

Dissemination of Education for Knowledge, Science and Culture”

- Shikshanmaharshi Dr. Bapuji Salunkhe

**Shri Swami Vivekanand Shikshan Sanstha's  
Vivekanand College, Kolhapur  
(Empowered Autonomous)**



***DEPARTMENT OF CHEMISTRY***

**Two Years PG Programme**

**Department/Subject Specific Core or Major (DSC)**

**Curriculum, Teaching and  
Evaluation Structure**

**As Per NEP 2020**

**For**

**M. Sc. II Analytical Chemistry**

**Semester-III & IV**

**to be implemented from Academic Year 2024-25**

**VIVEKANAND COLLEGE, KOLHAPUR**  
**(EMPOWERED AUTONOMOUS)**  
**DEPARTMENT OF CHEMISTRY**  
**Syllabus for the Master of Science in Chemistry**  
**M. Sc. II Analytical Chemistry (Sem. III & IV)**  
**(National Education Policy 2020)**  
**Applicable From Academic Year: 2024 - 2025**

- 1. Title:** M. Sc. Chemistry, Vivekanand College, Kolhapur (Empowered Autonomous)
- 2. Faculty:** Faculty of Science and Technology.
- 3. Year of Implementation:** For M. Sc. II (Semester III and Semester IV) From July 2024.
- 4. Programme Outcomes (POs):** After completing the M. Sc. Programme, the students will be able to:

<b>PO 1:</b>	<b>Disciplinary Knowledge:</b> Demonstrate comprehensive knowledge of the concerned discipline and execute theoretical and practical understanding
<b>PO 2:</b>	<b>Research-related skills and Scientific temper:</b> Infer scientific literature and formulate hypotheses for research problems; plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct, and creating awareness about intellectual property rights and issues of plagiarism.
<b>PO 3:</b>	<b>Entrepreneurship Development:</b> Apply acquired knowledge to build entrepreneurship
<b>PO 4:</b>	<b>Environment and Sustainability:</b> Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
<b>PO 5:</b>	<b>Self-directed and Life-long learning:</b> Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

**5. Programme Specific Outcomes (POs):** After completing the M. Sc. Programme in Chemistry, the students will be able to:

<b>PSO1:</b>	Demonstrate, solve, and understand major concepts in all disciplines of chemistry.
<b>PSO2:</b>	Think methodically, and independently, and draw a logical conclusion of chemistry.
<b>PSO3:</b>	Employ critical thinking and scientific knowledge to design, carry out, record, and analyze the results of chemical reactions.
<b>PSO4:</b>	Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
<b>PSO5:</b>	To inculcate the scientific temperament in the students and outside the scientific community.
<b>PSO6:</b>	Use modern techniques, decent equipment, and various chemistry software.

VIVEKANAND COLLEGE, KOLHAPUR (EMPOWERED AUTONOMOUS)

## Department of Chemistry

### Departmental Teaching and Evaluation Scheme

Two - Years PG Programme

Department/Subject Specific Core or Major (DSC) (as per NEP-2020 Guidelines)

### Analytical Chemistry

### First Year Semester - I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
<b>Semester-I</b>										
1	DSC-I	DSC16CHE11	Inorganic & Organic Chemistry	4	-	80	20	-	100	4
2	DSC-II	DSC16CHE12	Physical & Analytical Chemistry	4	-	80	20	-	100	4
3	DSE-I	DSE16CHE11	Inorganic Chemistry	4	-	80	20	-	100	4
	DSE-II	DSE16CHE12	Organic Chemistry							
	DSE-III	DSE16CHE13	Physical Chemistry							
	DSE-IV	DSE16CHE14	Analytical Chemistry							
4	RMD-I	RMD16CHE11	Research Methodology	4	-	80	20	-	100	4
5	DSC-PR-I	DSC16CHE19	Chemistry Lab-I	-	12	-	-	150	150	6
<b>Total</b>				<b>16</b>	<b>12</b>	<b>320</b>	<b>80</b>	<b>150</b>	<b>550</b>	<b>22</b>
<b>Semester-II</b>										
1	DSC-III	DSC16CHE21	Inorganic & Organic Chemistry	4	-	80	20	-	100	4
2	DSC-IV	DSC16CHE22	Physical & Analytical Chemistry	4	-	80	20	-	100	4
3	DSE-V	DSE16CHE21	Inorganic Chemistry	4	-	80	20	-	100	4
	DSE-VI	DSE16CHE22	Organic Chemistry							
	DSE-VII	DSE16CHE23	Physical Chemistry							
	DSE-VIII	DSE16CHE24	Analytical Chemistry							
7	OJT-I	OJT16CHE21	On Job Training (OJT)	-	4	-	-	-	100	4
8	DSC-PR-II	DSC16CHE29	Chemistry Lab-II	-	12	-	-	150	150	4
<b>Total</b>				<b>12</b>	<b>16</b>	<b>240</b>	<b>60</b>	<b>100</b>	<b>550</b>	<b>22</b>
<b>Total (Sem. I &amp; II)</b>				<b>28</b>	<b>28</b>	<b>560</b>	<b>140</b>	<b>250</b>	<b>1100</b>	<b>44</b>

## Second Year Semester-III & IV

Sr. No.	Course Abbr.	Course Code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
<b>Semester-III</b>										
1	DSC-V	DSC16CHE31	Advanced Analytical Techniques	4	-	80	20	-	100	4
2	DSC-VI	DSC16CHE32	Organo Analytical Chemistry	4	-	80	20	-	100	4
3	DSE-IX	DSE16CHE31	Electroanalytical Techniques in Chemical Analysis	4	-	80	20	-	100	4
	DSE-X	DSE16CHE32	Environmental Chemical Analysis and Control							
4	DSC-PR-III	DSC16CHE39	Chemistry Lab-III	-	12	-	-	150	150	6
5	RPR-I	RPR16CHE31	Research Project	-	4	-	-	-	100	4
				12	16	240	60	150	550	22
<b>Semester-IV</b>										
1	DSC-VII	DSC16CHE41	Organic Industrial Analysis	4	-	80	20	-	100	4
2	DSC-VIII	DSC16CHE42	Advanced Methods in Chemical Analysis	4	-	80	20	-	100	4
3	DSE-XI	DSE16CHE41	Applied Analytical Chemistry	4	-	80	20	-	100	4
	DSE-XII	DSE16CHE42	Quality Assurance and Accreditation							
7	DSC-PR-IV	DSC16CHE49	Chemistry Lab-IV	-	4	-	-	100	100	4
5	RPR-II	RPR16CHE41	Research Project	-	6	-	-	-	150	6
				12	10	240	60	100	550	22
<b>Total (Sem. I &amp; II)</b>				<b>24</b>	<b>22</b>	<b>580</b>	<b>140</b>	<b>250</b>	<b>1100</b>	<b>44</b>

### M. Sc. Part - II (Semester -III)

#### DSC16CHE 31: ADVANCED ANALYTICAL TECHNIQUES (4 Credits)

Course Outcomes: After the completion of the course, the student will be able to:

