



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Science
Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN201	DC	Spectroscopy and Spectrometry	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To give an in-depth account of different spectroscopic and spectrometric techniques with their specific applications
2. To recognize the principle and develop skills of UV, IR and Raman spectroscopy techniques
3. To expose the students to a breadth of experimental techniques using modern instrumentation of Mössbauer, Photoelectron, Molecular Luminescence and ESR
4. Impart training in operating different instruments for structural elucidation of unknown organic free radicals, inorganic complexes and understand the electron transfer mechanism

Course Outcomes: After completion of this course the students are expected to demonstrate following knowledge, skills and attitudes. The student can able to demonstrate the following

- CO1. To understand the theory and mechanism of different spectroscopic method of analysis.
- CO2. Recall the practical concepts of different Spectrometry techniques and their uses.
- CO3. Demonstrate and the Industrial applications different Spectrometry techniques
- CO4. Will gain the practical skills by handling the UV, IR, AAS, ESR, MS and PES instruments further impart the structural elucidation knowledge of unknown molecules

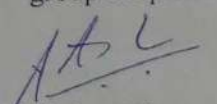
Syllabus:

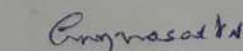
UNIT I: UV-Visible Spectroscopy

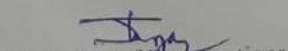
Quantitative aspects of absorption measurements-Beer Lamberts law, limitations of Beer's law, and numerical problems, Apparent deviations from Beer's law, Shapes of UV absorption curves, solvent effects on UV-absorption bands, Instrumentation, radiation sources, Monochromators, detectors, recording of the spectra, Applications in qualitative and quantitative analysis. Applications of UV spectroscopy to simple organic molecules like conjugated dienes, trienes, unsaturated carbonyl and aromatic compounds. Woodward-Fieser rules and its applications.

UNIT II: Infrared and Raman Spectroscopy

Theory of IR spectroscopy, modes of vibration, different types of vibration, Characteristic group frequencies of alkanes, alkenes, alkynes, cycloalkanes and alkyl groups.


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MSAN201	DC	Spectroscopy and Spectrometry	3	0	2	4	60	20	20	30	20

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Aromatic compounds, alcohols, phenols ethers, cyclic ethers, amines, compounds containing carbonyl group, carboxylic acids, esters and lactones, anhydrides, nitro, nitroso and nitriles. Factors influencing vibrational frequencies, Instrumentation of IR Spectrophotometer.

Raman Spectroscopy: Quantum theory of Raman effect, Rotational Raman and Vibrational Raman spectra, Stokes, anti-Stokes lines. Complementary nature of IR and Raman spectra.

UNIT III: Atomic Absorption and Emission Spectroscopy

Principle, theory of AAS, instrumentation, and analytical applications of AAS spectroscopy

Emission Spectroscopy: Flame Emission Spectroscopy, plasma emission spectrometry, basic principles of flame photometry, evaluation methods in flame photometry.

Molecular Luminescence Spectroscopy: Theory of fluorescence and phosphorescence, fluorimetry in quantitative analysis, fluorescence and structure, fluorescence quenching.

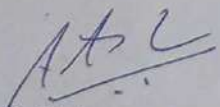
UNIT IV: Electron Spin Resonance Spectroscopy

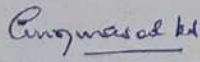
Basic principles, hyperfine couplings, the 'g' values, factors affecting 'g' values, isotropic and anisotropic hyperfine coupling constants, Zero Field splitting and Kramer's degeneracy. Instrumentation, electronic spin states in 1 and 2 electron systems, Measurement techniques and Applications to simple inorganic and organic free radicals and to inorganic complexes.

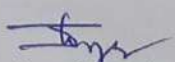
UNIT V: Mössbauer and Photoelectron Spectroscopy

The Mössbauer effect, chemical isomer shifts, quadrupole interactions, measurement techniques and spectrum display, application to the study of Fe^{2+} and Fe^{3+} compounds, Sn^{2+} and Sn^{4+} compounds (nature of M-L bond, coordination number, structure) and detection of oxidation states.

Photoelectron spectroscopy: Basic principles, valence and core binding energies, shifts in energies due to chemical forces, Photoelectron spectra of simple molecules, Auger transitions, measurement techniques and applications.


