysis (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Food Analysis]

Introduction to food analysis, regulations and international standards related to food analysis, nutritional labeling, Compositional analysis of foods for moisture, proteins, fat, fiber, ash, vitamins and minerals, Characterization of fats and oils: Saponification value, Iodine value, Acid value, Reichert Meissl Value, Polenske Value, Adulteration of fats and oils, Adulteration of milk and milk products.

UNIT-3 Pharmaceutical Analysis (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Pharmaceutical Analysis]

Instrumental and titrimetric assays for anti-diabetic (Zidovudine, Ritonavir), anti-cancer (Paclitraxel, Tamoxifen citrate), anti-tuberculosis (Moxifloxacin hydrochloride, Ciprofloxacin), anti-malarial (Proguanil hydrochloride, Mefloquine hydrochloride), anti-hypertensive (Clonidine, Prazosin) and anti-HIV (Glipizide, Metformin) drugs based on USP/BP/IP. Moisture/water content by Karl-Fischer titration: Principle, types of Karl Fischer titration, preparation and standardization of Karl Fischer reagent.

UNIT-4 Analysis of pesticides, fertilizers, soaps and detergents (15L) [14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Analysis of pesticides, fertilizers, soaps and detergents,]

Introduction of pesticides and fertilizers, Classification of insecticides, Analysis of organochlorine and organophosphate pesticides by instrumental methods, Types of fertilizers and analysis of different elements like phosphorous sodium, potassium and ammonia, Classification of soaps and detergents, Characterization of soaps and detergents.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester III

Core Reference Books

1. "Food Analysis" by Nielsen S. Suzanne, 3rd edition, Springer, 2003.
2. Industrial chemistry by B K Sharma, 17th edition , Krishna , 2014
3. Flow Injection Analysis , by Ruzika 2nd edition,

IV. Reference Books: PCH 3853: Industrial Analytical Chemistry (Theory)

1. "Analytical Chemistry", by Christian Gary D., 7th edition, John Wiley and Sons Inc. New Jersey, 2014.
2. "Principles of Instrumental Analysis" by Skoog, Holler Crouch, 6th edition, Cengage Learning, 2014.
3. "Flow injection analysis of pharmaceuticals: automation in the laboratory", by Calatayud Jose Martinez, Taylor and Francis, 1996.
4. "Food Analysis Laboratory Manual", by Nielsen S. Suzanne,3rd edition, Springer, 2003.
5. "Quantitative Analysis of Drugs in Pharmaceutical Formulation", by Sethi P. D., 3rd edition, CBS Publishers, 2008.
6. "Handbook of Modern Pharmaceutical Analysis", by Satinder Ahuja and Stephen Scypinski,Volume 3, Academic Press, 2001.
7. "Standard Method of Chemical Analysis", by F.J. Welcher, 6thedition, volume 1,2 & 3, Part two, Van Nostrand Reinhold Company, 1962.

M Sc Semester III (Analytical Chemistry -Theory)
PCH – 3854Forensic Sciences

CORE Paper: Forensic Sciences (Theory)
Course Code: PCH 3854
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes

CO1: To recognize the function, composition and examination of blood and can explain different test for its confirmatory analysis from forensic evidences.

CO2: To summarize DNA profiling and fingerprint analysis for forensic analysis based on various biochemical procedures.

CO3: To memorize the concept of toxicology in particular related to poisons, drugs and explosive materials and use various analytical methods for their forensic analysis.

I.Course Overview & Course Objectives

Unit AC 01:Forensic biology & serology

Unit AC 02:DNA and Finger printing

Unit AC 03:Forensic toxicology-I

Unit AC 04:Forensic toxicology-II

The main objective of the course will be to enhance the understanding and knowledge of Analytical Chemistry, for students studying, any branch of chemistry.

By the end of the paper, a student will be able to:

(a) Understand the important aspects of Forensic biology & serology.
(b)Learn the various aspects of DNA and Finger printing.
(c) Understand the important aspects of Forensic toxicology.
(d) Learn the Chemistry of drugs of abuse.