- CO1:** Students will acquire a thorough understanding of mass spectrometry, encompassing both its fundamental principles and advanced applications in scientific research. They will gain insights into the basic principles of mass spectrometry, including ionization, mass analysis, and detection. Additionally, students will be able to identify different types of mass spectrometry based on the ion sources used and explain the function and principles of quadrupole mass analyzers.
- CO2:** Students will develop a comprehensive understanding of nanomaterials and nanotechnology, from fundamental concepts to advanced applications. Also understand the types of nanomaterials like 0D (quantum dots), 1D, 2D, and 3D and processes for synthesis of nanomaterials. Identify and describe the various applications of nanotechnology across fields such as medicine, electronics, environmental science, and energy.
- CO3:** Students will gain a thorough understanding of advanced instrumentation techniques, including their principles, instrumentation, and practical applications of SEM, TEM, AFM etc.
- CO4:** Upon completing the course, students will have acquired a comprehensive understanding of several key analytical methods used in chemistry and research Raman Spectroscopy, XFS, ESR, and XPS. They will also study the principle of Auger electron emission, instrumentation and Secondary Ion Mass Spectrometry (SIMS).

Unit No.	Syllabus	Lectures
UNIT I	<b>Advances in Mass Spectrometry-A:</b> (i) Introduction to Mass spectrometry, (ii) principles, history, instrumentation, the concept of ion free path, (iii) classification of mass spectrometry based on nature of compound analyzed and the ion sources used (iv) ionization techniques;	<b>(15)</b>

	Electron impact (EI), chemical ionization (CI), Fast ion or atom bombardment ionization (FID/FAB), field desorption (FD), laser desorption ionization (LDI), plasma desorption ionization (PDI), thermo spray ionization (TSI), electrospray (ESI), atmospheric pressure ionization, and inductively coupled plasma (ICP). (v) Mass analyzers: Quadrupolar analyzers, Quadrupole ion trap or Quester, Ion trap detector, development of high Mass, High-resolution ion trap, tandem mass spectrometry in the ion trap, time of flight analyzer, magnetic and electromagnetic analyzer, ion cyclotron resonance and FT- MS, (vii) mass detectors.	
<b>UNIT II</b>	<b>Introduction to Nanotechnology and Nano Chemistry:</b> (i) Definition of nanomaterials and nanotechnology, (ii) significance of nanotechnology (iii) size and properties of nanomaterials, (iv) types of nanomaterials like 0D (quantum dots), 1D, 2D, and 3D, (v) introduction to physical, chemical and biological synthesis of nanomaterials with suitable examples, (vi) top-down and bottom-up approach, (v) chemical synthesis of nanomaterials-different types and processes for synthesis of nanomaterials using wet chemical approaches, (vi) fabricating nanomaterials with different morphology intended for specific applications, (vii) applications of nanotechnology.	<b>(15)</b>
<b>UNIT III</b>	<b>Advanced Instrumentation Techniques-A:</b> Studies of the following techniques with (a) Introduction, (b) principle, (c) instrumentation and (d) practical applications in analytical chemistry and research. <ul style="list-style-type: none"> <li>(i) Scanning Electron Microscope (SEM)</li> <li>(ii) Transmission Electron Microscope (TEM)</li> <li>(iii) Electron Dispersion Spectroscopy (EDS)</li> <li>(iv) Energy Dispersive X-ray Analysis (EDAX)</li> <li>(v) Scanning Tunnelling Microscopy (STM)</li> <li>(vi) Atomic Force Microscopy (AFM)</li> </ul>	<b>(15)</b>
<b>UNIT IV</b>	<b>Advanced Instrumentation Techniques-B:</b> Studies of the following	<b>(15)</b>

techniques with (a) introduction, (b) principle, (c) instrumentation and (d) practical applications in analytical chemistry and research.

- (i) Raman Spectroscopy
- (ii) X-Ray Fluorescence Spectroscopy (XFS)
- (iii) Electron Spin Resonance Spectroscopy (ESR)
- (iv) X-Ray Photoelectron Spectroscopy (XPS)
- (v) Auger Electron Spectroscopy
- (vi) Secondary Ion Mass Spectrometry (SIMS)

**RECOMMENDED BOOKS:**

1. E. De. Hoffmann, J. Charette, V. Stroobant, Mass Spectroscopy: Principles and Applications, John Wiley & Sons, Masson, Paris 1996.
2. J. H. Gross, Mass Spectroscopy: A Textbook, Springer-Verlag Berlin 2004.
3. C. G. Herbert, R. A. W. Johnstone, Mass Spectrometry Basics, CRC Press, Boca Raton, Florida, 2002.
4. K. Benjamin: Mass Spectrometry
5. A. I. Vogel: A textbook of Quantitative inorganic Analysis, Longmans.
6. G. H. Morrison and H, Freiser: Solvent Extraction in Analytical Chemistry (John Wiley NewYork, 1958 )
7. Willard, Merits, and Settle: Instrumental Methods of Analysis.
8. Principles of instrumental analysis- Holler, Skoog and Crouch
9. Instrumental methods of Chemical analysis. Kaur
10. Bhushan, Bharat 2004. Handbook of Nanotechnology. Springer.
11. Niemeyer, C.M. & Mirkin, C.A. 2004. Nanobiotechnology- Concepts, Applications and Perspectives. Wiley-VCH Verlag.
12. Zander, C., Enderlein, J. & Keller, R.A. 2002 Single Molecule Detection in Solution. Wiley- VCH Verlag.
13. Avouris, P., Klitzing, K. Von, Sakaki, H. & Wiesendanger, R .2003 Nano Science and Technology
14. Series. Scanning Probe Microscopy- Analytical Methods (R. Wiesendanger Ed), Springer.



15. Instrumental Analysis by Skoog

16. Nanochemistry, a chemical approach to nanomaterials, G. A. Ozin, and A. C. Arsenault, RSC Publishing, Cambridge, 2005. ISBN 0-85404-664-X

## **DSC16CHE32: ORGANO ANALYTICAL CHEMISTRY**

**(4 Credits)**

### **Course Outcomes: After the completion of the course, the student will be able to:**

- CO1:** Understand the disconnection approach using synthons, retrosynthesis of difunctional compounds, and the importance of reaction order, chemoselectivity regioselectivity, and stereoselectivity. Retro Diels-Alder reaction, Michael addition, Robinson annulation, and Umpolung concept.
- CO2:** Study the applications of different reagents like LDA, DCC, TBTH, lead tetra-acetate, as well as applications of hypervalent iodine acid.
- CO3:** Learn how the different metals like Pd, Ru, Rh, Tl, Si, and Cu as well as phosphines, NHCs, and oxazoline ligands in synthetic chemistry.
- CO4:** Learn the mechanism, stereochemistry, migratory aptitude, and applications of various name reactions such as Dienone-phenol, Favorskii, Smile's, Brook, Sommelet-Hauser rearrangement, etc.