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Text Books:

1. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle, CBS Publishers, Delhi, 1986.
2. Instrumental Methods of Chemical Analysis: Braun, Tata McGraw-Hill, 2012.
3. B.K.Sharma, Instrumental Methods of Chemical Analysis, Goel publishing.
4. P.S.Kalsi, Spectroscopy of Organic Compounds, 4th edition, New Age International (P) Ltd., Publishers, Hyderabad - 29.
5. C.N.Banwell and E.M.Mc Cash, Fundamentals of Molecular Spectroscopy, 4th edition Tata McGraw Hill, New Delhi, 1995.

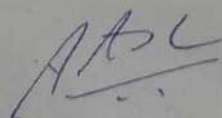
Reference Books:

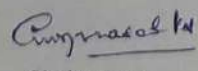
1. Instrumental Methods of Analysis: G. Chatwal and S. Anand, Himalaya Publishing House.
2. W.Kemp, Organic Spectroscopy, 3rd edition, ELBS, McMillan, London, 1991.
3. D.H.Williams and I.Flemming, Spectroscopic methods in Organic Chemistry, 4th edition, McGraw Hill, New York, 1989.

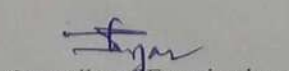
List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

credit lab is to be conducted by covering the most relevant and useful topics from mentioned syllabus.


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MSAN 202	DC	Applied Analysis	3	0	2	4	60	20	20	30	20

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Course Educational Objectives (CEOs): The objective of Applied Analysis course is

1. To develop the understanding of Analytical procedures involved in environmental monitoring and Analysis of metal and radioactive pollutants in effluents.
2. To give basic knowledge of different physical methods of analysis used in the analysis of cement, alloys and BOD, COD, DO, TOC of different water samples
3. Enable students to learn the experimental procedures and techniques used in Government environmental labs
4. Impart training in the analysis of food samples, analysis of pesticide residues in food grains

Course Outcomes: After completion of the course student can able to demonstrate the following skills and attitudes

- CO1. Theoretical understanding of commercially important samples (food, medicine) of analysis
 CO2. To recognize the importance of analysis and about pollutants, impurities of samples
 CO3. Student learns practical aspects of different analysis and instrumental methods
 CO4. Impart the training to evaluate the concentration of paracetamol, codeine in APC tablets by NMR, Phenobarbitone in tablets by IR and estimation of macro nutrients, micro nutrients

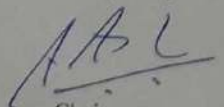
Syllabus:

UNIT I: Analysis of Finished Products and ores:

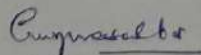
Analysis of Ferroalloys: Analysis of steel - Molybdenum, Phosphorous. Analysis of non-Ferrous alloys: Analysis of Tin, Zinc and Copper in Brass, Bronze. Analysis of Tin and lead in solder. Analysis of Cement: Composition of Portland cement, estimation of Aluminium oxide and Ferrous oxide. Determination of Al_2O_3 in Cement by Polarography. Ores: Iron ore- Analysis of the Constituents - Moisture, loss of ignition, Total Iron, ferrous Iron, ferric Iron, alumina, Silica, Titania, Lime, Magnesia, Sulphur, phosphorous, manganese, alkalies, combined water, Carbon in blast furnace, flue dust and sinter.

UNIT II: Analysis of Air and Water Pollutants:

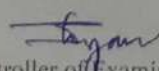
Air quality standards, sampling, analysis of air pollutants- SO_2 (UV-Vis, IR), H_2S (Spectro



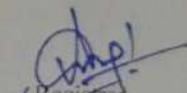
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photometry, Non-dispersive IR technique), NO-NO_x (Chemiluminescence technique, Colorimetric technique-Saltzman method), CO, CO₂ (IR, AAS & GC), Hydrocarbons (GC, GC-MS), Aromatic hydrocarbons in automobile exhaust, Petrol, air, O₃ (Chemiluminescence & Spectrophotometry), particulate matter analysis. Objectives of analysis, sampling, preservation and pre-concentration methods, physical analysis -colour, odour, temperature, pH, EC, redox potential, total dissolved solids (turbidimetry), Chemical analysis of anions – CN⁻, Cl⁻, F⁻, NO₂⁻, NO₃⁻ (spectrophotometry), SO₄²⁻, PO₄³⁻ anions. Determination of BOD, COD, TOC & DO Analysis of Toxic Metals: Hg, As, Pb, Cd, Be, Al, Cr (Atomic Absorption Spectroscopy and Spectrophotometry).