Thus, the knowledge from the course can help in the following:
(a) Finally, all students, of all branches whether organic or inorganic or analytical will be able to incorporate this knowledge, in their pursuit of research in their different fields.

Unit 1 Forensic biology & serology (15L)[14 Marks]
[Prerequisites or topics for Self-Study: Basic terms and fundamental aspects related to serology]

(a) Introduction to forensic biology and serology
Collection and preservation of biological materials

Evidence Collection: Collection of blood samples (liquid blood, wet stains and dry stains); Clean Collection Practices, Packaging of Evidence, Documenting Evidences, Storage of Biological Evidence

(b) Blood: Function of Blood; Composition of blood; Examination of blood: Physical examination; Presumptive screening test; Tetraethyl Benzidine (TMB) Test; Phenolphthalein Test (Kastle-Meyer Test); Luminol test; Lecomalachite Green test
Confirmatory test of blood: Hemochromogen Crystal test(Takayama's test); Haemin Crystal Test(Tichmann's test); Microscopic Method; Spectroscopic Method; Some special test; Detection of species origin of blood; Precipitin Tube Method; Age of blood stain; Detection of blood group; type of bloodstain pattern and application; Factors affecting the detection of blood group from blood stain.

Unit 2 DNA and Finger printing (15L)[14 Marks]

[Prerequisites or topics for Self-Study: Basic terms and fundamental aspects related to structure and function of DNA and fingerprint analysis]

(a) Electrophoresis: Introduction, Agarose gel electrophoresis, Double Diffusion Method; Cross electrophoresis, polyacrylamide gel electrophoresis, capillary zone electrophoresis, micellar electrokinetic electrophoresis, capillary electrochromatography and capillary gel electrophoresis.

(b) DNA Profiling: Introduction, principle, DNA and its polymorphism, DNA typing procedures-RFLP, PCR, MVRPCR, Dot-blot, AMP-FLP, STR, other methods, paternity testing, applications, interpretation and practical use.

(c) Fingerprint Analysis: Latent fingerprints; optical, physical, physico-chemical & chemical detection methods; fingerprints in blood, fingerprint detection sequences.

Unit 3 Forensic toxicology-I (15L) [14 Marks]

[Prerequisites or topics for Self-Study: Basic terms and fundamental aspects related to toxicology and explosives]

(a) Introduction to Toxicology, History of Toxicology, Classification of Toxicology, Concept of Forensic Toxicology and its significance, Development and Advances of Forensic Toxicology; Poisons: Type of poisons, Extraction of poisons; classification of matrices; isolation and clean up procedures using classical and modern techniques

(b) Explosive and Explosion: Introduction, classification of explosives primary ,secondary or High explosive , detonators pyro technique propellant IEDs and firing mechanism of IEDS; Analysis of explosive: Methods for extraction of explosive from post blast material/ debris, Qualitative analysis of explosives and explosion residue by colour test, TLC/HPTLC and High Performance Liquid Chromatography and FTIR, GC-Mass, LC-Mass. X ray diffraction, equipment used for Detection of explosives and explosive devices.

Unit 4 Forensic toxicology-II (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to drugs of abuse and alcohol]

(a) Drugs: Classification of drugs, isolation, identification and determination of following, Narcotics- heroin and cocaine, Stimulants- caffeine, amphetamines, Depressants- Barbiturates, Benzodiazepines.
(b) Alcohol in body fluids: Legal background, Sampling and sample preservation, analysis-GC, IR, enzymatic and other methods.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction-based teaching.

M Sc Semester III

Core Reference Books:

1. "Textbook of Forensic medicine and Toxicology: Principle and Practice", by Vij Krishnan, 5th edition, Elsevier, 2014.
2. Textbook of Medical Biochemistry, 2nd edition, Wolters Kluwer India Pvt Ltd,2017.
3. "Fundamentals of Forensic science", by Houck Max, Siegel Jay, Academic Press, 2015.
4. "Textbook of Medicinal Jurisprudence and toxicology", by Modi and Kannan K., Lexis Nexis, 2016.

