



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce

Department: Chemistry

Somaiya

TRUST

M.Sc. Analytical Chemistry Syllabus

DEPARTMENT OF CHEMISTRY

MASTER OF SCIENCE (M.Sc.): CHEMISTRY

SYLLABUS: 2020-2021

SEMESTER III & IV

Analytical Chemistry (A)

(Specialization)

SEMESTER III

(Analytical Chemistry)

Syllabus summary

Module	Topic	Common with
Paper I: FOOD ANALYSIS		
I	General introduction and preservation of food.	-
II	Preservation of Food	-
III	Food Quality Standards and Laws	-
IV	Food Packaging	-
Paper II: SOME ADVANCED INSTRUMENTAL TECHNIQUES		
I	Inductively coupled plasma source	-
II	Molecular Luminescence - Fluorescence	-
III	Molecular Luminescence - Chemiluminescence	-
IV	Refractrometry and automated methods of analysis	-
Paper III: ADVANCED INSTRUMENTAL TECHNIQUES AND SURFACE CHEMISTRY		
I	Mossbauer and Raman spectroscopy	P/I
II	ESR and Hyphenated techniques	P/I/O
III	X-ray spectroscopy and thermal methods	P/I
IV	Surface Characterization by spectroscopy and microscopy	P/I
Paper IV: NANO CHEMISTRY AND SOME IMPORTANT INDUSTRIAL MATERIALS.		
I	Nano Chemistry I	P/I
II	Nano Chemistry II	P/I
III	Paints, pesticides and detergents	P/I
IV	Petrochemical, explosives, glass and alloys	P/I

M.Sc. – II Analytical Chemistry
Semester 3 Course Code -- PSACH301
Paper I: FOOD ANALYSIS

Module I: General introduction and Preservation of Food		15 L
1.1	Food chemistry-definition and importance, water in food, water activity and shelf-life of food. Carbohydrates-chemical reactions, functional properties of sugars and Polysaccharides in foods.	03
	Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value.	03
	Protein and amino acids: physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing.-Losses of vitamins and minerals due	04
	Pigments in food, food flavours, browning reaction in foods.	02
	Enzymes in foods, and food industry, bio-deterioration of foods, food contaminants, additives and toxicants.	03
Module II: Preservation of Food		15 L
2.1	Introduction: Historical development of food processing and preservation, general principles of food preservation. Preservation by heating: Principles of the method, thermal resistance of the microorganisms and enzyme. Microwave heating: Principles and application in food processing.	03

2.2	Refrigeration and freezing preservation: Refrigeration and storage of fresh foods, major requirements of refrigeration plant, controlled atmospheric storage, refrigerated storage of various foods, freezing point of selected food, influence of freezing and freezing rate of the quality of food products, methods of freezing, storage and thawing of frozen foods.	04
2.3	Chemical Preservation: Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking. Concentration: Applications in food industry processes and equipment for manufacture of various concentrated foods and their keeping quality.	04
2.4	Drying and dehydrations: Sun drying of various foods, water activity and its effect on the keeping quality, sorption isotherms and their use. Characteristics of food substances related to their dehydration behaviour, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods; intermediate moisture foods	04
Module III: Food Quality Standards and Laws		15 L
3.1	Food quality: Various Quality attributes of food, Quality parameter and evaluation procedure. Appearance, colour texture, viscosity, consistency flavour defects, bacterial contamination and foreign matter.	03
3.2	Introduction to food safety and security: Hygienic design of food plants and equipment, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging &labelling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials	04