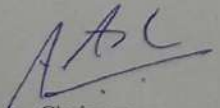
UNIT III: Clinical and Pharmaceutical Analysis

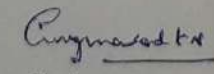
Clinical Analysis: Determination of (1) Serum Calcium (2) Plasma Bicarbonate (Titrimetry). Determination of Serum Chloride (Coulometry). Determination of the following (1) Cholesterol, (2) Total Protein (3) Blood Urea in Serum (4) Amylase (5) Aspartate Amino Transferase (AST) and Alanine Amino Transferase (ALT) (by Spectrophotometry). Determination of (1) Thyroxine and (2) Thyroid-Stimulating Hormone (TSH) (by RIA Method).

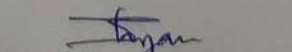
Pharmaceutical analysis: Determination of Diclofenac (non-aqueous titration), Calcium in Vitamin D and Calcium formulations (Complexometric), Sulphanilamide (potentiometry), Pethidine hydrochloride (UV-Vis), Frusemide (UV-Vis), Aspirin, paracetamol and codeine in APC tablets (NMR), Phenobarbitone in tablets (IR), pivalic acid in dipivefrin eye drops (GC), Assay of hydrocortisone cream (HPLC). Impurity profiling of Propranolol (GC-MS).

UNIT IV: Food Analysis

Introduction, Analysis of Chemical Additives in foods: Division of colour additives, Chromatographic identification of colours, and quantitative estimation of added dyes in foods (Titanium Trichloride Method) - chemical preservatives and synthetic sweetening agents. Organic-ether extractable and Non-ether extractable) - Analysis of SO₂ & Sodium Benzoate (Chemical Methods), Sorbic Acid (Chromatography).


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Types of Antioxidants used in Foods, Analysis of Butylated Hydroxy Toluene (BHT) (Spectrophotometry).

UNIT V: Agricultural Analysis

Analysis of soils for available Major Nutrients - Estimation of available Nitrogen (Kjeldahl Method), Phosphorus (Olsen's Method and Bray and Kurtz Method), and Exchangeable Calcium & Magnesium (by EDTA). Soil analysis for Micronutrients - Estimation of Available Zinc, Copper, Manganese and Iron (AAS)- Analysis of Pesticide Residues - Determination of Methyl Parathion Residues in food grains & vegetables (Solvent Extraction and Titrimetry) - Determination of Organochlorine pesticides by Gas Chromatography (Cypermethrin) - Determination of Malathion and DDT Residues in food grains (Spectrophotometry).

Text Books:

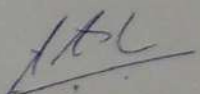
1. Analytical Chemistry, Gary Christian, VI Ed, John Wiley & Sons Inc, New York.
2. Pharmaceutical Drug Analysis, Ashtosh Kar, 3rd Edition, New Age international publishers.
3. Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed, Pearson Education Ltd.
4. Environmental Pollution Analysis, S M Khopkar, Wiley Eastern Ltd 1995.
5. Environmental Chemistry, B K Sharma, Goel Publishing House, Meerut.
6. Handbook of Analysis and quality control for fruit and vegetable products, S Ranganna, Tata McGraw Hill Publishers Ltd, 1986.

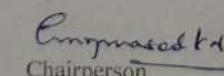
Reference Books:

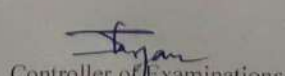
1. Environmental Analytical Chemistry, F Fifield, P Haines, Blackie Academic professional.
2. Introduction to chemical analysis of foods, S Suzanna & Nielsen, CBS Publishers.
3. Pharmaceutical Analysis, David G Watson, Churchill Livingstone Harcourt Brace and Company Ltd, 1999.
4. Laboratory handbook of instrumental drug analysis, Nagavi, Vallabh Prakashan Publishers
5. Medical Laboratory Technology - Ramnik Sood, Jaypee Brothers Ltd 1999.

List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical: 1 credit lab is to be conducted by covering the most relevant and useful topics from mentioned syllabus.


