Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce, and Science College, Ahmednagar
(Autonomous)
(Affiliated to Savitribai Phule Pune University, Pune)

National Education Policy (NEP)
Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of

Chemistry (Minor) - II Year

Implemented from

Academic Year 2024-25

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Chemistry

Sr. No.	Name	Designation
1.	Prof. Dr. D. R. Thube	Chairman
2.	Asso. Prof. P. S. Mutkule	Member
3.	Asso. Prof. S. B. Dare	Member
4.	Dr. S. J. Takate	Member
5.	Asst. Prof. P. B. Gaikwad	Member
6.	Asst. Prof. A. V. Karande	Member
7.	Dr. N. R. Dhatrak (SPPU)	Vice-Chancellor Nominee
8.	Dr. B. B. Shingate (BAMU, Aurangabad)	Academic Council Nominee
9.	Dr. S. S. Kolekar (Shivaji University,Kolhapur)	Academic Council Nominee
10.	Dr. P. C. Mhaske (S. P. College, Pune)	Alumni
11.	Dr. D. N. Sawant (NCL, Pune)	Industry Expert

1. Prologue/ Introduction of the programme:

Academics and research in India is a priority which depends upon the quality of education. Quality higher education include innovations that can be useful for efficient governance of higher education institutions, systems and society at large. Fundamental approach to learning outcome-based curriculum emphasizes upon demonstration of understanding, knowledge, skills, attitudes and values in particular programme of study. This approach is intended to follow flexibility and innovation in design of the programme, its assessment and expect graduate attributes demonstrating the level of learning outcome. It is expected to provide effective teaching – learning strategies including periodic review of the programme and its academic standard. The learning outcome-based curriculum for B.Sc. degree in Chemistry is designed to address the needs of the students with chemistry as the core subject of study. The curriculum is expected to assist in the maintenance of the standard of chemistry degrees/programmes and periodic programme review within a broad framework of agreed/expected graduate attributes qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework is intended to allow flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students learning levels.

This curriculum for the bachelor-level program in Chemistry is developed keeping in view of the student centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for Chemistry-related careers, careers with general graduate-level aptitude and for higher education in Chemistry and allied subjects. Augmented in this curriculum are graduate attributes including critical thinking, scientific reasoning, moral ethical reasoning, qualification descriptors that are specific outcomes pertinent to the discipline of chemistry, learning outcomes for individual courses, pedagogical methods and assessment methods. While designing syllabus, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in education section, this syllabus foster implementation of modern pedagogical tools

and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. The framework is designed such a way to enable the learners implementing the concepts to address the real world problems. The curriculum focuses on issues pertinent to India and also of the west; for example, green chemistry and biomaterials etc. Curriculum are holistic and aim to mould responsible Indian citizen to have reflective thinking, scientific temper, and digital literacy in order to acquire requisite skill to be self-employed entrepreneurial.

2. Programme outcomes for B.Sc. Chemistry

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

Programme Outcomes

· To understand the basic facts and concepts in Chemistry
· To understand the importance of Chemistry in daily life.
· To develop a better understanding and reasoning of facts.
· Gain the knowledge of Chemistry through theory and practicals.
· To skill-up for basic analytical tools.
· To skill-up for various laboratory techniques used in pharmaceutical laboratories and chemical industries.
· To make efficient for various spectrometric analyses
· Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.
· Solve the problem and also think methodically, independently and draw a logical conclusion.
· Employ critical thinking and the scientific knowledge to design, carry out, record and analyses the results of chemical reactions.
· Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
· Find out the green route for chemical reaction for sustainable development.
· To inculcate the scientific temperament in the students and outside the scientific community.
· Use modern techniques, decent equipment's and Chemistry software's
· Use modern chemical tools, Models, Chem-draw, Charts and Equipment's.
· To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.
· Identify chemical formulae and solve numerical problems.
· Know structure-activity relationship.
· Understand good laboratory practices and safety.