<b>UNIT I</b>	<b>Hyphenated Techniques</b>  Advanced techniques of analysis: UV-visible, IR, <sup>1</sup> H-NMR (Recapitulation), <sup>13</sup> CNMR, Mass spectrometry (Basic fundamentals of mass spectrometry, ionization, advanced organic analysis examples); Problems related to structure determination and applications of spectroscopic techniques as analytical tools.	<b>(15)</b>
<b>UNIT II</b>	<b>(A) Drug Analysis</b>  (i) Introduction to drugs and their classification, (ii) sources of impurities in pharmaceutical raw materials such as chemical, atmospheric and	<b>(15)</b>

	<p>microbial contaminants, (iii) Limit tests: limit test for impurities such as Pb, As, Fe, Se, etc. (iv) Estimation of moisture (K-F method), halide (Schnoiger's oxygen flask method), sulfate, and boron. (v) Analysis of commonly used drugs such as antihistamines, sulfa drugs, barbiturates, etc. using non-aqueous titrations, sodium nitrite titrations, differential UV methods, colorimetric and fluorimetric methods of analysis.</p> <p><b>(B) Analysis of Vitamins and Hormones</b></p> <p>Analysis of (i) vitamins: thiamine, ascorbic acid, Vit. A, Vit. B6, and Vit. K, (ii) hormones: progesterone oxytocin, and insulin (iii) chemical, instrumental, and biological assay for analysis of vitamins and hormones.</p>	
<b>UNIT III</b>	<p><b>(A) Clinical Analysis</b></p> <p>(i) Biological significance, (ii) analysis of assay of enzymes: pepsin, monoamine, oxidase, tyrosinase, (iii) composition and detection of abnormal levels of certain constituents leading to diagnosis of diseases, (iv) sample collection and preservation of physiological fluids, (v) analytical methods to the constituents of physiological fluids: blood, urine, and serum, (vi) Analysis of blood: Estimation of glucose, cholesterol, urea, hemoglobin, and bilirubin, (v) Analysis of Urine: urea, uric acid, creatinine, calcium, phosphate, sodium, potassium, and chloride (vi) composition and detection of abnormal level of certain constituents leading to diagnosis of diseases.</p>	<b>(15)</b>
<b>UNIT IV</b>	<p><b>(A) Pesticides Analysis:</b> (i) Introduction, (ii) classification of pesticides, (iii) sampling: sample pre-treatment and processing, (iv) Analysis of: DDT, gammexane, endosulphan, zinab, ziram, malathion, thiram, thiometon, simazine, and chloridane. (v) Applications of colorimetric and chromatographic techniques (GC-MS, HPLC-MS) in analysis of pesticide residue. (vi) Introduction to EPA regulatory body.</p> <p><b>(B) Forensic Analysis:</b> (i) Special features of forensic analysis, (ii)</p>	<b>(15)</b>

sampling: sample storage, sample dissolution, (iii) classification of poisons, (iv) lethal dose, (v) significance of LD-50 and LC-50. (vi) General discussion of poisons with special reference to the mode of action of cyanide, organophosphate, and snake venom. (vii) Estimation of poisonous materials such as lead, mercury, and arsenic in biological samples.

**RECOMMENDED BOOKS::**

F. J. Welcher: Standard methods of Chemical analysis, 6th Ed. Vol. I and II D. Van Nostard Comp.

I. M. Kolthoff: Treatise on Analytical Chemistry Vol. I & II

F. D. Snell: Encyclopedia of industrial Chemical Analysis Vol. 1 to 20 (John Wiley)  
Reich: Outline of Industrial Chemistry.

H. Buchel: Chemistry of Pesticides (John Wiley)

Indian, Pharmacopoeia, British Pharmacopoeia and U. S. Pharmacopoeia

V. M. Parikh: Absorption spectroscopy of organic molecules (Addison Wesley)

Willard, Merits, Dean and Settle: Instrumental methods of analysis (CBS)

D. H. Williams and J. Fleming: Spectroscopic methods in organic chemistry (Mc Graw Hill)

Silverstein : Spectroscopic Identification of organic compounds (John Wiley)

Jackmann and Sternhill : Applications of NMR spectroscopy of organic Chemistry (Pergamon Press)

J. D. Roberts : Nuclear Magnetic Resonance ( Mc Graw Hill)

K. Benjamin : Mass Spectrometry

Nichollas: Aids to the Analysis of foods and Drugs.

A. H. Beckett and J. B. Stanlake; Practical Pharmaceutical Chemistry Vol. I & II (CBS publishers)

S. Ranganna: Handbook of analysis and quality control for fruits and vegetable products (McGraw Hill)

Ramalu: Analysis of pesticides

**Elective Paper-1**

**DSE16CHE31: ELECTROANALYTICAL TECHNIQUES IN CHEMICAL  
ANALYSIS (4 Credits)**

**Course Outcomes: After the completion of the course, the student will be able to:**

- CO1:** Develop the new drugs, and procedures followed in drug design, History, and QSAR. Also, learn the concept of drug receptors and the relationship between structure and chemical reactivity. In addition, they will learn about antibiotics like  $\beta$ -lactam, cephalosporin, and SAR of both and understand the structural features of tetracycline & macrocyclic antibiotics.
- CO2:** Study the different types of drugs like antimalarials, anti-inflammatories, anesthetics, antitubercular, tranquilizers, etc. Also, they can study cardiovascular and antineoplastic drugs.
- CO3:** Understand the synthesis and reactions of five-membered heterocycles like furan, pyrrole, thiophene, benzofuran, and benzothiophene. In addition, they will learn about the synthesis and reactions of six-membered heterocycles like pyridine, quinoline, and coumarone.
- CO4:** Learn the synthesis and reactions of six-membered heterocycles diazines and triazines as of azepines, oxepines, and thiepinines as well as seven-membered heterocycles.

<b>UNIT I</b>	<b>Voltammetry Techniques</b>  (i) Introduction, principle, excitation signals in voltammetry, basic instrumentation based on operational amplifiers, and voltammetric electrodes, (ii) Cyclic Voltammetry: Instrumentation, determination of analytes using cyclic voltammetry, and applications. (iii) Pulse voltammetry: Introduction, normal pulse voltammetry, reverse pulse voltammetry, differential pulse voltammetry, (iv) Square wave voltammetry, (v) Stripping voltammetry: Cathodic and anodic stripping voltammetry, adsorptive stripping methods (vi) voltammetry with microelectrodes: electro deposition step, voltametric completion of the	<b>(15)</b>
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	analysis, (vii) Practical applications in analytical chemistry and research.	
<b>UNIT II</b>	<p><b>Colloids and Emulsion</b></p> <p><b>(A) Colloids:</b> (i) Colloidal solution, (ii) classification of colloids, (iii) theories of origin of charge on sol particles, (iv) determination of charge on a colloidal particle, (v) Stability of sols, Association colloids, Spontaneous ageing of colloids, Factors affecting the spontaneous ageing, theories of spontaneous ageing, coagulation, kinetics of coagulation.</p> <p><b>(B) Emulsion:</b> Types of emulsion, preparation, properties, characteristics, Identification test between two types of emulsions, emulsifiers, emulsifications.</p> <p><b>(C) Gels:</b> Introduction, classification, methods for the preparation of gels, properties of gels,</p> <p><b>(D) Practical applications of colloids, emulsion and gels in analytical chemistry and research.</b></p>	<b>(15)</b>
<b>UNIT III</b>	<p><b>Particle Size Analysis</b></p> <p>(i) Introduction, (ii) Low angle LASER light scattering: Instrumentation, theoretical models, Mie theory, Fraunhofer diffraction theory, particle size distribution analysis, and applications. (iii) Dynamic Light Scattering: Introduction, instrumentation, photodetector sample cell and sample handling, applications, (iv) Photosedimentation: Settling velocity and particle size, Stokes equation, instrumentation, sedimentation modes, particle size distribution analysis, photometric measurements and applications, (v) comparison with particle size measurements using XRD, SEM and TEM. (vi) practical applications in analytical chemistry and research.</p>	<b>(15)</b>
<b>UNIT IV</b>	<p><b>(A) Ion Selective Electrodes</b></p> <p>(i) Terminology, (ii) types and construction of electrodes, glass electrode,</p>	<b>(15)</b>