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MSAN203	DC	Electro Analytical Techniques	3	0	2	4	60	20	20	30	20

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Course Educational Objectives (CEOs):

1. To provide a broad foundation in Electro analytical techniques that stresses scientific reasoning and analytical problem solving with a molecular perspective
2. To provide the basic knowledge of pH, Electrogravimetry, calculation of theoretical cathode potential and effect of pH in electrolytic separations
3. To learn the practical applications of following electro analytical techniques Polarography, Cyclic Voltammetry and Amperometry
4. Making students to learn about analytical industrial chemistry, applications of Hydrodynamic voltammetry and Pulse polarography technique

Course Outcomes: The student can able to deliver the following

- CO1. Recall the basic concepts of Coulometry, Electrogravimetry and Voltammetry techniques.
- CO2. Apply and demonstrate the practical uses of Electrogravimetry and Pulse polarography
- CO3. Practical utility and Industrial applications of different Electro analytical techniques.
- CO4. Will gain the practical knowledge on differential pulse polarography, determination of toxic metals in various water samples by stripping method

Syllabus:

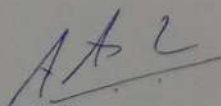
UNIT I: pH and Electrogravimetry

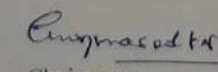
pH-metry: Accuracy of direct potentiometer measurements. Glass pH electrode, Theory, construction, standard buffers, accuracy and measurements with the pH meter, pH titration of unknown soda ash.

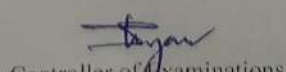
Electrogravimetry: Basic principles, Instrumentation, Experimental determination with constant applied voltage and at constant current. Problems based on effect of concentration on electrode potentials, calculation of theoretical cathode potential, effect of pH in electrolytic separations and Applications.


UNIT II: Coulometry

Current voltage relationship during an electrolysis, Operating cell at a fixed applied potential,


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MSAN203	DC	Electro Analytical Techniques	3	0	2	4	60	20	20	30	20

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Electrolysis at constant working electrode potential, Coulometric methods of analysis, Faraday laws of electrolysis, Instrumentation, Constant current and constant voltage instruments, potentiostatic coulometry, Instrumentation and applications, coulometric titrations (Amperostatic coulometry)-Apparatus and applications, advantages and limitations, problems.

UNIT III: Polarography methods of analysis

Linear scan polarography, principles, Instrumentation, types of microelectrode such as dropping mercury electrode, the static drop mercury electrode, rotating disc and ring disc electrode, cell for polarography, reference and counter electrode and circuit diagram.

Polarogram and polarographic currents, charging or capacitive current, role of supporting electrolyte, factors affecting on polarographic wave, Ilkovic Equation, advantages and disadvantages of DME, polarographic maxima and maxima suppressors, interference due to dissolved oxygen, Applications for qualitative analysis, quantitative analysis by calibration curve and standard addition methods.

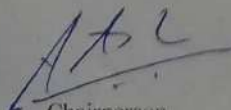
UNIT IV: Hydrodynamic Voltammetry and Pulse polarography

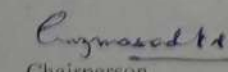
Hydrodynamic voltammetry, voltametric detectors in chromatography and flow injection analysis, Voltametric oxygen sensors, amperometric titration and applications.

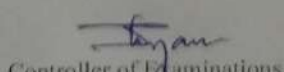
Pulse Polarography: different types of excitation signals in pulse polarography, Differential pulse polarography, square wave polarography, Stripping method. Voltammetry with ultramicro electrode, Applications of this technique for determination of Cu and Zn from tap water by differential pulse polarography and by square wave polarography, determination of Vitamin-C by differential pulse polarography, determination of Pb in tap water by stripping method.

UNIT V: Cyclic Voltammetry and Amperometry

Cyclic Voltammetry: Principle of cyclic Voltammetry, cyclic voltammogram of $K_3[Fe(CN)_6]$, and parathion, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes.


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MSAN203	DC	Electro Analytical Techniques	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Amperometry: Principle, Instrumentation, typical applications, amperometric titrations, Chrono amperometry and Chronopotentiometry. Controlled potential and constant current coulometry. Stripping analysis.