3.3	<p>Quality control for food: Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities. Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system.</p> <p>Food adulteration: Definition, common adulteration in different foods, contamination, and methods of detection. Sensory evaluation: Selection of panel of judges, sensory characteristics of foods, types of tests. Naturally occurring food toxins: Gossypol, hemagglutinins, trypsin inhibitors, lathrogens etc.</p>	05
3.4	<p>Food Laws: International and national food laws, Prevention of food adulteration Act. Food additives; colouring mater, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, Insecticides. PFA specification for food products.</p>	03
Module IV: Food Packaging		15 L
4.1	<p>Packaging as a method for conservation and protection of foods. Different packaging materials and their properties- including barrier properties, strength properties, optical properties etc. Glass, aluminium, tin, paper, boards, plastics, composites.</p>	07
4.2	<p>Packaging of various food commodities including fresh produce (fruits and vegetables), meat, fish, poultry and processed foods. Evaluation of quality and safety of packaging materials - different testing procedures</p>	04
4.3	<p>Selection of packaging material and design. Newer packaging technologies- CAP/MAP packaging, aseptic processing and packaging, irradiated packaging, retort pouch, microwaveable packaging</p>	04



References

1. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
2. Fennema, O.R, 2006, Food Chemistry, Academic Press
3. Meyer, L.H. 1987. Food Chemistry.CBS publishers and Distributors, New Delhi.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi
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10. Bender, A.E. 1978. Food Processing and Nutrition. Academic Press, London. Fellows, P. and Ellis H. 1990. Food Processing Technology: Principles and Practice, New York
11. Food Analysis: Theory and practice, YeshajahuPomeranz, Clifton E. Meloan, Springer.
12. Principles of package development, Gribbin et al
13. Modern packaging Encyclopaedia and planning guide, MacgraWreyco
14. Food Analysis, Edited by S. Suzanne Nielsen, Springer
15. Analytical Biochemistry, D, J. Homes and H. Peck, Longman (1983)
16. Bioanalytical Chemistry, S. R. Mikkelesen and E. Corton, John Wiley and sons 2004
17. Analysis of food and beverages, George Charalanbous, Accademic press 1978

M.Sc. – II Analytical Chemistry
Semester 3 Course Code -- PSACH302
Paper II: SOME ADVANCED INSTRUMENTAL TECHNIQUES

Module I: Inductively coupled plasma source		15 L
	Introduction: plasma appearance and spectra, analyte atomisation, ionisation direct current plasma source, plasma source, spectrometers, slew scan spectrometer.	06
	Instruments- spectrographs, multichannel, photoelectric spectrometers, arc source emission spectroscopy, characterisation of arc sources, applications	05
	Applications: Emission spectroscopy based on arc and sparc source, sample types and sample handling.	04
Module II: Molecular Luminescence-Fluorescence		15 L
2.1	Fluorescence sensing: Mechanism of sensing; sensing techniques based on i) collisional quenching, (ii) energy transfer, (iii) electron transfer; examples of (i) pH sensors (ii) glucose sensors (iii) protein sensors.	05
2.2	Novel fluorophores: (i) Quantum dots, (ii) lanthanides and (iii) long-lifetime metallic and complexes.	05
2.3	Radioactive decay engineering: metal enhanced fluorescence	05
	DNA technology –sequencing.	
Module III: Molecular Luminescence-Chemiluminescence		15 L
3.1	Chemiluminescence Phenomenon, Measurement, Applications	08
3.2	Photoacoustic spectroscopy, Reflectance spectroscopy	07
Module IV:		15 L
4.1	Refractometry-ORD,CD	07
4.2	Automated methods of analysis	08



References

1. Principles of Instrumental Analysis, D. A. Skoog, F. J. Holler and J.A. Niemann, 6th Edition,(2000) Holler and J.A. Niemann, 6th Edition,(2000)
2. Instrumental methods of Analysis, H. H. Willard, L. L. Merritt Jr, J. A. Dean and F. A. Settle Jr,7th Ed CBS (1986)
3. Introduction to instrumental analysis, R. D. Braun, McGraw Hill (1987)

