

Rayat Shikshan Sanstha's  
Karmaveer Bhaurao Patil College Vashi, Navi Mumbai  
(Autonomous)

Name of the Faculty: Science and Technology

Name of the Program: Masters in Science

Program Outcomes (POs)

PO-1	<b>Disciplinary Knowledge and Skills:</b> Acquire the comprehensive and in-depth knowledge of various subjects in sciences such as Physics, Chemistry, Mathematics, Microbiology, Bio-analytical Science, Computer Science, Data Science, Information Technology and disciplinary skills and ability to apply these skills in the field of science, technology and its allied branches.
PO-2	<b>Communication and Presentation Skills:</b> Develop various communication skills including presentation to express ideas evidently to achieve common goals of the organization.
PO-3	<b>Creativity and Critical Judgement:</b> Facilitate solutions to current issues based on investigations, evaluation and justification using evidence based approach.
PO-4	<b>Analytical Reasoning and Problem Solving:</b> Build critical and analytical attitude in handling the problems and situations.
PO-5	<b>Sense of Inquiry:</b> Curiously raise relevant questions based on highly developed ideas, scientific theories and its applications including research.
PO-6	<b>Use of Digital Technologies:</b> Use various digital technologies to explore information/data for business, scientific research and related purposes.
PO-7	<b>Research Skills:</b> Construct, collect, investigates, evaluate and interpret information/data relevant to science and technology to adapt, evolve and shape the future.
PO-8	<b>Application of Knowledge:</b> Develop scientific outlook to create consciousness against the social myths and blind faith.
PO-9	<b>Moral and Ethical Reasoning:</b> Imbibe ethical, moral and social values to develop virtues such as justice, generosity and charity as beneficial to individuals and society at large.
PO-10	<b>Leadership and Teamwork:</b> Work cooperatively and lead proactively to achieve the goals of the organization by implementing the plans and projects in various field-based situations related to science, technology and society at large.
PO-11	<b>Environment and Sustainability:</b> Create social awareness about environment and develop sustainability for betterment of future.
PO-12	<b>Lifelong Learning:</b> Realize that pursuit of knowledge is a lifelong activity and in combination with determined efforts, positive attitude and other qualities to lead a successful life.

  
Program  
Coordinator


  
BOS Chairman

  
Principal

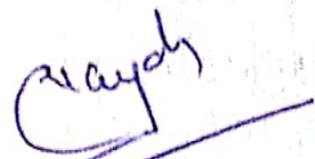
Name of the Faculty: Science and Technology  
Name of the Specific Program: MSc Chemistry  
Program Specific Outcomes (PSO)



PSO-1	Advanced knowledge of the topics which can develop the problem solving skills using chemical principles.
PSO-2	Understand advanced instrumental techniques and its applications in characterization and chemical reactions.
PSO-3	To inculcate the professional, ethical values, environmental aspects in various fields of chemistry.
PSO-4	Develop research skills through dissertation/Project work in different fields of chemistry

  
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**Title of Specific Program:**  
M.Sc. Analytical Chemistry

Course Code	Title of Course	Course Outcome
		After successful completion of each course in Chemistry a learner should be able to;
<b>Semester-I</b>		
PGCH101	Physical Chemistry	<ol style="list-style-type: none"> <li>To discuss concept of quantization, quantum numbers and degeneracy of energy level, kinetics and mechanism of chain reaction (2).</li> <li>To explain concept of classical thermodynamics and quantum chemistry (2).</li> <li>To deduce Maxwell equations and Schrodinger wave equation (4).</li> <li>To summarize basics of electrochemistry (2).</li> </ol>
PGCH102	Inorganic Chemistry	<ol style="list-style-type: none"> <li>To derive wave functions, construct molecular orbital diagram, and Symmetry adapted linear combinations (SALC) for polyatomic species (5,6)</li> <li>To analyse VBT, molecular symmetry and applications of group theory (4,5)</li> <li>To discuss the various aspects of materials chemistry, nanomaterials and co-ordination chemistry (2)</li> <li>To interpret the electronic spectra of co-ordination compounds (3)</li> </ol>
PGCH103	Organic Chemistry	<ol style="list-style-type: none"> <li>To apply the thermodynamic and kinetic requirements of a reaction (3).</li> <li>To explain nucleophilic substitution reactions and aromaticity (2)</li> <li>To determine stereochemistry of molecules with two or more chiral centres (2)</li> <li>To predict the reaction mechanism by using various oxidizing and reducing reagents (4)</li> </ol>
PGCH104	Analytical Chemistry	<ol style="list-style-type: none"> <li>To apply the various spectroscopic techniques for qualitative and quantitative analysis (3)</li> <li>To understand various terms used in analytical chemistry and hyphenated techniques (2)</li> <li>To determine the concentration of unknown sample by spectroscopic methods. (2)</li> <li>To interpret the thermo-gravimetric curves of various samples (4)</li> </ol>
PGCHP101	Physical Chemistry Practical	<ol style="list-style-type: none"> <li>To understand how to determine the heat of solution at different temperature, ionic strength of various inorganic salts (2)</li> <li>To evaluate kinetics of the reactions. (5)</li> <li>To understand various methods of graph plotting.</li> <li>To understands various instrumental techniques.</li> </ol>
PGCHP102	Inorganic Chemistry Practical	<ol style="list-style-type: none"> <li>To synthesize and characterize various inorganic complexes (5).</li> <li>To determine the electrolytic nature and equilibrium constants of inorganic compounds. (2)</li> </ol>