Text Books:

1. An Introduction to separation science, L.R. Snyder and C. Horvath, Wiley Interscience
2. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler and T.A. Nieman 5th edition (1998), Saunders College Publishing, Harcourt Brace & Company, U.S.A
3. Electrochemical Methods: Fundamentals and Applications, A.J. Bard and L.R. Faulkner 2nd Edition (2000), Wiley, New York.
4. Fundamentals of Electroanalytical Chemistry, P Monk, John Wiley, NY.
5. Instrumental Analysis, Y.H. Bauer, G.D. Christian, S.E. O'reilly, Allyn and Bacon Inc.
6. Molecular Structure and Spectroscopy - G. Aruldas, Prentice Hall of India
7. Cyclic Voltammetry and frontiers of electrochemistry, N.Noel, K.I. Vasu IBH, New Delhi
8. Introduction to instrumental analysis by R. D. Broun, McGraw Hill 6th edition

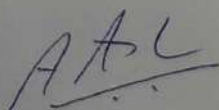
Reference Books:

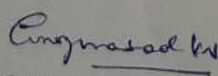
1. Physical Methods in Chemistry, R.S. Drago, Saunders College
2. X- Ray methods, Clive Whiston, John Wiley & Sons.
3. Solid State Chemistry and its Applications, A.R.West, John Wiley & Sons, New York (1984)
4. Instrumental Analysis, D. A. Skoog, F.J.Holler and S.R. Crouch, Thomson Brooks/Cole, Cengage Learning, UK

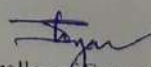
List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (A)	DE	Laboratory Automation and Sensors	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To provide the basic knowledge of laboratory automation, process control analyzers and micro fabrication
2. Student will learn about the green and sustainable chemistry approach and research on Nano bio-sensors further its applications in medical science
3. Apply knowledge about polymer replication technology and various types of sensors
4. To develop the understanding of Calibration and maintenance of UV, IR Spectrophotometers, pH meter, conductivity meter, AAS, GC and HPLC instruments

Course Outcomes: After completion of this course the students are expected to demonstrate following knowledge, skills and attitudes. The student can able to demonstrate the following,
CO1. Too aware of different types of chemical sensors, biosensors, calibration and maintenance various instruments and students will learn the industrial applications of instrumental techniques
CO2. To learn the practical importance of Calibration and maintenance of Instruments
CO3. Apply and demonstrate the uses of Laboratory automation, spectrophotometers. Students will gain the practical applications of Chemical and Bio sensors, AAS, GC, HPLC, UV and IR
CO4. Acquire the practical knowledge by doing experiments on the design of fibre optic sensors, and calibration of Conductivity meter, GC, AAS and HPLC

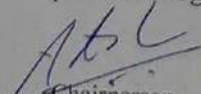
Syllabus:

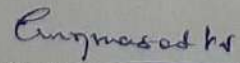
UNIT I: Automated Analysis


Introduction to the concept of automated laboratory analyses, Lab automation system, Continuous flow analyzers, Flow injection analyzers, discrete sample analyzers, Centrifugal force analyzers, Automatic titrations, Process control and process control analyzers.

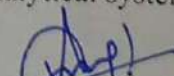
UNIT II: Miniaturized Analytical systems

Introduction, Concept, theory of miniaturization, micro fabrication, silicon and glass micromachining, polymer replication technology, miniaturized analytical components, sampling and sample pre-treatment, system integration, serial integration, parallel integration, future prospects and commercialization of miniaturized Analytical systems.


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Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (A)	DE	Laboratory Automation and Sensors	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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UNIT III: Chemical Sensors

Introduction, definition, descriptions of chemical sensors, Classification and types of chemical sensors - electrochemical sensors, potentiometric sensors, voltametric chemical sensors, sensors based on conducting properties. Optical sensors, design of fibre optic sensor, Calorimetric sensors, catalytic gas sensor, thermal conductivity sensor, mass sensor, Piezoelectric quartz crystal resonator, surface acoustic wave sensor.

UNIT IV: Biosensors in analysis

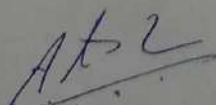
Introduction, forming and producing biological surfaces, Achievement of transduction and bio-transduction, Biomedical detection thorough nano-biosensors. Selection, Optimization and working of Nanomaterials in Sensor technology. Recent developments and applications of Biosensors.