solid state and precipitate electrodes, liquid-liquid membrane electrodes, enzyme and gas electrodes, and applications.

**(B) Electrophoresis**

(i) Introduction, (ii) paper electrophoresis: Technique, factors affecting migration of ions, capillary and zone electrophoresis and applications. (iii) Practical applications in analytical chemistry and research.

**RECOMMENDED BOOKS:**

1. R.D. Braun, Introduction to Instrumental Analysis.
2. A.Skoog, F. J. Holler, Principles of Instrumental Analysis, 6th edition.
3. Willard, DeRitt, Dean and Settle, Instrumental methods of Analysis.
4. F. J. Welcher, Standard Methods of chemical Analysis Vol.3, Part A & B.
5. G.W. Ewing, Instrumental Methods of Analysis 4th and 5th editions.
6. Chatawal and Anand, Instrumental Methods of Analysis.
7. Bassett, Denney-Jeffery and Mendham, Vogel's Textbook of Quantitative Inorganic Analysis, (5th edition).
8. Electro-analytical chemistry, edited by H.W. Nurnberg.
9. Stulic, Ion selective electrodes (John Wiley).

**Elective paper-2**

**DSE16CHE32 ENVIRONMENTAL CHEMICAL ANALYSIS AND CONTROL (4 Credits)**

**Course Outcomes: After the completion of the course, the student will be able to:**

**CO1:** Demonstrate a comprehensive understanding of fundamental polymer concepts such as monomers, functionality, repeat units, and degree of polymerization. Correctly define and use terms related to the general structure and naming of polymers.

**CO2:** Calculate and interpret the degree of crystallinity in polymers. Understand the concept of crystallites and factors affecting crystallinity in polymers. Identify and describe the properties and applications of key individual monomers. Understand the synthesis processes and properties of various

polymers derived from individual monomers.

**CO3:** Understand and explain the different types of polymer degradation including thermal, mechanical, photo, oxidative, and hydrolytic degradation. Identify the factors that contribute to each type of degradation.

**CO4:** Understand and explain geometric and optical isomerism in polymers. Analyse the results and understand the significance of molecular weight in polymer properties.

<p><b>UNIT I</b></p>	<p><b>Sampling in Analysis</b></p> <p>(i) Definition, theory and techniques of sampling, (ii) sampling of gas, liquids and solids, (ii) Criteria of Good sampling, (iii) Minimization of variables, transmission and storage of samples, high pressure ashing techniques (HPAT), particulate matter, its separation in gas stream, Filtering and gravity separation. Analysis of particulate matter like asbestos, mica, dust and aerosols etc.</p>	<p><b>(15)</b></p>
<p><b>UNIT II</b></p>	<p><b>Electrochemical and spectral methods Environmental analysis</b></p> <p>Introduction to instrumental techniques, principle instrumentation and applications with respect to environmental analysis of Conductometry, Potentiometry, Ion selective electrodes, Cyclic voltammetry, Amperometry, Coulometry, Atomic absorption spectrometry, Atomic fluorescence spectrometry, Inductively coupled plasma spectrometry, Turbidimetry, Non Dispersive Infrared Analysis (NDIR).</p>	<p><b>(15)</b></p>
<p><b>UNIT III</b></p>	<p><b>Air and Water Pollutant Analysis</b></p> <p>Chemistry of Air pollutants, characterization. Source, methods of analysis of air pollutants; CO, CO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>, H<sub>2</sub>S, SO<sub>2</sub> etc. Monitoring Instruments, Potable and Industrial water, major and minor components, dissolved oxygen (DO) Chemical oxygen demand(COD) Biochemical oxygen demand (BOD) and their measurements. Analysis of Pd, Cd, Hg, Cr, As and their physiological manifestations. Quality of industrial waste</p>	<p><b>(15)</b></p>

	water analysis for organic and inorganic constituents. Chemistry of odour and its measurements.	
<b>UNIT IV</b>	<b>Organic Pollutants and Their Analysis</b>  Sources, disposal, treatment and analysis of phenolic residues, methods of recovery of phenols from liquid effluents, Organomercurials and its analysis, Analysis of organochlorine pesticides, volatile organic pollutants and their analysis.	<b>(15)</b>
	<p><b>RECOMMENDED BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. A.K. De: Standard Methods of Waste and Waste water analysis.</li> <li>2. P. M. S. Monk Fundamentals of Electroanalytical chemistry-John Wiley &amp; Sons (2001)</li> <li>3. Instrumental methods of chemical analysis H. Kaur</li> <li>3. S.M. Khopkar, Environmental Chemistry ; Environmental pollution analysis</li> <li>4. M.S. Creos and Morr, Environmental Chemical Analysis, American publication(1988)</li> <li>5. A.K. De, Environmental Chemistry, New Age International publishers .Moghe and Ramteke, Water and waste water analysis : (NEERI)</li> <li>6. A.C. Stern, Air pollution: Engineering control Vol.IV(AP)</li> <li>7. P.N.Cheremisinoff and R.A.Young, Air Pollution control and Design. Hand Book Vol.I&amp;II (Dekker)</li> <li>8. R.B.Pohasek, Toxic and Hazardous waste disposal, Vol.I &amp; II (AAS)</li> <li>9. M.Sitting, Resources Recovery and Recycling, Handbook of industrial Waste.</li> <li>10. B.K.Sharma, Industrial Chemistry.</li> </ol>	



11. S.P.Mahajan, Pollution Control in Process Industries.

12. R.A.Horne, Chemistry of our Environment.

**DSC16CHE39: Analytical Chemistry Practical Course ACHP-V and ACHP-VI**

**(6 Credits) (150 Marks)**

**List of Experiments:**

**Major:**

1. Estimation of Sn, Zn, Cu and Pb from Bronze alloy (volumetric, gravimetric techniques can be used)
2. Estimation of Ca and Fe from milk powder
3. Analysis of Galena ore
4. Analysis of Benzoic acid and salicylic acid from medicated powder
5. Analysis of vitamin A in food products
6. Estimation of Aspirin
7. Kjeldahl's method of protein estimation in foods and feeds
8. Analysis of Lindane in BHC powder.
9. Determination of pK value of an indicator.
10. Polarographic estimation of traces of Cu, Cd, Ni, Zn and Fe in sample
11. To study the complex formation between Fe (III) and salicylic Acid and determine the stability constants of the complex by Job's variation
12. To determine the equivalence conductance and dissociation constant at infinite dilution independent of ionic mobility of weak electrolyte.
13. Any other suitable experiment may be added when required.