M.Sc. – II Analytical Chemistry

Semester 3 Course Code -- PSACH303

Paper III: ADVANCED INSTRUMENTAL TECHNIQUES AND SURFACE CHEMISTRY

Module I: Mossbauer and Raman spectroscopy/ nuclear methods		15 L
1.1	Mossbauer's spectroscopy: principle, recoilless emission absorption of gamma rays, experimental methods, instrumentation- drive mechanism, sources, detectors, absorbers effect, calibration of instrument, isomer shift, hyperfine structure (quadruple interactions), magnetic hyperfine interaction, applications, purity and characterization, detection of structurally different atoms in poly nuclear compounds of Iron and Tin	07
1.2	Raman Spectroscopy: theory of excitation of Raman spectra, mechanism of Raman and Rayleigh scattering, comparison of Raman and Infra-red spectra. Intensity of normal Raman peaks, instrumentation, organic and inorganic applications, surface enhanced Raman spectroscopy, resonant Raman spectroscopy, Non-linear Raman spectroscopy.	08
Module II: ESR and Hyphenated techniques		15 L
2.1	ESR: principle, instrumentation, spin-spin splitting, qualitative and multiple resonance (ENDOR, ELDOR) spin labelling, metallic complexes, applications.	07
2.2	Hyphenated techniques: Need for hyphenation, possible hyphenation, interfacing devices and applications of GC-MS, GC-IR, MS-MS, LC-MS, LC-IR, LC-NMR.	08

Module III: X-ray spectroscopy and thermal methods		15 L
3.1	X-ray spectroscopy: principles instrumentation and applications of X-ray fluorescence, X-ray absorption and X-ray diffraction spectroscopy.	07
3.2	Thermal methods: principle, instrumentation and applications of: differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermometric titrations, thermo mechanical analysis (TMA), simultaneous thermal analysis (STA), evolved gas analysis (EGA), application in material science.	08
Module IV: Surface Characterization by spectroscopy and microscopy		15 L
4.1	Introduction to study of surfaces, definition of a solid surfaces, types of surface measurements, general techniques in surface spectroscopy, surface spectroscopic methods, sampling surfaces, surface contaminants.	02
4.2.1	X-ray photoelectron spectroscopy (XPS)	02
4.2.2	Auger electron spectroscopy	02
4.2.3	Basic principle, Instrumentation and applications of Electron microprobe, SEM, TEM and AFM	09



References

1. Analytical Chemistry, G. D. Christian, 5th Ed. John Wiley, New York (2000)
2. Fundamentals of Analytical Chemistry, D. A. Skoog and D. M. West and F. J. Holler Holt-Saunders 9th Edition (2016)
3. Instrumental methods of Analysis, H. H. Willard, L. L. Merritt Jr, J. A. Dean and F. A. Settle Jr, 7th Ed CBS (1986)
4. Introduction to instrumental analysis, R. D. Braun, McGraw Hill (1987)
5. Wilson and Wilson's Comprehensive Analytical Chemistry, Ed. G. Svehla. (A series of Volumes)
6. Treatise on Analytical Chemistry, Eds I. M. Kolthoff and Others, Interscience Pub. (A series of volumes)
7. Standard Methods of Chemical Analysis, Eds. F. J. Welcher, Robert E. Krieger Publishing Company, (A series of volumes)
8. Spectroscopy by H Kaur, Prgatiprakashan, 2016
9. Instrumental methods of Analysis by Chatwal and Anand, S Chand, 2015
10. Nuclear Analytical Chemistry, D. Bane, B. Forkman, B. Persson, Chartwell - Bratt Ltd (1984)
11. Substoichiometry in Radiochemical Analysis, J. Ruticka and J. Stary, Pergamon
12. Radioisotope Techniques, Overman and Clark, McGraw Hill Book Co. INC New York

M.Sc. – II Analytical Chemistry

Semester 3 Course Code -- PSACH3O4

Paper IV: NANO CHEMISTRY AND SOME IMPORTANT INDUSTRIAL MATERIALS

Module I: Nano chemistry 1		15 L
1.1	Introduction, comparison between bulk and nano materials. Types of nano materials-zero, one, three dimensional nano materials,	02
1.2	Synthesis of nano materials: Physical methods, Chemical methods and biological methods.	06
1.3	Properties of nano material with respect to Au, CdSe ₂ , Silica, Polydimethylsiloxane-mechanical, structural, melting, electrical, optical and magnetic properties.	07
Module II: Nano chemistry 2		15 L
2.1	Some important nano materials- carbon nanotubes, porous silicon, mesoporous materials, aerogels, ordered porous materials, self- assembled nano materials and core shell particles.	09
2.2	Applications of nano materials in electronics, energy, automobiles, sports, textiles, cosmetics, domestic appliances, biotechnology, medical fields and space and research. Environmental effects of nanotechnology.	06
Module III: Paints, pesticides and detergents		15 L
3.1	Paints: Introduction, determination of volatile and non-volatile components, water content of paints, flash point, separation of pigments, binders and thinners of different types, identification and analysis of different types of pigments, organic and inorganic pigments, white tinted and coloured pigments.	06