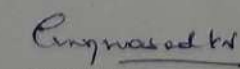
UNIT V: Calibration and maintenance of Instruments

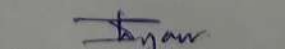
Instrument calibration, Linear calibration curves, equipment calibration, frequency of calibration, calibration of common laboratory instrument and equipment - Analytical balances, volumetric glassware, ovens, furnaces, UV / Visible, IR Spectrophotometers, pH meter, conductivity meter, AAS, GC, HPLC. Maintenance of instruments and equipment. Good laboratory practices (GLP), Quality Programme, Instrument and Organization calibration, Customer Satisfaction.

Text Books:

1. Standard methods of chemical analysis, F.J. Welcher, 6th Edition, ELBS, 2012.
2. Instrumental methods of analysis, R. D. Braun, 4th edition, Wiley-VCH
3. Quantitative Inorganic Analysis including Elementary Instrumental analysis, By A. I. Vogel, 12th edition, ELBS, 2014.
4. Analytical Chemistry, Ed. by Kellner, Mermet, otto, Valcarcel, Widmer, Second Ed. Wiley -VCH
5. Instrumental Analysis, D. A. Skoog, F.J. Holler and S.R. Crouch, Thomson Brooks/Cole, Cengage Learning, UK


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Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (A)	DE	Laboratory Automation and Sensors	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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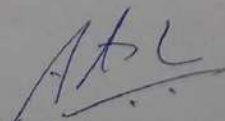
Reference books:

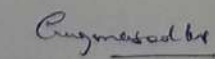
1. Handbook of Quality Assurance for the analytical chemistry laboratory, James P. Dux, Van Nostrand Reinhold, New York, 1986.
2. Applying ISO-9000 Quality Management Systems, International Trade Centre Publishing, UNCTAD/WTO. Geneva, Switzerland, Indian Edition Printed by D.L. Shah Trust.
3. How to practice GLP, PP Sharma, Vandana Publications, 2000, New Delhi

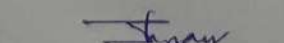
List of Practical's: (If Practical Credit Shown in Syllabus)

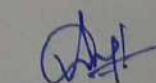
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Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (B)	DE	Chemistry of Advanced materials	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To provide a clear and incisive treatment of synthesis, size dependence properties of nano-materials, Surface-Plasmon resonance and its role in catalysis
2. To provide the practical knowledge of functionalization and reactivity of carbon nanotubes, Nano tweezers, applications in effluent treatment
3. To develop the practical understanding of polymerization process, specialty polymers
4. Impart training in the preparation and applications of Polyacetylenes, Polyanilines, Optical lithography, Polymer based nano- particles and LEDs, lithium-polymer batteries

Course Outcomes: The student will be able to deliver the following

- CO1. Theoretical and practical understanding of various smart materials and its applications
- CO2. Enable to gain the practical knowledge of characterization of speciality polymers and nano materials, Application of IR spectroscopy in the Nanomaterials analysis
- CO3. To learn the practical applications of Polymers, Nanomaterials in the Health science
- CO4. Impart practical experiments in the preparation of photochromic coordination compounds, shape-memory polymers, dielectric elastomers and self-healing polymers

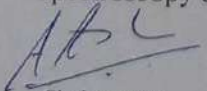
Syllabus:

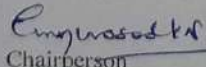
UNIT I: Introduction to Nanomaterials

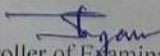
Nanomaterials types, 0D, 1D, 2D and 3D, fundamental and physicochemical principles, size dependence properties of nanomaterials, quantum confinement, synthesis of Nanomaterials by Sol-Gel, colloidal precipitation, co-precipitation, hydrothermal, vapour deposition and sono-chemical methods. Metal nanoparticles, Size control, characterization, and properties (optical, electronic, magnetic) Surface-Plasmon resonance, its applications and role in catalysis.

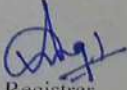
UNIT II: Basic tools and applications of nanotechnology:

Principles and applications of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM) and Energy Dispersive X-ray Spectroscopy (EDAX), Powder X-ray diffraction and determination of particle size, UV-Visible spectroscopy and determination of band gap, Application of IR spectroscopy in the analysis of


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Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (B)	DE	Chemistry of Advanced materials	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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Nanomaterials. Carbon nano structures, Fullerenes: C₆₀, C₈₀ and C₂₄₀-Synthesis, Properties and applications of C₆₀. Functionalization and reactivity of carbon nanotubes. Nano tweezers, Applications of nano technology in effluent treatment and photo catalysis.