16. Estimation of Sulphur and Nitrogen.

**Minor:**

1. Analysis of plaster of Paris for calcium content

2. Fertilizer analysis for P (colorimetrically), K (Flame photometrically).

3. Determination of Barium ions by Turbidimetry.

4. Analysis of iodized table salt.

5. Analysis of soda ash.

6. Estimation of copper fungicide

7. Analysis of sulphur drug

8. Analysis of vitamin-C in juices and squashes.

9. Analysis of ethambutol

10. Identification of organic compounds by their IR spectra

11. Determination of strength of acetic acid in commercial vinegar by conductometric method

12. Determination of chloride content from saline water by potentiometry.

13. Estimation of bicarbonate and carbonate by potentiometric method.

14. Estimation of Fe by ceric sulphate and potassium dichromate titration potentiometrically

15. XRD and Thermal analysis Kaolinite, cobalt oxalate and zinc oxalate.

16. Estimation of vitamin B2 in the medicinal tablets fluorimetrically.

17. Kinetic study of hydrolysis of ethyl acetate in presence of OH<sup>-</sup> ions conductometrically

18. Determination of pK of given dibasic acid pH-metrically.

19. Determination of relative strength of acetic acid, chloroacetic acid and trichloroacetic acid

conductometrically.

(At least 10 major and 10 minor experiments should be carried out

**Jornal and Oral (20 Marks)**

**RECOMMENDED BOOKS:**

- 1 Textbook of Practical Inorganic Chemistry –Gurudeep Raj.
- 2 Practical Organic Chemistry – Mann & Saunders.
- 3 A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.

**RPR: DSC14CHE31**

**Research Project (4 Credits) (100 Marks)**

Research Project Paper Guidelines

1. The students should write a synopsis of the proposed research work.
2. The students should perform a detailed literature survey related to the research problem.
3. The students should write a review article related to the research problem.
4. It is expected to publish the review article in peer-reviewed journals.
5. The students should design the problem and start experimental work. The students should complete at least 25% of their experimental work during semester III and the same work to be continued in semester IV.
6. The student should submit the spiral-bound copy of research work carried out during semester III including the synopsis, research proposal, review article, and certified progress report.
7. The Research Project will be examined jointly by internal and external examiners during the practical examination at the end of the semester.
8. The students should present their work during the evaluation in the form of PowerPoint presentation (PPT).

Marking Scheme:

<b>Sr. No.</b>	<b>Description</b>	<b>Marks</b>
1	Synopsis	10
2	Research Proposal	20
3	Review article on proposed work	20
4	Daily Lab notebook record	10
5	Progress of Experimental work	20
6	Quality and effectiveness of presentation	20
	<b>Total</b>	<b>100</b>

### **Broad guidelines for the preparation of synopsis**

**A.** The proposed synopsis for research should be self-contained and should cover the rationale for carrying out research.

**B.** There should not be a repetition of the work topic or theme.

**C.** The synopsis of the proposed research shall contain the following points :

- 1 Title of the Research Proposal
- 2 Motivation with reasoning and significance of the proposed research
- 3 Statement of the problem
- 4 Review of the relevant literature
  1. Objectives of the study
  2. The methodology comprising
    - a) Methods of research
    - b) Sampling design and assumptions
    - c) Conceptual framework if any
    - d) Research design (explanation of how research is being conducted and the tools used for the same)
    - e) Methods of data collection
    - f) Methods of data analysis (use of parametric and non-parametric tools and techniques as the case may be)
  3. Expected outcome
  4. Bibliography.

### **Template for Research Proposal**

1. Title
2. Introduction
3. Origin of the research problem
4. Interdisciplinary relevance
5. Review of Research and Development in the Subject
6. Significance of the study
7. Objectives
8. Plan of research work

## M.Sc. Part-II ( Sem-IV) Analytical Chemistry

### Paper No. -XIII, DSC 16 CHE 41: ORGANIC INDUSTRIAL ANALYSIS (4 Credits)

#### Course Outcomes: After the completion of the course, the student will be able to:

- CO1:** Understand the concept of aromaticity in benzenoids, Hückle's rule, energy level of pi-molecular orbital, calculation of energies of cyclic and acyclic systems, different concepts of Hückle's as well as calculation of charge densities - PMO theory and reactivity index.
- CO2:** Adopt the knowledge about the path and to determine the rates of reactions by Kinetic and non-kinetic methods, steps involved, reaction rate determination, order and molecularity, Testing and trapping of intermediates, stereochemistry and Hammett Taft equation.
- CO3:** Learn about the Kinetic and thermodynamic control of reaction, they will get the knowledge about Nitration and sulphonation of naphthalene, about Wittig reaction, Enolization, F. C. reaction and Diel's Alder reaction. Understand non-classical carbonation - Formation, stability, reactivity and synthetic applications.
- CO4:** Understand the concept of Pericyclic reactions, Woodward Hoffman correlation diagrams - FMO, PMO approach, conrotatory and disrotatory motion. Also identify the reactions as  $4n$ ,  $4n+2$  and  $2+2$  addition of ketenes, sigmatropic shifts (3, 3) and (5, 5) Claisen and Cope and Aza Cope rearrangement.

<b>UNIT I</b>	<b>Industrial Analysis</b>  <b>A) Analysis of oils, fats and Soaps</b>  Introduction to natural fats and oils; isolation of oils from natural resources and their purification. Analysis of oils and fats: Softening point, Congeal point, Titre point, Cloud point, Iodine, saponification, acid,	<b>(15)</b>
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	<p>hydroxyl, R-M and Polenske value, Elaiden test, etc.</p> <p>Introduction to soaps, manufacture of soaps (in brief), analysis of soaps: total anhydrous soap and combined alkali, potassium, water, free fatty acids, saponifiable and non-saponifiable matter in soaps, estimation of phenol, copper and germicidal agents in soaps, determination of inorganic fillers and soap builders, and other additives, estimation of soap in detergents (THAM method)</p> <p><b>B) Analysis of Detergents</b></p> <p>Classification of detergents, analysis of raw materials, separation as alcohol soluble and alcohol insoluble matter, additives in detergent formulation (chlorides, sulfates, phosphates, silicates, borates, oxygen releasing substances, CMC, EDTA, etc.), their role and analysis; analysis of active ingredients in detergents (methylene blue and Hyamine-1622 method).</p>	
<p><b>UNIT II</b></p>	<p><b>Food and Food Additive Analysis</b></p> <p><b>A) Food Analysis</b> <span style="float: right;">Food</span></p> <p>flavors, food colors, food preservatives, analysis of milk and milk products, adulterants in milk and their identification, analysis of honey, jam and their major component. Practical applications and examples in analytical chemistry and research.</p> <p><b>B) Food Additive Analysis</b></p> <p>Additives in animal food stuff: Antibiotics: penicillin, chlorotetracyclin, oxytetracyclin in diet supplements; Identification and estimation of growth promoting drugs such as. Sulfaquinoxaline, methyl benzoquate, sulfanitran, pyrimethamine, nitrovin, nitrofurazone, acinitrazole, etc.</p>	<p><b>(15)</b></p>