IV. Reference Books: PCH 3854: Forensic Sciences (Theory)

1. "Essential Forensic biology", by Gunn Alan, 2nd edition, wiley, 2009.
2. "Basic Analytical Toxicology", by Flanagan R. J., Braithwaite R. A., Brown S. S., WHO, 1995.
3. "Forensic Chemistry", by Bell Suzanne, 1st edition, Person Education Ltd, 2005.
4. Explosives; by Samuel Delvin, Sarup Book publishers, 2000
5. "Textbook of Medical Jurisprudence Forensic Medicine and Toxicology", by Parikh C. K, 6th edition, CBS, 2007.

SEMESTER -3 (Analytical Chemistry -Practical)
PCH – 3855 L
Analytical Instrumental techniques

Course Outcomes

CO1:To perform analysis of cations through flame photometry.

CO2: To apply spectrophotometric techniques for quantative determination of cations and dissociation constants of an indicator

1. Spectrophotometric determination of the p*K* value of an indicator (Methyl red).
2. Spectrophotometric determination of the p*K* value of an indicator (Bromothymol blue).
3. Simultaneous determination of chromium and manganese by spectrophotometry.

4. Spectrophotometric determination of titanium and vanadium in a mixture.
5. Determination of sodium from water samples by flame photometry.
6. Determination of potassium from water samples by flame photometry.

SEMESTER -3 (Analytical Chemistry -Practical)
PCH – 3856 L
Industrial applications and titrimetric methods

Course Outcomes

CO1: To apply ion-exchange chromatography principle for separation of cations.
CO2: To apply kjeldhal's method for determination of total nitrogen.

1. Determination of the capacity of an ion exchange resin.
2. Separation of Zn^{2+} and Mg^{2+} from a mixture by ion-exchange chromatography.
3. Separation of Ni^{2+} and Fe^{3+} from a mixture by ion-exchange chromatography.
4. Separation of Co^{2+} and Ni^{2+} from a mixture by ion-exchange chromatography.
5. Estimation of ammoniacal nitrogen and total kjeldhal nitrogen by kjeldhal's method.

Demo practical

1. Isolation of DNA from blood
2. Determination of blood groups
3. PCR analysis of DNA
4. RAPD analysis of given DNA sample

St. Xavier's College (Autonomous), Ahmedbad-09

Proposed Syllabus: M Sc Analytical Chemistry Semester IV

Effective from Dec 2019

M. Sc. Semester IV (Analytical Chemistry) Overview

Sub. code	Course	Instruction Hrs/week	Internal Assessment Marks	Max Marks Semester Exams	Duration of Semester Exam (Hrs)	Credit
THEORY						
PCH 4851	Analytical spectroscopy – II	4	40	60	3	4
PCH 4852	Pharmaceutical Chemistry	4	40	60	3	4
PCH 4853	Advanced Analytical Instrumentation	4	40	60	3	4
PCH 4854	Environmental Chemistry	4	40	60	3	4
PRACTICALS						
PCH 4855L	Analytical Chemistry Lab-I	3	40	60	3	4
	Industrial/Pharmaceutical Analytical Chemistry	3			3	
PCH 4856L	Analytical Chemistry Lab-II	3	30	60	3	4
	Analytical Chemistry - Dissertation/Industrial Training	3			3	
	Total	**28**	**240**	**360**		**24**

Note:- Semester -I and Semester-II syllabus is common for all specializations to be selected by the students for final year i.e. Inorganic, Organic, Physical and Analytical. At present St. Xavier's College (Autonomous) offers Organic as well as Analytical Chemistry as a specialization in the final year of M Sc Chemistry.

M. Sc. Semester IV (Analytical Chemistry)

CORE Paper: Analytical spectroscopy – II (Theory)
Course Code: PCH 4851
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes:
CO1: To be able to identify, recognize and compare principle, instrumentations and application of Atomic Absorption Spectroscopy (AAS), inductively coupled plasma atomic emission spectroscopy (ICP-AES), Atomic Florescence Spectroscopy (AFS) and implement them effectively for qualitative and quantitative assessment of elements.