UNIT III: Polymerization processes

Free radical addition polymerization-kinetics and mechanism. Step growth polymerization - Linear Vs cyclic polymerization. Other methods of polymerization - bulk, solution, emulsion and dispersion techniques.

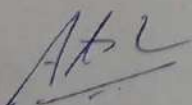
Polymer stereochemistry: Configuration and conformation. Chiral polymers, characterization of Polymers, Methods for determining molecular weights - static, dynamic, viscometry, light scattering and GPC. Glass transition temperature and crystalline melting of polymers. Degree of crystallinity, Thermal stability of polymers- Application of DSC.

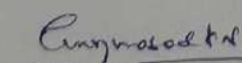
Unit IV: Speciality Polymers

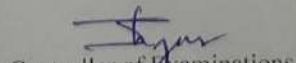
Industrial Polymers: carbon chain and hetero chain polymers, Synthesis and applications. Polymeric reagents, catalysts and substrates, conducting polymers. Synthesis and applications of polyacetylenes, polyanilines, polypyrroles and polythiophenes. Photo responsive, Photo-refractive polymers. Polymers in Optical lithography, Drug delivery, Polymer based nano-particles and LEDs, lithium-polymer batteries, Liquid crystalline polymers, Phase morphology.

Unit V: Smart materials

Piezoelectric, Magnetostrictive, Halochromic, Electrochromic, Thermochromic, Magnetocaloric and Thermoelectric materials. Chemistry of photochromism in spiropyrans, spirooxazines, diarylethenes, azobenzenes, quinones. Examples of photochromic coordination compounds. Shape-memory polymers, pH-sensitive polymers, Temperature-responsive polymers, dielectric elastomers, self-healing polymers and concept of mechanophores, polymorphism in polycaprolactone, introduction to ferrofluids, concept of pseudoelasticity.


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Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (B)	DE	Chemistry of Advanced materials	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Text Books:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.
2. B. Viswanathan, Nanomaterials, Alpha Science, 2009
3. R. J. Young, Principles of Polymer Science, Chapman and Hall, N.Y, 3rd Edition, 1991.
4. P. J. Flory, A Text Book of Polymer Science, Cornell University Press, Ithaca, 1953.
5. F. Ullrich, Industrial Polymers, Kluwer, N.Y. 1993.
6. H. G. Elias, Macromolecules, Vol. I & II, Academic, N.Y. 1991.
7. R. Metzger et al, Intelligent Materials, RSC Publishing, 2007
8. Encyclopaedia of Smart Materials, John Wiley and Sons (available online)


Reference books:

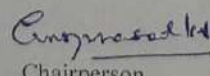
1. G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press, London, 2004.
2. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume I, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2004.
3. J. MohdJani, M. Leary, A. Subic and M. Gibson, Materials & Design, 2014, 56, 1078–1113.
4. J. M. G Cowie, Polymers: Physics and Chemistry of Modern Materials, Blackie, London, 1992.
6. M. Schwartz, Smart Materials, CRC Press, 2008.
7. F. W. Billmayer, Textbook of Polymer Science, Wiley, N.Y, 3rd Edition, 1991

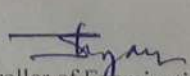
List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Science
Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (C)	DE	Pharmaceutical and impurity Analysis	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. The purpose of the course is to make the students to understand pharmaceutical analysis, standardization and different method of assays
2. To provide basic knowledge of the stability studies, quantification of impurities and impurity profiling of drugs
3. To develop the practical understanding of elemental impurities of API's, drugs, their sources and detailed analytical procedures
4. Applying practical aspects of formulation and detailed study of Pharmacopoeial compounds, impart training on Colorimetric estimation of drugs

Course Outcomes: After completion of the course student demonstrate the following

- CO1. To become aware of the types of impurities in drugs, stability testing protocols
CO2. Apply and demonstrate the different analysis and learn its practical applications
CO3. Practical understanding of stability studies of drugs, API's and its importance in Chemical, Pharmaceutical industries
CO4. Design experiments on functional group analysis, limit tests, assay tests further students will learn the different instrumental techniques for the characterization of drugs, API's

Syllabus:

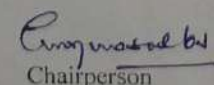
UNIT I: Pharmaceutical Analysis

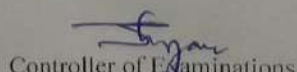
General idea regarding the Pharmaceutical Industry, definition and Classification of drugs, introduction to pharmaceutical formulations and classification of dosage forms. Role of FDA in pharmaceutical industries. Sources of impurities in pharmaceutical products and raw materials. Standardization of finished products and their characteristics, official methods of quality control.


