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

B.Sc. Chemistry (Major)

Implemented from

Academic Year 2023-24

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

Type of Courses		III Yr	IV Yrs (Honours)	IV Yrs Research
Major Marathi	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

B. Sc. Programme Framework: Credit Distribution

Year	Semester	Level	Major											Minor	OE	CC	AEC	VEC	Total
			DSC		DSE		SEC		VSC		FP/ OJT /IN/ CEP		IKS						
I	I	4.5	T	P	T	P	T	P	T	P	T	P		T/ P	-	-	-	-	-
I	II	4.5	4	2	-	-	-	2	-	-	-	-	2	03	3	2	2	2	22
			6	-	-	-		2	-	2	-	-		03	3	2	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with Major and Minor																			
II	III	5.0	6	2	-	-		2	-	-	-	2		03	3	2	2	-	22
II	IV	5.0	6	2	-	-		-	-	2	-	2		03	3	2	2	-	22
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																			
III	V	5.5	8	2	2	2	-	-	-	2		2		04	-	-	-	-	-	22
III	VI	5.5	6	2	2	2	-	-	-	2		4		04	-	-	-	-	-	22

Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																				
IV	VIII	6.0	8	6	2	2	RM-4		-	-	-	-		-	-	-	-	-	-	-	22
IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4		-	-	-	-	-	-	-	22
Four Year UG Degree(Honours) with Major and Minor with 176 credits																				
IV	VIII	6.0	6	4	2	2	RM-4		-	-	-	4		-	-	-	-	-	-	-	22
IV	VIII	6.0	6	4	2	2	-	-	0	-	-	8		-	-	-	-	-	-	-	22
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																				

B. Sc. Programme Framework: Course Distribution

			Major																	
Year	**Semester**	**Level**	**DSC**		**DSE**		**SEC**		**VSC**		**FP/OJT/IN/CEP**		**IKS**	**Minor**		**OE**	**CC**	**AEC**	**VEC**	**Total**
I	-	-	T	P	T	P	T	P	T	P	T	P		T	P	-	-	-	-	-
I	I	4.5	**2**	**1**	**-**	**-**	**-**	1	**-**	**-**	**-**	**-**	1	1		1	1	1	1	10
	II	4.5	**2**	**-**	**-**	**-**		1	**-**	**1**	**-**	**-**		1		1	1	1	1	09
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																				
II	III	5.0	**2**	**1**	**-**	**-**		**1**	**-**	**-**	**-**	**1**		1		1	1	1	-	09
II	IV	5.0	**2**	**1**	**-**	**-**		**-**	**-**	**1**	**-**	**1**		1		1	1	1	-	09
Exit Option: Award of UG Diploma in Major with 88 credits and an \additional 4 credit core NSQF course /Internship or Continue with major and minor																				
III	V	5.5	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**		**1**		1		-	-	-	-	08
III	VI	5.5	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**		**1**		1		-	-	-	-	08
Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																				
IV	VII	6.0	**3**	**3**	**1**	**1**	**0**	**1**	**-**	**-**	**-**	**-**		**-**	**-**	-	-	-	-	09
IV	VIII	6.0	3	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**		**-**	**-**	**-**	**-**	-	-	09
Four Year UG Degree(Honours) with Major and Minor with 176 credits																				

IV	VII	6.0	**2**	**2**	**1**	**1**	**0**	**1**	-	-	-	**1**		-	-	-	-	-	-	08
IV	VIII	6.0	**2**	**2**	**1**	**1**	-	-	-	-	-	**1**		-	-	-	-	-	-	07
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																				

Programme Framework (Course Distribution): B.Sc. Chemistry (Major)

Year	Semester	Level	Major											Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/PR		IKS		
			T	P	T	P	T	P	T	P	T	P	T	T	P/PR
I	I	4.5	2	1	-	-	-	1	-	-	-	-	01	03	02
I	II	4.5	2	-	-	-		1	-	1	-	-		02	02
II	III	5.0	2	1	-	-		1	-	-	-	1		02	03
II	IV	5.0	2	1	-	-		-	-	1	-	1		02	03
III	V	5.5	2	1	1	1	-	-	-	1		1		03	04
III	VI	5.5	2	1	1	1	-	-	-	1		1		03	04
B.Sc. Honours															
IV	VII	6.0	3	3	1	1	RM-1		-	-	-	-		05	04
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1		04	05
B.Sc. Honours with Research															
IV	VII	6.0	2	2	1	1	RM-1		-	-	-	1		04	04
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1		03	04