· Develop research-oriented skills.
· Make aware and handle the sophisticated instruments/equipment's

Credit Distribution: B.Sc. Chemistry including Minor and OE and other courses.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Research
Major Chemistry	Discipline-Specific Courses (DSC)	46	74	66
	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other Courses	Open Elective (OE)/ Multidisciplinary Courses	12	12	12
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

Programme Framework (Courses and Credits): B.Sc. Chemistry (Minor)

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	MNR-1	BS-CH101	Basics of Chemistry-I	03
2.	I	II	4.5	MNR-2	BS-CH201	Basics of Chemistry-II	03
3.	II	III	5.0	MNR-3	BS-CH301	Chemical Science -I	03
4.	II	IV	5.0	MNR-4	BS-CH401	Chemical Science -II	03
5.	III	V	5.5	MNR-5	BS-CH501	DEF	04
6.	III	VI	5.5	MNR-6	BS-CH601	GHI	04
							20

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Syllabus

B.Sc. Chemistry (Minor)

Title of the Course: Chemical Science - I								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-3	BS-CH 301 T/P	02	01	03	60	30	70	100

Learning Objectives:

1. To understand periodic table and trends in periodic properties for s and p block elements.
2. To understand concept of bonding and their types.
3. To learn volumetric estimation.
4. Analysis of commercial product.
5. To understand chromatographic technique.
6. To know removal of errors during chemical analysis.

Course Outcomes (Cos)

1. Understand rules for filling electrons in various orbitals and understand periodicity in properties of elements.
2. Learn types of chemical bonding.
3. To know about data analysis used in chemical analysis.

Detailed Syllabus:

Unit I: Periodic Table and Periodicity of Elements (10)

Periodic table: periodic table after 150 years
Review on the eve of the international year of periodic table [IYPT]. Periodicity of elements: Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations, Long form of periodic table: s, p, d and f block elements. Detailed discussion of following properties of elements with reference to s and p block: Effective nuclear charge, shielding effect, Atomic and ionic radii, Crystal radii, Covalent radii, Ionization energies, Electronegativity, Pauling's Electronegativity scale, Oxidation states of elements.

Unit II: Chemical Bonding (10)

Attainment of stable electronic configurations.
Types of Chemical bonds: Ionic, covalent, coordinate and metallic bonds.
Ionic Bond: General characteristics of ionic bonding, Types of ions, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, polarizing power and polarizability. Fajan's

rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bond: Valence Bond Approach, Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. VSEPR theory, Assumptions, need of theory, application of theory to explain geometries of molecules such as i) ClF_3 ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$

Unit III: Errors in Quantitative Analysis (10)

Introduction, accuracy, precision, methods of expressing accuracy and precision: errors, Absolute and Relative error, mean, average and standard deviations, classifications of errors, minimization of errors, limitations of analytical methods, significant figures and computation reliability of results and numerical.

Suggested Readings/Material:

1. Concise Inorganic Chemistry by Lee, J.D., ELBS, 1991.
2. Basic Inorganic Chemistry by Cotton, F.A., Wilkinson, G. & Gaus, P.L., 3rd edition, Wiley.
3. Concepts and Models in Inorganic Chemistry by Douglas, B.E., McDaniel, D.H., John Wiley & Sons.
4. Inorganic Chemistry: Principles of Structure and Reactivity by Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K., Pearson Education India, 2006.
5. Basic Concept of Analytical Chemistry by S. M. Khopkar.

Detailed Syllabus: Practical (1 Credit)- Six Experiments

1. Separation of ink/dye by paper chromatography.
2. Separation of leaves pigment by paper chromatography.
3. Separation of metal ions by column chromatography.
4. Estimation of Ca from calcium supplementary tablet by Complexometric titration.
5. Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ syrup
6. Estimation of selectively Cu (II) from brass alloy by iodometrically (Use KIO_3 as primary Standard for standardization of $Na_2S_2O_3$).
7. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.
8. Determination of basicity of oxalic acid hence determination equivalent weight.
9. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

Suggested Readings/Material:

1. Vogel's Textbook Quantitative Chemical Analysis, 5th Ed.
2. Experiments in Chemistry by D. V. Jahagirdar, Himalaya Publication.
3. Vogel's Quantitative Chemical Analysis by Mendham, J., Pearson, 2009.
4. Senior Practical Physical Chemistry by Khosla, B. D.; Garg V. C. & Gulati A., R.Chand & Company, New Delhi, 2011.