UNIT II: Drugs

Analysis of compounds based on functional groups, instrumental methods for analysis of drugs, assays involving chromatographic separations, proximate assays, assays of enzyme containing substances, biological and microbiological assays and tests. Limit tests, solubility tests, disintegration tests, stability studies, impurity profile of drugs, bioequivalence and bioavailability studies. Polymers in pharmaceuticals and novel drug delivery systems.


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Shri Vaishnav Institute of Science

Department of Chemistry

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (C)	DE	Pharmaceutical and impurity Analysis	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;
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UNIT III: Impurities in drug products and Stability studies

Stability studies: Definition, classification of impurities in drug Substance or Active Pharmaceutical Ingredients (API) and quantification of impurities as per ICH guidelines. Impurity profiling of drugs.

Impurities in new drug products: Rationale for the reporting and control of degradation products, reporting degradation products content of batches, listing of degradation products in specifications, qualification of degradation products.

UNIT IV: Impurities in residual solvent and Elemental impurities:

Residual solvent: General principles, classification of residual solvents, Analytical procedures, limits of residual solvents, reporting levels of residual solvents.

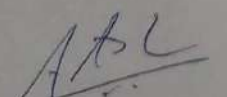
Elemental impurities: Classification of elements, Potential sources of elemental Impurities and their identification, detailed analytical procedures, C, H, N and S analysis.

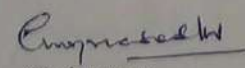
UNIT V: Stability testing protocols and practical applications

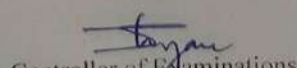
Concept of stability, selection of batches, test parameters, sampling frequency, specification, storage conditions, recording of results. Important mechanistic and study of following stability factors temperature, pH, ionic strength and dielectric constant. Detailed study of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, Colorimetric estimation of drugs.


Text books:

1. Encyclopedia of Industrial Chemical Analysis, Foster Dee Snell et al, Interscience Publishers, 1967.
2. Bio analytical Chemistry, Susan R Mikkelesen and Eduardo Cotton, John Wiley and Sons, 2004.
3. Chemical Analysis of Drugs, Takeru Higuchi, Interscience Publishers, 1995.


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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science

Department of Chemistry

Name of Program: M.Sc. (Analytical Chemistry) (CBCS) (2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY		PRACTICAL		
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MSAN 204 (C)	DE	Pharmaceutical and impurity Analysis	3	0	2	4	60	20	20	30	20

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

4. Text book of Pharmaceutical Analysis, Kenneth Antonio Connors, 14th Edition, John Wiley & Sons, 2001.

5. Vogel's textbook of quantitative chemical analysis - Jeffery J Bassett, J. Mendham, R. C. Denney, 5th edition, ELBS, 1991.

6. Practical Pharmaceutical Chemistry - Beckett and Stenlake, Vol II, 4th Edition, CBS publishers, New Delhi, 1997.

7. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers New Delhi, 1997.

8. Pharmaceutical Analysis- Modern methods - J W Munson - Part B, Volume 11, Marcel Dekker Series.

Reference books:

1. The Quantitative analysis of Drugs - D C Carratt, 3rd edition, CBS Publishers, New Delhi, 1964.

2. Indian Pharmacopoeia Vol. I, II & III 2007, 2010, 2014.

3. Analytical Profiles of drug substances - Klaus Florey, Volume 1 - 20, Elsevier, 2005.

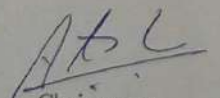
4. Analytical Profiles of drug substances and Excipients - Harry G Brittan, Volume 21 - 30, Elsevier, 2005.

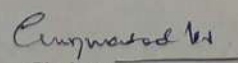
5. ICH Guidelines for impurity profiles and stability studies.

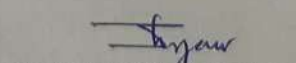
List of Practical's: (If Practical Credit Shown in Syllabus)

Guidelines for Practical:

credit lab is to be conducted by covering the most relevant and useful topics from mentioned syllabus.


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