3.2	Pesticides: Introduction, definition, classification, biodegradation and determination of pesticides. pesticide residue analysis, extraction and cleavage of various type of pesticides, use of instrumental method like GLC, TLC, etc.	06
3.3	Detergents: classification, general scheme of analysis, quantitative method of analysis, active ingredient and equivalent combined SO ₃ analysis.	03
Module IV: Petrochemical, explosives, glass and alloys		15L
4.1	Petrochemical analysis: Introduction, definition-fuels, calorific values of fuel, composition and properties of fuels, analysis of petrochemicals, distillation range, moisture content, flash point, fire point, sulphur and carbon residue, doctor test.	04
4.2	Explosives: definition, heat of explosion, qualitative tests for explosives, quantitative methods for explosive mixtures.	04
4.3	Alloys: definition, analysis of copper based alloys, aluminium and stainless steel.	03
4.4	Glass: analysis of different types of glass, soda lime glass, lead glass and borate glass.	04



References

1. Analytical Chemistry, G. D. Christian, 5th Ed. John Wiley, New York (2000)
2. Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt-Saunders 9th Edition (2016)
3. Principles of Instrumental Analysis, D. A. Skoog, F. J. Holler and J.A. Niemann, 8th Edition(1998)
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8. Standard Methods of Chemical Analysis, Eds. F. J. Welcher, Robert E. Krieger Publishing Company, (A series of volumes)
9. Spectroscopy by H Kaur, Prgatiprakashan, 2016.
10. Instrumental methods of Analysis by Chatwal and Anand, S Chand, 2015.
11. Concepts of nano chemistry by Cadmitri and others, Wiley publications.
12. Nanotechnology by SulbhaKulkarni, CRC press, 4th edition, 2010



PRACTICALS

Semester III Course Code — PSACHP301

- 1) Analysis of milk: Determination of Fe, Ca and P in milk sample.
- 2) Estimation of Lactose in milk powder.
- 3) To determine iodine value and acid value of given oil sample (Castor oil, Coconut oil)
- 4) To determine saponification value of an oil sample.
- 5) Estimation of Vitamin C in lemon juice/lemon squash sample.

Semester III Course Code — PSACHP302

Nuclear Chemistry experiments.



Semester III Course Code — PSACHP303

Project

Semester III Course Code — PSACHP304

- 1) To synthesize CuO nano particles using precipitation/ Sol-Gel method.
- 2) To synthesize and study UV transition spectrum of Ag nano particles.
- 3) Determination of percentage purity of methylene blue dye.
- 4) Analysis of Brass alloy, Zinc blende and Galena for major and minor constituents.
- 5) Cement analysis, Fe, Setting and hardness.

SEMESTER IV

(Analytical Chemistry)

Syllabus summary

Module	Topic	Common with
PAPER I: FORENSIC CHEMISTRY AND TOXICOLOGY		
I	Poisons	-
II	Isolation and different methods of extraction	-
III	Introduction to Cosmetics	-
IV	Analytical Chemistry in Cosmetics	-
Paper II: PHARMACEUTICAL AND BIOANALYTICAL CHEMISTRY		
I	Pharmaceutical Chemistry	-
II	Analytical method development and validation	-
III	Bioanalytical Chemistry	-
IV	Bioinformatics	-
Paper III: RESEARCH METHODOLOGY, ELECTRO ANALYTICAL AND POLYMER CHEMISTRY		
I	Research methodology	-
II	Modern polarographic techniques	P
III	Polymer Synthesis, Properties	P
IV	Polymer Structure, Properties, Characterization and Applications	P
Paper IV: ENVIRONMENTAL AND GREEN CHEMISTRY		
I	Air and Water Pollution	P/I/O
II	Pollution control technology	P/I/O
III	Non renewable energy sources	P/I/O
IV	Environmental policies, Regulation, Assessment and Green chemistry	P/I/O

