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)

Implemented from

Academic Year 2023-24

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.	Dr. A. E. Athare	Chairman
2.	Asso. Prof. P. S. Mutkule	Member
3.	Asso. Prof. S. B. Dare	Member
4.	Dr. S. J. Takate	Member
5.	Asst. Prof. A. V. Karande	Member
6.	Dr. B. B. Shingate (BAMU, Aurangabad)	Academic Council Nominee
7.	Dr. S. S. Kolekar (Shivaji Uni.,Kolhapur)	Academic Council Nominee
8.	Dr. N. R. Dhatrak(SPPU)	Vice-Chancellor Nominee
9.	Dr. P. C. Mhaske (S. P. College ,Pune)	Alumni
10.	Dr. D. N. Sawant (NCL, Pune)	Industry Expert

Prologue/ Introduction of the programme:

Academics and research in India is a priority which depends upon the quality of education. Quality higher education includes 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 programmes of study. This approach is intended to follow flexibility and innovation in design of the programme, its assessment and expected 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 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 Chemistryrelated 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 the education sector, this syllabus fosters implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e- learning platforms. The framework is designed in 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 mold responsible Indian citizens to have reflective thinking, scientific temper, and digital literacy in order to acquire requisite skill to be self employed entrepreneurial.

2. Programme Outcomes (POs)

1.PO-1: **Disciplinary knowledge and skill:** A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related

soft-wares for chemical analysis, characterization of materials and in separation technology.

PO-2: **Skilled communicator:** The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

PO-3: **Critical thinker and problem solver:** The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out,record and analyze the results of chemical reactions. Students will be able to think and apply evidence based comparative chemistry approaches to explain chemical synthesis and analysis.

PO-4: **Sense of inquiry:** It is expected that the course curriculum will develop inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

PO-5: **Team player:** The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situations and industry.

PO-6: **Skilled project manager:** The course curriculum has been designed in such a manner as to enable a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO-7: **Digitally literate:** The course curriculum has been designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO-8: **Ethical awareness:** A graduate student requires understanding and developing ethical awareness or reasoning which is adequately provided through the course curriculum.

PO-9: **Environmental Awareness:** As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to

understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO-10: **Lifelong learner:** The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

PO-11: **Analytical skill development and job opportunity:** The course curriculum is designed in such a way that Chemistry graduate students can handle many Chemistry based software, decent instruments and advanced technologies to synthesize, characterize and analyze the chemical compounds very skillfully. Such a wonderful practice in the graduate level will bring a

good opportunity to the students for getting jobs in industries besides academic and administrative works.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Researc h
Major	Discipline-Specific Courses (DSC)	46	74	66
Marathi	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	Open Elective (OE)/ Multidisciplinary	12	12	12
Courses	Courses			
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

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

Sr. No	Voor	Samasta	Lovo	Cour	Course Code	Title	Cradita
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		r	1	se			
				Туре			
1.	Ι	Ι	4.5	MN	BS-CH101	Basics of	03
				R-1		Chemistry - I	
2.	Ι	II	4.5	MN	BS-CH201	Basics of	03
				R-2		Chemistry - II	
3.	II	III	5.0	MN	BS-CH301	Chemistry of	03
				R-3		Cosmetics and	
						Perfumes	
4.	II	IV	5.0	MN	BS-CH401	Dairy and	03
				R-4		Agriculture	
						Chemistry	
5.	III	V	5.5	MN	BS-CH501	Food	04
				R-5		Adulteration	
6.	III	VI	5.5	MN	BS-CH601	Soil and Water	04
				R-6		Analysis	
							20

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

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's New Arts, Commerce and Science College, Ahmednagar (Autonomous) Syllabus B.Sc. Chemistry (Minor)

Title of the Course: Basics of Chemistry I								
Year: I				Semester: I				
Course Type	Course Code	Credit Dis	Credit Distribution					
		Theory Prac		Credits	Allotted Hours	Allotted Marks		
			Practical			CIE	ESE	Tota 1
MNR-1	BS-CH101 T/P	02	01	03	60	30	70	100

Learning Objectives:

- 1. To understand basics of gaseous and liquid state.
- 2. To learn thermodynamic concepts.
- 3. To prepare solutions of different concentration.

Course Outcomes (Cos)

- 1. Understand derivatives and Integration.
- 2. Learn and master in graph and logarithm.
- 3. Acquainted with fundamentals of thermodynamics
- 4. Understand basics of gaseous and liquid state.

Detailed Syllabus: Example

Unit I: Gaseous and Liquids State: -

Ideal and non- ideal gases, deviation of gases from ideal behavior, compressibility factor (Z), van der Waal's equation of state and its application to explain deviation of gases. Critical constant of gas in terms of van der Waal's constant, Experimental determination of Pc, Tc and Vc, Reduced equation of state, Law of corresponding state. Measurable physical properties of liquid such as vapour pressure, Surface tension and viscosity and their experimental determination (One method of each).

Unit II : Chemical Thermodynamics: -

Second law of thermodynamics, Carnot cycle, mechanical efficiency, Entropy changes for system and surroundings for reversible and irreversible processes, Entropy changes for an ideal gas in isothermal, isobaric and isochoric changes, Entropy Changes in chemical reactions. Entropy changes accompanying fusion.