Programme Framework (Credit Distribution): B.Sc. Chemistry (Major)

Year	Semester	Level	Major						Total
			DSC	DSE	SEC	VSC	FP/OJT /IN/CEP/RP	IKS	

			T	P	T	P	T	P	T	P	T	P	T	
I	I	4.5	4	2	-	-	-	2	-	-	-	-	02	10
I	II	4.5	6	-	-	-		2	-	2	-	-		10
II	III	5.0	6	2	-	-		2	-	-	-	2		12
II	IV	5.0	6	2	-	-		-	-	2	-	2		12
III	V	5.5	8	2	2	2	-	-	-	2		2		18
III	VI	5.5	6	2	2	2	-	-	-	2		4		18
IV	VII	6.0	8	6	2	2	RM -4		-	-	-	-		22
IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4		22
IV	VII	6.0	6	4	2	2	RM -4	-	-	-	-	4		22
IV	VIII	6.0	6	4	2	2	-	-	-	-	-	8		22

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

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	DSC-1	BS-CH111T	Physical and Analytical Chemistry - I	02
2.	I	I	4.5	DSC-2	BS-CH112T	Organic and Inorganic Chemistry - I	02
3.	I	I	4.5	DSC-3	BS-CH113P	Physical Chemistry Practical - I	02
4.	I	I	4.5	SEC-1	BS-CH114P	Organic Chemistry Practical - I	02
5.	I	I	4.5	IKS-1	BS-CH115T	History of Indian Chemistry	02
6.	I	II	4.5	DSC-4	BS-CH121T	Physical and Analytical Chemistry - II	03
7.	I	II	4.5	DSC-5	BS-CH122T	Organic and Inorganic Chemistry - II	03
8.	I	II	4.5	SEC-2	BS-CH123P	Inorganic Chemistry Practical - I	02
9.	I	II	4.5	VSC-1	BS-CH124P	Analytical Chemistry Practical - I	02
10.	II	III	5.0	DSC-6	BS-CH231T	Physical and Analytical Chemistry - III	03
11.	II	III	5.0	DSC-7	BS-CH232T	Organic and Inorganic Chemistry - III	03
12.	II	III	5.0	DSC-8	BS-CH233P	Physical Chemistry Practical - II	02
13.	II	III	5.0	SEC-3	BS-CH234P	Organic Chemistry Practical - II	02
14.	II	III	5.0	FP-01	BS-CH235P	Field Project	02

15.	II	IV	5.0	DSC-9	BS-CH242T	Physical and Analytical Chemistry - IV	03
16.	II	IV	5.0	DSC-10	BS-CH242T	Organic and Inorganic Chemistry - IV	03
17.	II	IV	5.0	DSC-11	BS-CH243P	Inorganic Chemistry Practical - II	02
18.	II	IV	5.0	VSC-2	BS-CH244P	Analytical Chemistry Practical - II	02
19.	II	IV	5.0	CEP-01	BS-CH245P	Material Analysis	02
20.	III	V	5.5	DSC-12	BS-CH351T	Physical and Analytical Chemistry - V	04
21.	III	V	5.5	DSC-13	BS-CH352T	Organic and Inorganic Chemistry - V	04
22.	III	V	5.5	DSC-14	BS-CH353P	Physical Chemistry Practical - III	02
23.	III	V	5.5	DSE-01	BS-CH355T	Industrial Chemistry OR Polymer Chemistry	02
24.	III	V	5.5	DSE-02	BS-CH356P	Organic Chemistry Practical – III OR Isolation of Natural Products	02
25.	III	V	5.5	VSC-3	BS-CH357P	Analytical Chemistry Practical - III	02
26.	III	V	5.5	FP-02	BS-CH358P	Field Project	02
27.	III	VI	5.5	DSC-15	BS-CH361T	Physical and Analytical Chemistry - VI	03
28.	III	VI	5.5	DSC-16	BS-CH362T	Organic and Inorganic Chemistry - VI	03
29.	III	VI	5.5	DSC-17	BS-CH363P	Inorganic Chemistry Practical - III	02
30.	III	VI	5.5	DSE-03	BS-CH364T	Chemistry of Biomolecules OR Environmental Chemistry	02
31.	III	VI	5.5	DSE-04	BS-CH365P	Biochemistry Practicals OR Environmental Chemistry Practical	02
32.	III	VI	5.5	VSC-4	BS-CH366P	Applied Chemistry Practicals	02
33.	III	VI	5.5	OJT-01	BS-CH367P	On Job Training	04