M.Sc. – II Analytical Chemistry
Semester 3 Course Code -- PSACH401
Paper I: FORENSIC CHEMISTRY AND TOXICOLOGY

Module I: Poisons		15 L
1.1	Classification and Types of Poisons: Metallic, Inorganic, Organic, Volatile, Animal, Plant, Insecticides, Pesticides, etc. their nature, Use, Administration, Fatal dose, fatal period, Symptoms, some common Antidotes Post-mortem findings, Collection and preservation of viscera and other samples	03
1.2	Volatile Poisons: Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of: Acetone, Ether, Oxalic Acid, Phenols, Camphor, Chloral Hydrate, Chloroform, Acetaldehyde Methyl alcohol, ethyl alcohol, illicit liquor, country-made liquor, etc. Analysis by color tests, chromatographic techniques (TLC, FTIR, NMR, GC, GC-MS, etc.)	04
1.3	Metallic and Non-metallic Poisons: Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of metallic poisons including: Lead, Copper, Mercury, Arsenic, Barium, Selenium, Magnesium, Aluminium etc. Non-metallic poisons including: chlorine, bromine, iodine, phosphorus etc. Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation. Analysis by colour tests, AAS, FTIR etc.	08

Module II: Isolation and different methods of extraction		15 L
	Different methods of extraction for poisons from viscera: Solvent extraction, distillation /steam distillation, micro diffusion, dialysis, dry ashing, wet digestion, modified star-otto method, ammonium sulphate method, residue levels, toxic levels and therapeutic levels, fatal levels of commonly encountered poisons in blood, urine and tissues.	07
	Extraction of poisons from blood, urine, stomach washes and vomits, food material and toxicological analysis of decomposed materials. Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples, some interesting and their importance in view of specific approach in examination.	08
Module III: Introduction to Cosmetics		15 L
	Introduction, Impact of Cosmetics on skin and hair, Basic Regulations in cosmetics pertaining to manufacturing and selling	05
	Theory and Formulation of Cosmetics: 1 Hair oils 2. Face powder 3. Gels 4. Creams and lotions. 5. Shampoos	05
Module IV: Analytical Chemistry in Cosmetics		15 L
	Different methods of analysis of Cosmetics, lipid analysis, heavy metal testing, surfactant analysis, Instrumental evaluation of Cosmetics using pH, Viscosity, Spectrophotometry, Gas Chromatography,	07

	Analysis of emulsions with pH metre, Viscosity measurements, non- volatile matter by IR spectroscopy, conductivity method, Qualitative and quantitative estimation of heavy metal, arsenic, lead and iron in emulsions.	O7
	Analysis of Cosmetic raw materials: Qualitative and quantitative estimation of: ethanol, stearic acid, Glycerine, water. Basics methods of evaluation of Ash analysis, Potentiometric titration, iodometric titration, chloride evaluation, sulphate evaluation, alcohol evaluation,	O6

References

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3. Clark, E.G.C.; Isolation and Identification of Drugs, Vol. I and Vol. II, Academic Press, (1986).
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 19. Gossel T.A; Principles of Clinical Toxicology 3rd Ed., Roven, NY (1994)
 20. Gossel S S; Handbook of Highly Toxic Materials handling and Management, Marcel Dekker NY (1995)

M.Sc. – II Analytical Chemistry
Semester 3 Course Code -- PSACH4O2
Paper II: PHARMACEUTICAL AND BIOANALYTICAL CHEMISTRY