<b>UNIT III</b>	<p><b>Analysis of cosmetics products</b></p> <p>Introduction to cosmetics, definition, types of cosmetics, background, development in cosmetic industry, issues in cosmetic industries (contamination and adulteration), future scope and role of analytical chemistry.</p> <p><b>A) Analysis of cream and lotions</b></p> <p>Composition of creams and lotions, determination of water, propylene glycol, non-volatile matter and ash content; estimation of borates, carbonates, sulphates, phosphates, chlorides, ammonia, nitro methane, oxalic acid, 4- hydroxyl benzoic acid, sodium iodate, free formaldehyde, H<sub>2</sub>O<sub>2</sub>, mercatoacetic acid, titanium and zinc oxides. Practical applications and examples in analytical chemistry and research.</p> <p><b>B) Analysis of face powder</b></p> <p>Composition of face powder, estimation of boric acid, Mg, Ca, Zn, Fe, Al and Ba. Analysis of deodorants and antiperspirants-composition, analysis of fats and fatty acids, boric acid, magnesium, calcium, zinc, iron, titanium, aluminium, phenol, methanamine, hexachlorophenone, sulphonates, urea, etc. Practical applications and examples in analytical chemistry and research.</p>	<b>(15)</b>
<b>UNIT IV</b>	<p><b>Analysis of Paints, pigments and petroleum products</b></p> <p><b>A) Analysis of Paints and pigments</b></p> <p>Composition of paint, preliminary inspection of sample, test on the total coating, separation and estimation of pigments, binder and thinner of latex paints; modification of binder, flash point of paints. Practical applications and examples in analytical chemistry and research.</p> <p><b>B) Analysis of petroleum products</b></p> <p>Introduction, constituents and petroleum fractionation, quality control; -</p>	<b>(15)</b>



	<p>specific gravity, viscosity, Cloud point, pour point, flash point, vapor pressure, Doctor test, sulphuric acid absorption, aniline point, and colour détermination, cloud point, pour point. Determination of water, neutralization value (acid and base numbers), ash content, sulphur and mercaptan sulphur. Determination of lead in petroleum; Analysis of coal and coke: Types, composition, preparation of sample, proximate and ultimate analysis calorific value by Bomb Colorimetry.</p>	
	<ol style="list-style-type: none"> <li>1. <b>RECOMMENDED BOOKS:</b></li> <li>2. S. R. Junk and H. M. Pancoast: Hand book of sugars(AVI)</li> <li>3. B. Bilot and B. V. Well: Perfumery technology (JW)</li> <li>4. I. M. Kolthoff: Treatise on Analytical Chemistry Vol. I and I</li> <li>5. D. Pearson: Laboratory techniques in food analysis.</li> <li>6. S. Ranganna: Handbook of Analysis and Quality control for fruits and vegetable products, 2nd Ed. (Mc Graw Hill.)</li> <li>7. Nicholls: Aids to the analysis of foods and drugs.</li> <li>8. G. J. Mountrey: Poultry product technology (AVI)</li> <li>9. Karamer Twig: Quality control for food industry (AVI)</li> <li>10. G. F. Longonan: the analysis of detergents and detergent products (JW)</li> <li>11. A. Davidsohn &amp; B. M. Mlwidaky : Synthetic detergents (Book center, Mumbai)</li> <li>12. M. Ash and L. Ash: A formulary of cosmetic preparations. (G. Goodwin)</li> <li>13. Kurl Bauer, Dorothea Garhe, Horst Surburg: Common fragrance and flavour materials, (VCH publisher, New York)</li> </ol>	

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|--|---|--|
|  | <p>14. F. J. Welcher: Standard Methods of Chemical analysis Vol I &amp; II (6th Ed.)</p> <p>15. S. N. Mahendru: Analysis of food products (Swan Publishers)</p> |  |
|--|---|--|

**Paper No. - XV, DSC 16 CHE 42: ADVANCED METHODS IN  
CHEMICAL ANALYSIS**

**(4 Credits)**

**Course Outcomes: After the completion of the course, the student will be able to:**

- CO1:** Adopt the knowledge of about stereoselective, stereospecific synthesis as well as chemoselective and regioselective reactions -enantioselective synthesis, reactions with hydride donor, catalytic hydrogenation via chiral hydrazones and oxazolines etc.
- CO2:** Understand the stereochemistry of acyclic and alicyclic compounds. Understand in depth stability and reactivity of diastereoisomers - Curtin-Hammett principle. Some aspects of stereochemistry of ring compounds. The shapes of the rings other than six membered rings. Also, they will learn the conformational effects in medium sized rings and the concept of I-strain.
- CO3:** Knowledge about conformation and configuration fused bicyclic rings and bridged rings - Types, Nomenclature, stereochemical restrictions, and Bredt's rule. Understand O. R. D. and C. D. - Types of curves, circular dichroism, the Octane rule and axial haloketone rule.
- CO4:** Explain the stereochemistry of Allenes, Spiranes, and Biphenyls and how to assign the configuration and by using physical and chemical methods.

**UNIT I**

**Fluorescence and Phosphorescence Spectrophotometry**

**(15)**

Fluorimetry, types of luminescence, Instrumentations, theories of fluorescence and phosphorescence, electronic transition, structural factors,

	<p>solvatochromism, solvation dynamics, faith of excited molecules, solvent effect on fluorescence, effect of intermolecular process,</p> <p>Fluorescence anisotropy and time domain fluorescence life time measurements. Relation between concentration with fluorescence and phosphorescence intensity, fluorescence quenching mechanism, resonance energy transfer. Chemiluminescence, Fluorescence sensing, Synchronous spectrum, Fluorescent nanomaterials. Practical applications, examples and problems in analytical chemistry and research.</p>	
<b>UNIT II</b>	<p><b>Kinetic Methods</b></p> <p>Theoretical basis of kinetic methods of analysis, methods of determining amount of the substance, Tangent Method, Fixed Time and Concentration method. Addition Method, Oxidation Reactions of H<sub>2</sub>O<sub>2</sub> with thiosulphate, iodide and amino, Enzyme catalyzed reactions. Inhibitors and Activators.</p>	<b>(15)</b>
<b>UNIT III</b>	<p><b>Photoelectron spectroscopy</b></p> <p>Basic principles, photoelectric effects, Photoionization process, Koopman's theorem, photoelectron spectra of simple molecules, ESCA, chemical shift, Auger electron spectroscopy - basic idea.</p>	<b>(15)</b>
<b>UNIT IV</b>	<p><b>X-ray spectroscopy</b></p> <p>Introduction, X-Ray generation, Properties of X-radiation, X-Ray, Instrumentation, X-Ray Absorption, Fluorescence and Diffraction methods of analysis and their applications.</p>	<b>(15)</b>
	<p><b>RECOMMENDED BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Gary D Christian, Analytical chemistry 6th edition. John Willey and sons INC (2003) H.</li> <li>2. Kaur, Instrumental Methods of Chemical Analysis. Pragati</li> </ol>	

Prakash an, Meerut.