PGCHP103	Organic Chemistry Practical	<ol style="list-style-type: none"><li>1. To plan the synthesis of organic compounds. (4,6)</li><li>2. To know safety aspects including MSDS. (1)</li><li>3. To calculate stoichiometric requirement (5)</li></ol>
PGCHP104	Analytical Chemistry Practical	<ol style="list-style-type: none"><li>1. To estimate the amount of Cr (III), Fe(II), alloy sample by complexometric titration. (5)</li><li>2. To determine the breakthrough capacity of a cation exchange resin (2)</li></ol>
<b>Semester-II</b>		
PGCH201	Physical Chemistry	<ol style="list-style-type: none"><li>1. To describe the fugacity of real gases using graphical method, equation of state, and various mixing properties (2)</li><li>2. To deduce various equations in modern thermodynamics, surface chemistry and quantum chemistry. (4)</li><li>3. To construct probability density curves, radial and angular plots for different orbitals. (4,6)</li><li>4. To understand chemical kinetics, molecular reaction dynamics, solid state chemistry and phase equilibria (2)</li></ol>
PGCH202	Inorganic Chemistry	<ol style="list-style-type: none"><li>1. To explain the methods of determining rate of reaction and inorganic reaction mechanism (2)</li><li>2. To apply Eighteen and sixteen electron rules for various organometallic compounds (3,5)</li><li>3. To discuss the environmental concepts of heavy metals (2)</li><li>4. To understand various concepts in bioinorganic chemistry (2)</li></ol>
PGCH203	Organic Chemistry	<ol style="list-style-type: none"><li>1. To understand the basic concept of molecular orbital theory, UV-Visible and IR spectroscopic techniques. (2)</li><li>2. To predict the reaction mechanism of various rearrangement reactions (4)</li><li>3. To illustrate various alkylating agents using carbanion intermediate (2)</li><li>4. To understand and apply various spectroscopic techniques for predicting organic compounds (2,4,5)</li></ol>
PGCH204	Analytical Chemistry	<ol style="list-style-type: none"><li>1. To understand concepts in chromatography, spectroscopic and radio - analytical techniques. (2)</li><li>2. To study the different types of surface analytical techniques. (2)</li><li>3. To evaluate electro analytical techniques (5)</li><li>4. To summarize the instrumentation of selected analytical techniques (2)</li></ol>
PGCHP201	Physical Chemistry Practical	<ol style="list-style-type: none"><li>1. To construct polar plots of atomic orbitals, phase diagram. (4,6)</li><li>2. To evaluate the transition temperature and rate constant of chemical reactions. (5)</li><li>3. To measure physical parameters of chemical reaction using various instrumental techniques. (5)</li></ol>
PGCHP202	Inorganic Chemistry Practical	<ol style="list-style-type: none"><li>1. To analyse various ore and alloy for metal contents (4)</li><li>2. To estimate amount of metal potentiometrically in given sample. (5)</li></ol>
PGCHP203	Organic Chemistry Practical	<ol style="list-style-type: none"><li>1. To separate given binary mixture. (4)</li><li>2. To identify separated organic components by microscale technique. (2,5)</li></ol>
PGCHP204	Analytical Chemistry Practical	<ol style="list-style-type: none"><li>1. To analyse the fertilizer sample using flame -photometry</li><li>2. To determine amount of various metal ions by using different analytical techniques (2)</li></ol>