Unit III : Stoichiometry

i) Mole concept, Determination of mole wt. By gram molecular volume relationship, problems based on mole concept ii) Methods of expressing concentrations, strength, Normality, Molarity

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& Molality, ppm. iii) Standardization of solutions, primary and secondary standard substances. iv) Preparation of standard solution of acids and bases, problems related to acid base titrations only.

Suggested Readings/Material:

- 1. Mathematical preparation for physical Chemistry By F. Daniel, Mc. Graw Hill publication.
- 2. University General Chemistry. By C.N. R. Rao Mc. Millan Publication.
- 3. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
- 4. Physical Chemistry. By G.M. Barrow.
- 5. College Chemistry by Linus Paulling (Page 165 to 171)

6. Calculation of Analytical Chemistry by Hamilton, Simpson & Ellis 7th Edn. (Pages 154 – 199)

7. Quantitative Inorganic Analysis by A.I Vogal. (Page 257-262) 4) Analytical Chemistry by G.D. Christian relevant pages.

Detailed Syllabus: Practical (1 Credit)

1. Determination of heat capacity of calorimeter for different volumes.

2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

- 3. Determination of enthalpy of ionization of acetic acid.
- 4. Determination of integral enthalpy of solution of KNO₃ or NH₄Cl.
- 5. Determination of enthalpy of hydration of copper sulphate.
- 6. To draw polar plots of s orbitals.

7. To draw polar plots of p orbitals.

Suggested Readings/Material:

1. Practical Chemistry, Panday, Bjpai, Giri, S.Chand and Co.

2. Khosla, B. D.; Garg V. C. & Gulati A., Senior Practical Physical Chemistry, R.Chand & Company, New Delhi, 2011.

3. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

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Title of the Course: Basics of Chemistry II									
Year: I Semester: I									
Course Type	Course Code	Credit Distribution							
		Theory Pr	Practical	Credits	Allotted Hours	Allotted Marks			
						CIE	ESE	Tota 1	
MNR-2	BS-CH101 T/P	02	01	03	60	30	70	100	

Learning Objectives:

- 1. Understand the fundamental concepts of structure, bonding, properties of organic molecules.
- 2.To know the reactivities of organic molecules such as covalent character, hybridization, bond angles, bond energies, bond angles, bond polarities, shapes of molecules.
- 3.To know the terms related to classification of elements, their properties and different theories of bonding.

Course Outcomes (Cos)

- 1. Learn to correlate the properties of organic molecules with their structure.
- 2. Learn the chemistry of different functional groups.
- 3. Classification of elements depending on entries of Valency electrons viz s, p, d & f block Elements.
- 4. Definition of different types of bonds with example.

Detailed Syllabus:

Unit I: Structure and Bonding in Organic Molecules (06) Unique Properties of organic compounds, applications of organic compounds. Covalent bond, Hybridization in organic molecules (sp3, sp2, sp), bond length, bond angles, bond energies, localized & delocalized chemical bond, Vander-Waal's interactions, Inter & Intra molecular forces & their effects on physical properties. Structural effects like inductive, resonance, hyper conjugation, steric effect, Hydrogen bonding. Organic acids and bases; their relative strengths.

Unit II: Chemistry of functional groups

Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions of: Alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, amines.

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Unit III: 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. The long form of periodic table-s, p, d, and f block elements. A detailed discussion of the following properties of elements with reference to s and p block a. Effective nuclear charge, shielding or screening effect b. Atomic

and ionic radii c. Crystal radii d. Covalent radii e. Ionization energies f. Electronegativity, Pauling's / electronegativity scale g. Oxidation states of elements

Unit IV: Chemical Bond and Reactivity

(06)

Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis dot structure, Sidgwick Powell Theory, basic VSEPR theory: Assumptions, need of theory, application of the theory to explain geometry of irregular molecules like H2O, NH3, TiCl4, CIF3, ICl2, BrF3, BrF5, OF2 Limitations of VSEPR theory. Concept of hybridization

i) Definition, need of hybridization, steps involved in Hybridization, Explanation of covalency of atoms in the molecules on the basis of hybridization, types of hybridization involving S, P orbitals and S, P, d orbitals

Applications of hybridization concept, geometries of molecules like BeF2 CH4, BF3, SiCl4, PCI5, IF7, SF6, [Ni (CN)4]2-

Suggested Readings/Material:

- 1. Organic Chemistry by Clayden, Oxford uni.press.
- 2. Organic Chemistry by Morrison & Boyd, 6th Edition.
- 3. Concise Inorganic Chemistry By J.D. Lee, Chapman & Hall 5th Ed.
- 4. Advanced Inorganic Chemistry by Satya Prakash Tuli, Basu & Madan 6th edn
- 5. Calculation of Analytical Chemistry by Hamilton, Simpson & Ellis 7th Edn.

Practicals:

- 1) Purification of Organic Compounds and recording physical constant (Three compounds)
 - i) Crystallization ii) Sublimation iii) Distillation.
- 2) Analysis of given Organic Compounds (Minimum Four Compounds)
 - i) Type Determination.
- ii) Recording of physical constants.
- iii) Determination of functional groups.
- 3) Inorganic Chemistry Practicals (Any Two)
 - i) To standardize NaOH solution & hence find the strength of given HCl solution.
 - ii) To standardize KMnO4 soln. & hence find strength of the given solution.
 - iii) Estimation of sodium carbonate present in a Detergent.
 - iv) Determination of basicity of boric acid or oxalic acid or citric acid hence determination of their equivalent weight.

Suggested Reading:- Organic Chemistry by Vogel.