Module I: Pharmaceutical Chemistry		15
I.1	Introduction to pharmacy, classification of drugs and dosage forms. Routs of drug administrations. Pharmacopeia (IP/BP/USP) and its history	O2
I.2	QUALITY ASSURANCE OF PHARMACEUTICALS	
	1. Concepts of Quality and Total Quality Management (TQM). 2. Quality Control and Quality Assurance.	O3
	3. Good Manufacturing Practices (GMP): 3.1 Organization and personnel – Responsibilities and Training. 3.2. Good Laboratory Practices (GLP): Instruments – qualification and calibrations, Protocols, Controls on Animal House, Applications of Computers in Quality Control Laboratory. 3.3. Finished Product Release: Quality Review, Quality Audits, Batch Release document 3.4 Warehousing: Good ware housing practices, Materials Management 3.5 Documentation and maintenance of record: Product Development, Standard Operating Procedures, Analytical Specifications and Test Procedures, Analytical raw data. Cleaning methods, Batch Manufacturing Records, Distribution records, Complaints and recalls records, retention of records. 3.6 Qualifications: Air Handling Units, Water System (Potable water, Deionised, Demineralised, Distilled, Purified, and Water for injection)	O5
	Pharmaceutical regulations: Drugs and Cosmetic Act, DPCO, Intellectual	O2

	Regulatory Affairs: WHO certification procedure, New Drug Applications (NDA), Abbreviated New Drug Application (ANDA). ICH requirements for registration of Pharmaceuticals	03
Module II: ANALYTICAL METHOD DEVELOPMENT AND VALIDATION		15L
2.1	Concept of Analytical Method development, Analytical Method Validation procedure	05
2.2	Stability study as per ICH guideline	05
2.3	Drug impurities and their effects.	05
Module III: Bioanalytical Chemistry		15
3.1	Ethical issues in clinical trials, origin of ethical issues, ensuring compliances to ethical issues- ethical committees and their set up- regulatory process of ethical committees- ethical issues to animal studies- compliance to ethical guidelines.	07
3.2	Bioavailability and bioequivalence study (BA and BE): definition, parameters to evaluate BA and BE, factors affecting BA and BE of drug, evaluating BA/BE of drug, estimating BA/BE parameters of drug.	08
Module IV: Bioinformatics		15
4.1	Database and search tools: Different search engines, applications, using various libraries, internet application of bioinformatics- inter protocols and search tools, genome and proteome analogues.	05

4.2	Statistical approach to biological sample, variation in biological samples and their statistical treatment, introduction to data-collection techniques, design of experiment using block design, Latin square COV, ANOVA, students test, F-test, regression analysis with application to standard graphs, non-parametric tests with examples, statistical guidelines from regulatory agencies.	10
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References

1. Analytical Biochemistry, D. J. Homes and H. Peck, Longman (1983)
2. Bioanalytical Chemistry, S. R. Mikkelesen and E. Corton, John Wiley and sons 2004
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11. Chemical analysis of drugs, Higuchi, Interscience 1995
12. Connors Text book of pharmaceuticals Analysis, J wiley 2001

M.Sc. – II Analytical Chemistry

Semester 3 Course Code -- PSACH4O3

Paper III: RESEARCH METHODOLOGY, ELECTRO ANALYTICAL & POLYMER CHEMISTRY

Module I: RESEARCH METHODOLOGY		15
	Introduction: definition of research, objectives of research, Types of research, research approaches, Criteria of good research.	02
	The research process: Eight step model of research process, Steps in planning of research, steps in conducting a research study.	03
	Formulating a research problem: Reviewing the literature, Identification and formulation of research problem. The research design: Definition, need for research design, features of good design, different research designs, Basic principles of experimental designs.	05
	Measurement and Scaling techniques in research: Measurements in research, measurement scales, sources of error in measurement, techniques of developing measurement tools, Scaling, Scale classifications, important scaling techniques. Processing and data analysis. Chi square test and its significance.	05
Module II: Modern polarographic techniques		15 L
2.1	Recapitulation: classical polarography	02
2.2	Cyclic voltammetry	02
2.3	Pulse polarography, different pulse polarography, square wave polarography	03
2.4	Stripping methods- Anodic and Cathodic stripping methods, Adsorptive stripping methods	04