CO2: To be able to memorize the theory and principle of mass spectroscopy, various ionization techniques involved and different types of detectors used and to implement the theory to interpret the mass spectra.

I. Course Overview & Course Objectives

Unit -AC 01 Atomic Absorption Spectrometry
Unit-AC 02 Inductively Coupled Plasma Atomic Emission Spectroscopy
Unit-AC 03 Atomic Fluorescence Spectroscopy
Unit-AC 04 Microscopic techniques

II. Course Content
Unit -1 Atomic Absorption Spectrometry (15L)[14 Marks]
[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Atomic Absorption Spectrometry]
Introduction, Necessity of hollow cathode lamp as a source along with its working, premix chamber burner and total consumption burner, Flame atomizer – principle and working mechanism of electro-thermal atomizers, line width, different interferences observed in AAS, different methods used for background correction, fundamental difference between atomic emission and adsorption, different methods used for the analysis – standard curve method, standard addition method and internal standard method of analysis, Applications of AAS.

Unit-2 Inductively Coupled Plasma Atomic Emission Spectroscopy (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Inductively Coupled Plasma Atomic Emission Spectroscopy]

Introduction, Physical and Chemical Principles, Spectrometers, Detection, Calculation, and Output, Analytical Information: Qualitative and Quantitative, Applications

Unit-3 Atomic Fluorescence Spectroscopy (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Atomic Fluorescence Spectroscopy]

Introduction, Physical and Chemical Principles, Instrumentation, Accuracy, Precision, detection Limits, Analytical Information: Quantitative, Applications

Unit-4 Mass spectrometry (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Advanced mass spectrometry]

Theory and principles of mass spectroscopy, Instrumentation, low and high resolution mass spectra, Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Ion Bombardment (FAB), Electronspray Ionization (ESI) and Matrix Assisted Laser Desorption/Ionization (MALDI). Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak. Fragmentations – rules governing the fragmentations, McLafferty rearrangement, Selected Mass analyzers- quadrupole, ion-trap, time of flight (TOF).

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester IV

Core Reference Books:

1. "Handbook of Instrumental Techniques for Analytical Chemistry", Frank Settle, published by Prentice Hall PTR, New Jersey, 1997.
2. "Principles of Instrumental Analysis" by Douglas A. Skoog, 3rd Edition, Holt-Saunders International Editions.
3. Modern spectroscopy ,Hollas J.M., 4th edition John Wiley and sons Ltd., 2004.

IV. Other Reference books: PCH 4852: (Theory)

1. "Specrochemical Analysis by Atomic Absorption and Emission", Lajunen L H J, Cambridge, UK : The Royal Society of Chemistry, 1992.
2. "Advances in Atomic Spectroscopy", Sneddon J, CT : JAI Press, Greenwich, 1992.
3. "CRC Handbook of Inductively Coupled Plasma Atomic Emission Spectrometry", Varma A, FL : CRC Press, Boca Raton, 1991.
4. "Multielement Detection Systems for Spectrochemical Analysis", Busch K W, Busc M A, Wiley, New York, 1990.
5. "Principles and Practice of X – Ray Spectrometric Analysis", 2nd edition, Bertin, Eugene, Plenum Press, New York, 1975.
6. "An Introduction to X –Ray Spectrometry", Jenkins, Ron, Heyden & Sons, London 1974.
7. "Principles of Quantitative X – Ray Fluorescence", Tertian R, Claisse F, Heyden, London, 1982.
8. Introduction to Mass Spectrometry: Instrumentation, Applications, and Strategies for Data Interpretation by J. Throck Watson, O. David Sparkman, Wiley, 2007.
9. Interpretation of Mass Spectra by Fred W. Mc Lafferty, Turecek University Science Books, 1993.
10. Mass spectrometry-Principles and Applications by Edmond de Hoffmann and Vincent Stroobant, John Wiley and Sons, 2007.