### Semester-III

PGCHA301	Quality In Analytical Chemistry - I	<ol style="list-style-type: none"> <li>1. Students should understand and the concept of sampling. Pre-treatment of sampling. Incorrect analytical results, method validation.(2)</li> <li>2.To integrate Measurement of uncertainty Signal to noise, requirements for maintenance and calibration (6)</li> <li>3.To summarise various chromatographic techniques and its applications.(2)</li> <li>4.To generalize Pharmaceutical Legislation (2)</li> </ol>
PGCHA302	Advance Instrumental Techniques	<ol style="list-style-type: none"> <li>1. To Understand Principle instrumentation and applications of the various Spectral Methods (2)</li> <li>2. To correlate various advanced Electro analytical Techniques.(3)</li> <li>3. To explain different advance analytical techniques.(2)</li> <li>4. To interpret and correlate different instrumental techniques.(3, 4)</li> </ol>
PGCHA303	Bio-analytical Chemistry and Food Analysis	<ol style="list-style-type: none"> <li>1. To describe &amp; analyse various Composition of body fluids.(2,4)</li> <li>2. To illustrate general processes of immune response, antigen-antibody, reactions, precipitation reactions, radio, enzyme.(2)</li> <li>3. To determine fuel value of food and importance of food nutrients.(3)</li> <li>4. To analyse various food products- Milk, Oils, fats and spices.</li> </ol>
PGCHA EC-II 304	Pharmaceutical and Organic Analysis	<ol style="list-style-type: none"> <li>1. To understand general idea regarding the different process in Pharmaceutical Industry.</li> <li>2. To evaluate and correlate various methods for drug analysis.</li> <li>3 To judge &amp; apply method of analysis in forensic sciences &amp; toxic materials.</li> <li>4. To illustrate Cosmetic formulation, standards and methods of analysis.</li> </ol>
PSCHA3P1 Group-A	Bio-analytical Chemistry and Food Analysis Practical	<ol style="list-style-type: none"> <li>1. To determine and estimate pK value of an indicator, copper and bismuth in mixture by photometric titration</li> <li>2. To estimate strength of strong acid, weak acid mixture by conductometer.</li> <li>3. To apply pH metric techniques for analysis of various mixture of salts</li> </ol>
PSCHA3P2 Group-B	Pharmaceutical and Organic Analysis Practical	<ol style="list-style-type: none"> <li>1. To estimate amount of drugs in different sample using non-aqueous, fluoride in a tooth paste, cholesterol and Uric acid in</li> <li>2. To deduce percentage purity of different indicators used in chemistry</li> </ol>
PSCHA3P3 Group-C	Bio-analytical Chemistry and Food Analysis Practical	<ol style="list-style-type: none"> <li>2.To analyse lactose in milk, reducing sugars before and after inversion in honey</li> <li>3.To estimate Caffeine in tea, Vitamin C in lemon, Iodine value of oil / fat</li> </ol>
PSCHA3P4 Group-D	Pharmaceutical and Organic Analysis Practical	<ol style="list-style-type: none"> <li>1. To analyse Pyrolusite for: Fe (colorimetry), Mn (volumetry), Mg (complexometry), Ti (Colorimetry) / Al (gravimetry) / Fe (volumetry)</li> <li>2. Analysis of water sample: Total hardness and salinity, Acidity and sulphate (Benzidine method).</li> </ol>