2.5	Voltammetry with ultra-microelectrodes	02
2.6	Biamperometric titrations –Karl Fisher Titrations	02
Module III: Polymer Synthesis, Properties		15
3.1	Polymer science, fundamental terms, historical outline, Classification: Based on origin (natural, semi-synthetic, synthetic), The structure(linear, branched, network, hyper branched, dendrimer, ladder, cross linked, IPN), The type of chain(homo chain, hetro chain), The polymerization mechanism (condensation, addition), the thermal behavior (thermoplastic and thermosetting), the form and application (plastics, elastomers, fiber), Polymer structure; Homopolymers, Copolymers, Tacticity, Geometric Isomerism	03
3.2	Molecular Weight and Molecular weight distribution: Average molecular weight, Molecular weight distribution, molecular weight determination by End group analysis, Colligatve property measurement, Light scattering, Ultracentrifugation, Solution viscosity and GPC	03
3.3	Polymer Synthesis Step-growth Polymerization, Chain-growth Polymerization, Polymerization Techniques (Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization) Solid state, Gas phase and Plasma Polymerization, Chemical modification , Preparation of polymer Derivatives	07
3.4	Polymer Solutions: Criteria for polymer solubility, Thermodynamics of polymer solutions, Solubility parameter, Theta temperature	02

Module IV: Polymer Structure, Properties, Characterization and Applications		15
4.1	Solid state properties: Amorphous state, Crystalline state, Thermal transition and properties, Mechanical properties, Visco elasticity and Rubber elasticity	03
4.3	Polymer Degradation: Thermal degradation, oxidative and UV stability, Chemical and hydrolytic stability,	02
4.4	Polymer Technology	
4.4.1	Polymer Additives, Blends and Composites, Additives: Plasticizers, fillers, other important additives. Blends and Composites	02
4.4.2	Elastomers: Introduction, Types of Rubber, Vulcanization, properties	02
4.4.3	Fibers: Introduction, Production, Fibre spinning, textile fiber, industrial fiber	02
4.4.4	Polymer processing: Extrusion, Molding, Calendaring, Coating Polymer Rheology: Non Newtonian flow, Melt instabilities, Drag reduction	02
4.5	Polymers and advanced Technologies Membrane Science and technology, Bio medical engineering, applications in electronics, photonic polymers	02



References

1. Principles of Instrumental Analysis, D. A. Skoog, F. J. Holler and J.A. Niemann, 5th Edition (1998)
2. Instrumental methods of Analysis, H. H. Willard, L. L. Merritt, Jr. J. A. Dean and F. A. Settle Jr 6th Ed CBS (1986).
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M.Sc. – II Analytical Chemistry
Semester 3 Course Code -- PSACH404
Paper IV: ENVIRONMENTAL AND GREEN CHEMISTRY

Module I: Air and Water Pollution		15 L
	Air pollution:	07 L
1.1	Natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffusion of pollutants, gas laws governing the behaviour of the pollutants in the atmosphere.	03
1.2	Sampling and analysis of: particulate matter, aerosols, SO ₂ , H ₂ O, NO _x , CO, NH ₃ , organic vapours.	03
1.3	Effect of pollutants on human beings, plants, animals, materials and on	01
	Water pollution:	08 L
1.4	Sources of water pollution, basic chemistry of water pollutants, effects	02
1.5	Determination of water pollution parameters and their significance.	01
1.6	Physical parameters: colour, pH, Temperature, odour, turbidity, density, TOS, TSS, TDS.	02
1.7	Chemical parameters- acidity, alkalinity, hardness, DO, COD, BOD, TOC, THOD, MPN, biological parameters.	02
1.8	Heavy metal pollutants like Hg, Pb, Cd, As, Cu, Cr with respect to their sources, distribution, speciation, toxic effect, control, treatment.	02
Module II: Pollution control technology		15 L
	Air pollution control technologies: methods to control air pollution in the environment, Limestone injection and fluidised bed combustion, desulphurisation, catalytic convertor and control of vehicular emission, gravity setting chamber, fabric filters.	05