M Sc Semester IV (Analytical Chemistry)

CORE Paper: Pharmaceutical Chemistry (Theory)
Course Code: PCH 4852
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes:

CO1: Would have basic infer of clinical biochemistry, and pathobiochemistry of different organs and various organ function tests. Would be able to estimate urea, uric acid, SGPT, SGOT and creatinine in blood serum.

CO2: To discuss and memorize the discovery of new drugs and fundamentals of various steps involved in drug development, and to know method development and its validation.

CO3: Recognize the different phases of clinical trials, role of quality control and quality assurance departments in the drug development, and to discuss about International conference on harmonization (ICH) and FDA guidelines.

CO4: To describe various components of bioanalytical methodology, various parameters related to method validation, to discuss incurred sample reanalysis, and USFDA guidelines.

I. Course Overview & Course Objectives

Unit -AC 01 Clinical Chemistry
Unit-AC 02 Analytical Aspects of Drug Discovery
Unit-AC 03 Clinical and Regulatory Aspects of Drug Discovery
Unit-AC 04 Bioanalysis

II. Course Content

Unit -1Clinical biochemistry (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Clinical Chemistry*]*

Introduction to biochemical tests in clinical medicine, criteria for selecting method of analysis, pathobiochemistry of liver, kidney and cardiac diseases, organ function test- liver, kidney and heart, analysis of blood glucose, urea, uric acid, haemoglobin, complete blood count and various indices derived from it, markers for brain diseases like EEG, ECG, Isoenzymes analysis.

Unit-2 Analytical Aspects of Drug Discovery (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Analytical Aspects of Drug Discovery]

Discovery of new chemical entity, Identity and purity assessment, bioavailability/dissolution requirement, high-throughput screening, degradation and impurity analysis of drug substances, residual solvent and its classification, stability studies, pre-formulation studies, method development and validation.

Unit-3 Clinical and Regulatory Aspects of Drug Discovery (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Clinical and Regulatory Aspects of Drug Discovery]

Clinical trials - Phase I, II, III and IV. Quality control and quality assurance. Regulatory considerations, regulatory compliance, International Conference on Harmonization (ICH) classification and FDA guidelines, global CMC NDA.

Unit-4 Bioanalysis (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Specialized chromatographic techniques]

Components of bioanalytical methodology: extraction from biological matrices, chromatography and detection systems. Bioanalytical method validation parameters: sensitivity, selectivity, accuracy and precision, linearity (calibration curves), recovery, matrix effect and stability. Bioavailability and bioequivalence study, incurred sample reanalysis test for subject samples. USFDA guidelines for bioanalytical method validation and the acceptance criteria.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester IV(Analytical Chemistry)

Core Reference books

1. "Handbook of Modern Pharmaceutical Analysis" by Satinder Ahuja and Stephen Scypinski, Volume 3, Academic Press, 2001.
2. Medicinal biochemistry by rajinder Chawla and Tarek H. EI Metwally, United India Periodicals Pvt. Ltd. (2012)

IV. Other Reference books: PCH 4852: Pharmaceutical Chemistry (Theory)

1. "Handbook of Modern Pharmaceutical Analysis" (Drug and the Pharmaceutical Sciences) by Lena Ohannesian and Anthony Streeter, Marcel Dekker Inc., New York, 2001.
2. Quantitative Analysis of Drugs in Pharmaceutical Formulation, 3rd edition, P.D. Sethi, CBS Publishers, 2008.
3. Bioanalytical Chemistry by S. Mikkelsen and E. Corton, John Wiley and Sons, 2004.
4. Clinical Chemistry: Principles, Procedures, Correlations, 4th edition by Michael L. Bishop, JanetL. Duben-Engelkrik, Edward P. Fody, Lippincott Williams and Wilkins, 2000.

M Sc Semester IV (Analytical Chemistry)

CORE Paper: Advanced Analytical Instrumentation (Theory)
Course Code: PCH 4853
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes:

CO1: Infer and memorize the theory, principle, instrumentation and the applications of various hyphenated techniques like UHPLC, SFC, LC-NMR, LC-MS and ICP-MS.

CO2: To memorize the principle, theories and instrumentation of Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM) and their industrial applications.