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Syllabus

B.Sc. Chemistry (Minor)

Title of the Course: Chemical Science -II								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-4	BS-CH 401 T/P	02	01	03	60	30	70	100

Learning Objectives:

1. To study various concepts in chemical kinetics such as rate law, mechanism, order, molecularity and activation parameters.
2. To correlate coordination number and structure of complex ions.
3. To explain various types of organic reactions on the basis of the structure of the product. organic qualitative analysis of binary mixture

Course Outcomes (Cos)

1. Learn the basic concept of elementary reactions in chemical kinetics.
2. Apply IUPAC nomenclature, to coordination compound, differentiate between primary and secondary valency.
3. Know the different types of organic reactions.
4. To Understand electrophilic / nucleophilic substitution reactions, addition, elimination and rearrangement.

Detailed Syllabus:

Unit I: Chemical Kinetics **(10)**

Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws and rate constants, reaction order and molecularity, determination of rate law, factors affecting reaction rates, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), half-life period, Reaction dynamics - collision theory and transition-state theory of bimolecular reactions, comparison of the two theories and numerical.

Unit III: Introduction to Coordination Compounds **(10)**

Double salt and coordination compound, basic definitions: coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio; Werner's work and theory, Effective atomic number, equilibrium constant, chelate effect, IUPAC nomenclature.

Unit II: Types of Organic Reactions: Substitution Reactions (10)

Types: Addition, elimination, substitution, rearrangement with definition.
Addition reaction: to carbon-carbon double bond and triple bond, carbon oxygen double bond with examples of each. Elimination reaction: to form double, triple bonds with examples. Substitution reaction: electrophilic and nucleophilic substitutions reactions. Rearrangement reaction: Pinacol and Beckmann.

Suggested Readings / Material:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th Ed.
2. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania, 46th Ed. Vishal Publishing Company, 2013.
3.Principles of Physical Chemistry by S.H. Maron and C. F. Prutton, 4th Edition, Macmillan, New York, 1964.
4. Concise Inorganic Chemistry by J. D. Lee, 5th Ed (1996) Blackwell Science
5. Inorganic Chemistry by James E. House, Academic Press (Elsevier), 2008
6. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
7. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, 2nd edition, Oxford University Press, 2012.
8. Fundamentals of Organic Chemistry by McMurry J.E., 9th edition, Cengage Learning UK, 2018.
9. Organic Chemistry by Bruice Paula, 8th Edition, Pearson Education, USA, 2016.

Detailed Syllabus: Practical (1 Credit)

1. To study the acid catalyzed hydrolysis of an ester (methyl acetate) and determine the rate constant (K). (First order reaction).
2. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.
3. To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life method following the kinetics of persulfate-iodide reaction.
4. Preparation of Hexammine nickel(II)Chloride.
5. Preparation of potassium trioxalatoferrate (III).
6. Preparation of chloropentaammine cobalt chloride.
7. Nitation of acetanilide to p-Nitroacetanilide.
8. Bromination of acetanilide using KBr and CAN (Green Chemistry Approach)
9. Bromination of Cinnamic acid to 2,3-Dibromo,3-phenyl propanoic acid.

Suggested Readings / Material:

1. Experimental Physical Chemistry by Athawale and Parul Mathur, New Age International Publication, 2001.
2.Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publishing House, 2018.
3. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
4. Experiments in Chemistry by D. V. Jahagirdar, Himalaya Publication.
5. Vogel A. I. Qualitative Organic Analysis, 4th edition (ELBS).