3. W H Willard, L L Merritt and J A Dean, Instrumental Methods of Analysis.
4. S. M.Khopkar, Basic Concepts in Analytical Chemistry.
5. D. Skoog and D. West, Principle of Instrumental Analysis.  
Holl Seamlers
6. E. Berlin, Principles and Practice of X-Ray Spectrometric Analysis, Plenum, NewYork.
7. J. Winefordner, S. Schulman and T O Haver :Luminescence Spectrometry in
8. Analytical Chemistry.Wiely Interscience NewYork.
9. H. Mark and G Rachnitz, Kinetics in Analytical chemistry. Interscience NY.
10. 8.Gary D Christian,Analytical chemistry 6th edition.John Willey and sons INC (2003)
11. Engineering chemistry, R Gopalan, G. S. Nagrajan.
12. 10 Engineering chemistry B. K. Sharma

### **ELECTIVE PAPERS-1**

**Paper No. -XVI(A), DSE16CHE41: APPLIED ANALYTICAL CHEMISTRY**

**(4 Credits)**

**Course Outcomes: After the completion of the course, the student will be able to:**

	<p><b>CO1:</b> Learn the classification and isolation methods of natural products. Reveal the classification and isolation methods of terpenoids-structure and synthesis of Camphor, Carvone, Abietic acid, zingiberene, alpha-santonin and <math>\beta</math>-caryophyllene.</p> <p><b>CO2:</b> Know all about Alkaloids - the occurrence, isolation, structures, functions, stereochemistry and synthesis of the major Alkaloids like-Morphine, Reserpine, Atropine and Conin.</p> <p><b>CO3:</b> Learn the occurrence, nomenclature, basic skeleton of steroids and study the synthesis of hormones like cholesterol, Androsterone, Testosterone, Estrone etc. Study the nomenclature, classification, biogenesis, physiological effects and synthesis of prostaglandin PGE2 and PGF2.</p> <p><b>CO4:</b> Study about the Vitamins - Classification, Nomenclature, Source, effects due to deficiency, synthesis and biological functions of vitamin B1, B2, B5, B6 and Biotin i.e. vitamin H.</p>	
<b>UNIT I</b>	<p><b>Spectrochemical Methods of Analysis</b></p> <p>Introduction to spectrochemical methods. Electronic spectra and molecular structure, NIR spectrometry for nondestructive testing. Solvents for spectrometry, FTIR spectrometer, Fluorimetry, optical sensors. Analysis of ores -bauxites, dolomites, monazites. Analysis of Portland cement.</p>	<b>(15)</b>
<b>UNIT II</b>	<p><b>Analysis of metals and alloys</b></p> <p>Introduction, Foundry materials, ferroalloys, and special steels, slags, fluxes. Analysis of alloys ,bronze, brass, Alnico and Nichrom</p>	<b>(15)</b>
<b>UNIT III</b>	<p><b>Analysis of soil and fertilizers</b></p> <p>Introduction, Method of soil analysis, soil fertility its determination, determination of inorganic constituents of plant materials, Chemical analysis as measure of soil fertility, analysis of fertilizers.</p>	<b>(15)</b>
<b>UNIT IV</b>	<p><b>Analysis of Commercial materials</b></p> <p>Introduction, Analysis of explosive materials, TNT, RDX, lead azide, EDNA (ethylene dinitramine).Analysis of conducting polymer, resins and</p>	<b>(15)</b>

	rubber. Analysis of luminescent paints, Analysis of lubricants and adhesive.	
	<p><b>RECOMMENDED BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Hillebrand Lhundel, Bright and Hoffiman, Applied Inorganic Analysis, John Wiley.</li> <li>2. Snell and Biffen, Commercial Methods of Analysis.</li> <li>3. P.G. Jeffery, Chemical Methods of Rock Analysis, Pergamon.</li> <li>4. Buchel, Chemistry of Pesticides. J Wiley.</li> <li>5. Rieche, Outlines of Industrial Organic Chemistry, ButterWorth.</li> <li>6. F.A.Henglein, Chemical Technology, Pergamon.</li> <li>7. Kent, Riegl's Industrial Chemistry, Rainhold.</li> <li>8. Chopra and Kanwar, Analytical Agriculture Chemistry, Kalyani Publishers.</li> <li>9. Aubert and Pintes, Trace Elements in Soils.</li> <li>10. Bear, Chemistry of Soil.</li> <li>11. Hauson, Plant Growth Regulators, Noyes.</li> <li>12. P.G.Jeffery and D.J. Hutchinson, Chemical Methods of Rock Analysis.</li> <li>13. F.J.Weleher, Standard Methods of Chemical Analysis, A Series of Volumes Robert and Krigeger Publishing Company.</li> <li>14.I. M. Colhoff and PJ Ewing, Treatise o Analytical Chemistry, A series of Volumes.</li> <li>15. R.D. Reeves and R.R. Brooks, Trace element Analysis of Geological Materials, John Wiley &amp; Sons NewDehli.</li> <li>16. W.M. Johnson and J.A.Maxwell, Rock and Mineral Analysis, John Wiley and Sons, New York.</li> <li>17. W. F. Hildebrand, G H C Landell and HABrighot, Applied Inorganic Analysis, John Wiley 2nd Edition.</li> <li>18. K. J. Das, Pesticide Analysis(MD).</li> </ol>	

**Paper No. -XVI (B), DSE 16 CHE 42 (B): QUALITY ASSURANCE AND**

**ACCREDITATION (4 Credits)**

<b>UNIT I</b>	<b>Quality Assurance</b>  Introduction to Quality Control and quality assurance: Concepts and significance. Quality control and statistical techniques: Quality control charts, the X-quality control chart, the R-quality control chart and its interpretation, spiked sample control charts, use of blind samples in quality control, use of proficiency evaluations in quality control. Calibration and maintenance of Instruments Equipment: 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 spectrophotometer, pH meter, conductivity meter, IR spectrophotometers, AAS, GC, HPLC etc.,). Maintenance of instruments and equipment.	<b>(15)</b>
<b>UNIT II</b>	<b>Documentation for Quality Assurance: Raw Data</b>  Type of notebooks, control of notebook distribution and data entry. General Reagents and volumetric reagents. Sampling – sampling methods, sample labelling, and sample login/register. Sample analysis, reporting, recording and personal training. Instrument calibration and maintenance. Analytical report, Personnel, training, records - professional personnel, technician personnel. Filing quality assurance documentation. Good laboratory practices and personnel, Quality Programme, Instrument and Organisation calibration, Customer Satisfaction.	<b>(15)</b>
<b>UNIT III</b>	<b>Documentation for Quality Assurance: Raw Data</b>  Computers and quality assurance: Sample handling. Data Acquisition. Quality control data and calculations. Computer generated analytical reports. Security considerations. Hardware and software. Establishing a Quality Type of notebooks, control of notebook distribution and data entry. General Reagents and volumetric reagents. Sampling – sampling	<b>(15)</b>