I. Course Overview & Course Objectives

Unit -AC 01 UHPLC and SFC
Unit-AC 02 Advanced mass spectrometry
Unit-AC 03 LC-NMR and LC-MS
Unit-AC 04 ICP-MS

II. Course Content

Unit -1UHPLC and SFC (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to UHPLC and SFC]

Principle, theory, instrumentation and applications of ultra high-performance liquid chromatography (UHPLC) and super critical fluid chromatography (SFC). Comparison with HPLC.

Unit-2 Microscopic techniques (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to microscopic techniques]

Introduction to scanning electron microscopy (SEM), Scanning tunneling microscopy (STM) and atomic force microscopy (AFM); basic principles and theory; instrumentation and operating parameters and applications.

Unit-3 LC-NMR and LC-MS (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Electrophoresis]

Principle, theory, instrumentation and applications of liquid chromatography-nuclear magnetic resonance and liquid chromatography-mass spectrometry. Applicationof LC-NMR-MS.

Unit-4 ICP-MS (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to ICP-MS]

Principle, theory, instrumentation and applications of inductively coupled plasma-mass spectrometry.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books

and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester IV(Analytical Chemistry)

Core Reference Books:

1. "Quantitative Chemical Analysis" by Daniel C. Harris, 7th Edition, W.H. Freeman And Company, New York.
2. "Analytical Chemistry" by Gary D. Christian, 6th Edition, John Wiley and Sons Inc.New Jersey.

IV. Reference books: PCH 4853: Advanced Analytical Instrumentation (Theory)

1. On-line LC-NMR and related techniques, Klaus Albert (editor), John Wiley and Sons, 2002.
2. Practical Guide to ICP-MS by Robert Thomas, Marcel Dekker Inc., 2004.
3. Packed columns SFC by T.A. Berger, RSC Chromatography Monographs, RSC, 1995.
4. Microscopic and Spectroscopic Imaging of the Chemical State, Michael D. Morris, Marcel Dekker, Inc. (NY.).

M Sc Semester IV (Analytical Chemistry)

CORE Paper: Environmental Chemistry (Theory)
Course Code: PCH 4854
No. of Credits: 04
Learning Hours: 60 hrs (70 Marks)

Course Outcomes:

CO1: To explain the principles of green chemistry, microwave assisted organic synthesis, and to study in detail the green alternatives for molecular rearrangements, electrophilic aromatic substitution reactions, oxidation- reduction reaction etc

CO2: Able to gain basic information about the pollutants in air, water and soil and to describe its composition, sources, sampling and analysis through various chemical and instrumental methods.

I. Course Overview & Course Objectives

Unit -AC 01 Green Chemistry
Unit-AC 02 The atmosphere
Unit-AC 03 The hydrosphere
Unit-AC 04 The lithosphere and the biosphere

II. Course Content

Unit -1 Green Chemistry (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to Green Chemistry]

Principles of green chemistry, atom economy, principles of green organic synthesis, green alternatives of organic synthesis-coenzyme catalysed reactions, green alternatives of molecular rearrangements, electrophilic aromatic substitution reactions, oxidation-reduction reactions, clay catalysed synthesis, condensation reactions, Green photochemical reactions. Green Solvents: ionic liquids, supercritical CO_2, fluorous chemistry, General principles of microwave assisted organic synthesis.

Unit-2 The atmosphere (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to the atmosphere]

Composition of the atmosphere, Common air pollutants and their sources, Air pollution and health, Sampling of atmospheric gases, Determination of aromatic hydrocarbons in exhaust, petrol and air, Determination of low level of carbon monoxide-catalytic conversion, Some chemical methods for determining trace gases-oxides of sulphur, oxides of nitrogen and oxides of carbon.

Unit-3 The hydrosphere (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to The hydrosphere]

The hydrological cycle and pollution, The oxygen balance in natural waters, Selected analytical methods for water quality control – pH measurement (the glass electrode), Conductivity, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Methods for the determination of inorganic nitrogen – ammonia, nitrate and nitrite, Determination of phosphate by colorimetric method and fluoride by ion selective electrode, Determination of chloride by titrimetry, photometric and polarographic determination of heavy metals, Trace organics in water – total organic carbon (TOC), Determination of hydrocarbons and phenols in polluted water.