**Semester - IV**



PGCHA401	Quality in Analytical Chemistry	<ol style="list-style-type: none"> <li>1. Student should be able to understand the theory and application of, solvent extraction, microfiltration, ultrafiltration, reverse osmosis, dialysis and electro-dialysis.</li> <li>2. To evaluate physical, chemical, spectral and toxicological standardization, qualitative and quantitative estimations.</li> <li>3. To explain emerging green technologies: photochemical reactions (advantages and challenges), examples.</li> <li>4. To study Introduction to Nanotechnology, analytical techniques in nanotechnology, consequences of the nanoscale, (nanoparticles morphology,</li> </ol>
PGCHA402	Advanced Instrumental Techniques	<p>Unit I: Separation Science</p> <ol style="list-style-type: none"> <li>1. To understand the theory, Instrumentation and application of NMR, Raman, Auger electron, Ultraviolet photoelectron spectroscopy.</li> <li>2. To correlate between ESCA &amp; Auger spectroscopy.</li> <li>3. To illustrate the theory, instrumentation and application of mass spectroscopy, Raman Spectroscopy.</li> <li>4. To study theory, instrumentation and applications of Neutron Activation Analysis, Thermal Analysis, Evolved gas analysis.</li> <li>5. To explain theory, Instrumentation and application of Hyphenated techniques- GC – MS, ICP -MS, GC - IR, Tandem Mass Spectrometry, LC – MS, HPLC-MS, CE-MS</li> </ol>
PGCHA403	Selected Topics in Analytical Chemistry	<ol style="list-style-type: none"> <li>1. To discuss various methods of treatment of waste water, permissible limits and removal of heavy metals from waste water.</li> <li>2. To understand the solid waste management process.</li> <li>3. To explain classification, impurities and impact of plastic on environment.</li> <li>4. To analyse geochemical materials and alloys- Dolomite, Ilmenite, Monazite, Hematite, Pyrolusite, Stainless Bronze and Gun metal, Solder alloy</li> </ol>
PGCHIE-I 404	Research methodology	<ol style="list-style-type: none"> <li>1. To understand various terminologies like Journal abbreviations, abstracts, current titles, reviews etc.</li> <li>2. To deduce information related given subject from digital sources available online.</li> <li>3. To analyse and present data of studied material using various calculative methods, tools and software.</li> <li>4. To publish scientific work done by using ethics and avoiding plagiarism.</li> <li>5. To demonstrate disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals</li> </ol>
PGCHAP401 Group – A	Quality in Analytical Chemistry Practical	<ol style="list-style-type: none"> <li>1. To determine pK value of H<sub>3</sub>PO<sub>4</sub> potentiometrically</li> <li>2. To estimate Na<sup>+</sup> in dairy whitener by flame photometry</li> <li>3. To analyse pH of buffer solution. And Simultaneous determination of Fe<sup>3+</sup> and V<sup>5+</sup> spectrophotometrically by H<sub>2</sub>O<sub>2</sub> method.</li> <li>5. To estimate Bronze for Zn by complexometric method.</li> </ol>
PGCHAP402 Group – B	Advanced Instrumental Techniques Practical	<p>Students can learn:-</p> <ol style="list-style-type: none"> <li>1. To analyse drugs and detergents.</li> <li>2. To determine the purity of crystal Violet Indicator</li> <li>3. To estimate of waste water sample for heavy metals by AAS.</li> </ol>
PGCHAP403 Group – C	Selected Topics in Analytical Chemistry	<ol style="list-style-type: none"> <li>1. To identify Calcium, Iron and Phosphorous in milk sample</li> <li>2. To Determine SAP value of oil.</li> <li>3. To estimate aldehyde in lemon grass oil / Cinnamon oil &amp; glucose by Folin-Wu method.</li> </ol>



	practical	4 To analyse $Mn^{2+}$ in water sample by colorimetric method.
PGCHAP404 Group - D	Project Evaluation	1. To develop research attitude &. Presentation Skill. 2. To inspire mind towards applied research.

Numbers in bracket ( ) indicates cognitive levels of revised Blooms Taxonomy as follows:

(1): Remembering, (2): Understanding, (3): Applying, (4): Analysing, (5): Evaluating, (6): Creating

Sr. No	Course Code	Name of Course Coordinator	Signature
SEM-I			
1	PGCH101	Dr. B. S. Shinde	
2	PGCH102	Dr. V. A. Thakur	
3	PGCH103	Dr. G.C. Wadhwa	
4	PGCH104	Dr. R.D. Mohite	
5	PGCHP101	Dr. B. S. Shinde	
6	PGCHP102	Dr. V. A. Thakur	
7	PGCHP103	Dr. L. V. Gavali	
8	PGCHP104	Dr. G.C. Wadhwa	
SEM-II			
9	PGCH201	Dr. B. S. Shinde	
10	PGCH202	Dr. V. A. Thakur	
11	PGCH203	Dr. G.C. Wadhwa	
12	PGCH204	Dr. R.D. Mohite	
13	PGCHP201	Dr. B. S. Shinde	
14	PGCHP202	Dr. V. A. Thakur	



15	PGCHP203	Dr. L. V. Gavali	
16	PGCHP204	Dr. G.C. Wadhwa	
SEM-III			
17	PGCHA301	Dr. R.D. Mohite	
18	PGCHA302	Dr. B. S. Shinde	
19	PGCHA303	Dr. B. S. Shinde	
20	PGCHA EC-II 304	Dr. G.C. Wadhwa	
21	PSCHA3P1	Mr. S. Y. Salunkhe	
22	PSCHA3P2	Mr. S. Y. Salunkhe	
23	PSCHA3P3	Mr. P. U. Mane	
24	PSCHA3P4	Mr. P. U. Mane	
SEM-IV			
25	PGCHA401	Dr. R.D. Mohite	
26	PGCHA402	Dr. B. S. Shinde	
27	PGCHA403	Dr. B. S. Shinde	
28	PGCHIE-I 404	Dr. G.C. Wadhwa	
29	PGCHAP401	Mr. S. Y. Salunkhe	
30	PGCHAP402	Mr. S. Y. Salunkhe	
31	PGCHAP403	Mr. P. U. Mane	
32	PGCHAP404	Mr. P. U. Mane	

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