2.1	Solid Waste disposal: solid waste disposal methods- open dumps, ocean dumping, land-fills, incineration, recycling and reuse, organic pollutants and hazardous waste disposal and management, non-destructive solid waste, biomedical waste.	O5
2.2	Sewage and waste water treatment system: primary, secondary and tertiary treatments, measurements of treatment efficiencies. biological treatments-aerobic verses anaerobic treatments, bio augmentation and bio stimulation, biofilms in treatments.	O5
Module III: Non renewable energy sources		15 L
3.1	Concept and demand of energy, Growing energy needs, Renewable and non-renewable sources of energy.	O2
3.2	Use of alternate energy sources, Wind energy, Solar energy, Nuclear energy, Tidal energy. Water as source of energy,	O6
3.3	Bio fuels production, use and sustainability, use and over exploitation of energy sources and associated problems	O4
3.4	Role of an individual in conservation of natural resources. Equitable use resources for sustainable lifestyles	O3
Module IV: Environmental policies, Regulation, Assessment and Green chemistry		15 L
4.1	Important environmental laws in India: Article 48A, Article 51 A, and other laws for environmental management.	O3
4.2	Environmental impact assessment (EIM): need of EIA, scope, objectives, types of environmental impacts, steps involved in conducting the EIA studies, techniques- Ad-hoc method, checklist method, overlay mapping method, merits and demerits of EIA studies.	O4
4.3	Environmental audit: types, objectives, benefits, practice and procedures.	O3

4.4	Principle and concept of green chemistry, environmental benign solutions, solvent free systems, SCF, ionic liquids as catalysts and solvents, photochemical reactions, chemistry using microwave, sono-chemistry, electrochemical synthesis, Designing greener processes- inherently safer designs (ISD), process intensification (PI) in process monitoring. Porous phase reactions, heterogeneous catalysis, bio-catalysis, greener methods.	05
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References

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3. Water pollution, Arvindkumar, APH publishing (2004)
4. Introduction to Potable Water Treatment Processes Simon Parsons, Bruce Jefferson, Paperback publication.
5. Guidelines for drinking-water quality, third edition, (incorporating first and second addenda). WHO report.
6. Solid waste management, K Sasikumar and SanoopGopi Krishna PHI publication (2009)
7. Solid waste management, SurendrakumarNorthen Book Center (2009)
8. Handbook of chemical technology and pollution control 3rd Edn Martin Hocking AP Publication (2005).
9. Fundamental Concepts of Environmental Chemistry, Second Edition G. S. Sodhi , Alpha Science, 2005
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 12. Alloying: understanding the basics, edited by Joseph R. Davis, ASM International (2001).
 13. Zone refining and allied techniques, Norman L. Parr, G. Newnes Technology & Engineering (1960).

PRACTICALS

Semester IV Course Code — PSACHP4O1

- 1) Cosmetic practical's in collaboration with V G Vaze college.

Semester IV Course Code — PSACHP4O2

- 1) Limit tests of Active Pharmaceutical Ingredients (APIs) as per IP,BP and USP.
- 2) Total analysis of APIs like Aspirin, Paracetamol, Sulfamethaxolas per IP, BP and USP.
- 3) To separate toluene and benzene using GC.
- 4) To separate and estimate Co, Mn, Zn and Ni from a solution using HPTLC.
- 5) HPLC-Separation of mixture of esters on HPLC and calculation of HETP of column

Semester IV Course Code — PSACHP4O3

Project and Dissertation

Semester IV Course Code — PSACHP4O4

- 1) Waste Water analysis: Determination of, BOD, COD, of various water bodies like lake, rivers, wells, creek etc. (minimum 3 different water samples)
- 2) Drinking water analysis: Determination of DO, turbidity, salinity, hardness, alkalinity
Microbial contaminants in potable water.
- 3) Estimation of Na⁺ and K⁺ from soil samples by Flame Photometry.
- 4) Green synthesis : Acetylation of aniline using zinc dust
- 5) KF alumina mediated Erlenmeyer's synthesis of Azalactone