	<p>methods, sample labelling, and sample login/register. Sample analysis, reporting, recording and personal training. Instrument calibration and maintenance. Analytical report, Personnel, training, records - professional personnel, technician personnel. Filing quality assurance documentation. Good laboratory practices and personnel, Quality Programme, Instrument and Organization calibration, Customer Satisfaction. Assurance program: Management commitment. Define the quality assurance program. Writing standard operating procedures. Topics for standard operating procedures. Consolidating the programme. Monitoring the program - monitoring quality assurance data, reporting quality assurance problems. Writing the quality assurance manuals.</p>	
<b>UNIT IV</b>	<p><b>Quality Accreditation</b></p> <p>Laboratory Accreditation: Need for laboratory accreditation. International aspects of laboratory accreditation and in India. Criteria for laboratory accreditation. Benefits of laboratory accreditation, Evolution and significance of Quality Management, Background to ISO 9000, comparison between ISO-9001, ISO-9002 &amp; ISO-9003., ISO 9000-2000 series of standards on quality management system, - evolution of series of standards, introduction to ISO organization, and Registration / certification- benefits of QMS certification. Structure of ISO 9000-2000 family of standards. Advantages of ISO 9000-2000. Requirements of ISO 9001-2000 QMS and applications, Steps for effective implementations. Significance of ISO - 9001, 9002, 9003 &amp; 9004. Requirements of ISO9000/ IS14001. Concepts of OHSMS (BS 8800) Quality Management Principles in QMS, QMS documentation, Quality Manual, Quality policy, conformities and Nonconformities.</p>	<b>(15)</b>
	<p><b>RECOMMENDED BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Handbook of Quality Assurance for the analytical chemistry laboratory, James P. Dux, Van Nostrand Reinhold, New York, 1986.</li> <li>2. Applying ISO-9000 Quality Management Systems, International</li> </ol>	



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
4. Training manuals on ISO 9000 / 2000 PQM, Gerhard J Giyani, Raj Publishing House, 2001
5. Quality Assurance in Analytical Chemistry, B.W. Wenclawiak, Springer, India, 2004.

**M.Sc. Part-II (Sem-IV)**

**DSC16CHE49: Analytical Chemistry Practical Course ACHP-VII and ACHP - VIII**  
**(4 Credits)**

**List of Experiments:**

**Major**

1. Cement analysis
2. Analysis of Chrome steel alloy for Cr and Ni content
3. Analysis of bauxite ore to estimate the amount of silica, aluminium and iron.
4. Estimation of salicylic acid and zinc oxide from medicated powder
5. Determination of saponification value and iodine value of oil
6. Estimation of amount of copper (II) with EDTA spectrophotometrically.
7. Simultaneous spectrophotometric determination of Cr and Mn
8. Analysis of milk.

9. Analysis of some common pesticides, insecticides, plastics and detergents.
10. Estimation of Urea, Uric acid and creatinine in Urine.
11. Estimation of blood sugar, calcium and total nitrogen and non-protein nitrogen in blood.
12. Studies on the effect of substituent at ortho position of benzoic acid on its equilibrium constant pH metrically.
13. Agricultural analysis of soil sample, animal feeds, soil micronutrients, milk powder for Ca, Fe and P content.

**Minor**

1. Estimation of Fe from soil sample
2. Analysis of Na and K from soil sample
3. Determination of chemical oxygen demand of water sample (dye solution)
4. Estimation of lactose from milk sample
5. Determination of flash point of oil/fuel
6. To estimate the amount of glycine from amino acid
7. To determine the amount of alkali content of antacid tablet titrimetrically
8. Determination of dissociation constant of weak acid pH-metrically.
9. Estimation of Zn in the given solution fluorimetrically.
10. Determination of pK of tribasic acid, by potentiometry.
11. Determination of critical micelle concentration of given surfactants

conductometrically

12. Estimation of acetyl salicylic acid in the given aspirin tablet by titrating against 0.1N alcoholic KOH potentiometrically.

13. To determine the acid base dissociation constant and isoelectric point of amino acid pH metrically

14. (Any other experiments may be added when required.)

(At least 6 major and 6 minor experiments should be carried out. More time should be given to project work)

**A) Project:**

Projects on contemporary issues of societal significance which should include literature survey, synthesis, reaction mechanism and kinetics, analysis of air, water and soil samples, solid state materials, energy generation and storage materials, nanochemistry, green chemistry, organic materials, organo-metallic, bioinorganic materials, novel materials etc. The Project/Review work (50 Marks) will be examined jointly by internal and external examiners at the time of practical examination.

(Any other experiments may be added when required.)

**Study tour is compulsory for M.Sc. Part- II Students to visit Chemical Industries in India.**

**Journal and Oral (10 Marks)**

**RECOMMENDED BOOKS:**

1. A Textbook of Practical Inorganic Chemistry – Gurudeep Raj.
2. Practical Organic Chemistry – Mann & Saunders
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke

<b>RPR14CHE41</b>		
<b>RESEARCH PROJECT: (6 CREDITS) (150 MARKS)</b>		
<ol style="list-style-type: none"><li>1. The student should submit the final bound dissertation/thesis copy of research work carried out during semester III and IV.</li><li>2. It should include title page, certificate, declaration, acknowledgement, abbreviations, index, abstract, introduction, experimental section, results and discussion, conclusions, references, participation in conferences/seminars and publications if any.</li><li>3. The students should present their work during the evaluation in the form of power point presentation (PPT).</li></ol>		

• **Marking Scheme:**

Sr. No.	Description	Marks
1	Dissertation/thesis bound copy	30
2	Quality of work ( Innovative concepts, social relevance, extent of work etc.)	50
3	Publications	20
4	Participation in conferences	10 maximum
	a) Oral/Poster Presentation (10 marks)	
	b) Only attended (7 marks)	
5	Final Dissertation/thesis defence	40
	<b>Total</b>	<b>150</b>

**Note:**

1. The Project will be examined jointly by internal (Project Supervisor) and external examiners (preferably Associate professor and above with Ph. D.) at the end of the semester. The project can be given individually or a maximum group of three students is allowed. (Not more than three students allowed).
2. There will be a industrial visit for M.Sc. Part- II Students during the academic year.



*S.D. Shirke*  
 Dr. (Mrs). S, D, Shirke  
**HEAD**  
 DEPARTMENT OF CHEMISTRY  
 VIVEKANAND COLLEGE, KOLHAPUR  
 (EMPOWERED AUTONOMOUS)