Unit-4 The lithosphere and the biosphere (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms and fundamental aspects related to the lithosphere and the biosphere]

Introduction, Particles size distribution in solids, Sampling problems with rocks and soils, Subsampling, Some selected chemical methods in soil analysis – pH measurements, available phosphorus, available nitrogen, total nitrogen, the nature of the biosphere, need for plant analysis, Analysis of plant tissues for N, P, K, Ca and Mg, Boron, Cobalt, Sulphur, Cold vapour and hydride generation systems in AAS, determination of mercury in urine.

III. Teaching methodologies: Apart from the conventional black board teaching, other modes of teaching that will be adopted are power points, problem solving, and group discussion. Assignments will be designed such that students inculcate the habit of reading reference books and science journals. The use of smart boards for teaching will also be promoted to enable more interaction based teaching.

M Sc Semester IV

Core Reference books

1. Lain L. Marr, Malcolm S. Cresser, "Environmental Chemical Analysis", Published by International Textbook Company, New York
2. V.K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, CRC, 2008.

IV. Other Reference books: PCH 4854: Environmental Chemistry (Theory)

1. Laitinen, H. A. and Harris, W. E., "Chemical Analysis", 2dn Edition, McGraw-Hill, New York.
2. Katz, M., "Methods of Air Sampling and Analysis", 2ed Edition, American Public HealthAssociation, Washington, DC.
3. Israel, H. and Israel, G.W., "Trace Elements in the Atmosphere". Ann Arbor, Michigan.
4. Z. Marczenko, "Spectrophotometric Determination of the Elements", Ellis Horwood, Chichester.
5. Wilson, A.L., "The Chemical Analysis of Water : General Principles and Techniques", The Society for Analytical Chemistry, London.
6. Black, C.A., "Methods of Soil Analysis", American Society of Agronomy, Madison, Wisconsin.
7. Brooks, R.R., "Geobotany and Biogeochemistry in Mineral Exploration", Harper and Row, New York.
8. S.E. Manahan, Environmental Chemistry, 9th Edn., CRC Press, 2010.
9. C.L. Wilson, D.W. Wilson, Comprehensive Analytical Chemistry, Elsevier, 1982.
10. H.A. Laitinen, W.E. Harris, Chemical Analysis, McGraw Hill,1975.
11. F.W. Fifield, D. Kealey, Principles and Practice of Analytical Chemistry, Blackwell Science, 2000.
12. W. Horwitz (Editor), Official Method of Analysis of AOAC International, 18th Edn., AOAC, 2010

SEMESTER - 4 (Analytical Chemistry -Practical)
PCH – 4855 L
Industrial/Pharmaceutical Analytical Chemistry

Course Outcomes:

CO1: To perform various organ function test like bilirubin, SGPT, SGOT, creatinine, uric acid, urea, alkaline phosphatse, phosphorous in blood serum.

CO2: To apply principle of Karl-Fisher titration for moisture content determination.

CO3: To perform total organic carbon estimation in soil.

1. Determination of moisture content in food/drug sample using Karl-Fischer titrator.
2. Separation of leaf pigments of spinach leaves by TLC.
3. To determine the amount of organic carbon in a given soil sample by Walkley-Black method.
4. Determination of nicotine in tobacco by non-aqueous titration.
5. Determination of salt iodate and salt iodide content by titration method.
6. Estimation of urea in biological matrix
7. Estimation of uric acid in biological matrix
8. Estimation of creatinine and creatine in biological matrix
9. Estimation of alkaline phosphates in biological matrix
10. Estimation of phosphorous in biological matrix
11. Estimation of bilirubin in biological matrix
12. Estimation of SGPT in biological matrix
13. Estimation of SGOT in biological matrix

SEMESTER -4 (Analytical Chemistry - Dissertation/Industrial Training)
PCH – 4856 L