34.	IV	VII	6.0	DSC-18	BS-CH471T	Inorganic Chemistry - I	03
35.	IV	VII	6.0	DSC-19	BS-CH472T	Organic Chemistry - I	03
36.	IV	VII	6.0	DSC-20	BS-CH473T	Physical Chemistry - I	02
37.	IV	VII	6.0	DSC-21	BS-CH474P	Inorganic Chemistry Practical - I	02
38.	IV	VII	6.0	DSC-22	BS-CH475P	Organic Chemistry Practical - I	02
39.	IV	VII	6.0	DSC-23	BS-CH476P	Physical Chemistry Practical - I	02
40.	IV	VII	6.0	DSE-05	BS-CH477T	Chemical Biology OR Mathematics for Chemist	02
41.	IV	VII	6.0	DSE-06	BS-CH478P	Chemical Biology Practical OR Practicals in Bioanalytical Techniques	02
42.	IV	VII	6.0	RM-01	BS-CH479T/P	Research Methodology	04
43.	IV	VIII	6.0	DSC-24	BS-CH481T	Inorganic Chemistry - II	03
44.	IV	VIII	6.0	DSC-25	BS-CH482T	Organic Chemistry - II	03
45.	IV	VIII	6.0	DSC-26	BS-CH482T	Physical Chemistry - II	02
46.	IV	VIII	6.0	DSC-27	BS-CH482P	Inorganic Chemistry Practical - II	02
47.	IV	VIII	6.0	DSC-28	BS-CH482P	Organic Chemistry Practical - II	02
48.	IV	VIII	6.0	DSC-29	BS-CH482P	Physical Chemistry Practical - II	02
49.	IV	VIII	6.0	DSE-07	BS-CH485T	Organometallic and Inorganic Reaction Mechanism	02

						OR Material Characterizatio n Techniques	
50.	IV	VIII	6.0	DSE-08	BS-CH486P	Analytical Chemistry Practical OR Interpretation and Analysis of Spectra	02
51.	IV	VIII	6.0	OJT-02	BS-CH487P	On Job Training	04

B.Sc. Chemistry (Major Honours with Research)

34.	IV	VII	6.0	DSC-20	BS-CH471T	Inorganic Chemistry - I	03
35.	IV	VII	6.0	DSC-21	BS-CH472T	Organic Chemistry - I	03
36.	IV	VII	6.0	DSC-22	BS-CH473P	Inorganic Chemistry Practical - I	02
37.	IV	VII	6.0	DSC-23	BS-CH474P	Organic Chemistry Practical - I	02
38.	IV	VII	6.0	DSE-05	BS-CH475T	Physical Chemistry – I OR Mathematics for Chemist	02
39.	IV	VII	6.0	DSE-06	BS-CH476P	Physical Chemistry Practical – I OR Analytical Chemistry Practical	02
40.	IV	VII	6.0	RM-01	BS-CH477T/P	Research Methodology	04
41.	IV	VII	6.0	RP-01	BS-CH488P	Research Project	04
42.	IV	VIII	6.0	DSC-20	BS-CH481T	Inorganic Chemistry - II	03
43.	IV	VIII	6.0	DSC-21	BS-CH482T	Organic Chemistry - II	03
44.	IV	VIII	6.0	DSC-22	BS-CH483T	Physical Chemistry - II	02
45.	IV	VIII	6.0	DSC-23	BS-CH484P	Inorganic Chemistry Practical - II	02

46.	IV	VIII	6.0	DSE-07	BS-CH485P	Organic Chemistry Practical – II OR Interpretation and Analysis of Spectra	02
47.	IV	VIII	6.0	DSE-08	BS-CH486P	Physical Chemistry Practical – II OR Practicals in Bioanalytical Techniques	02
48.	IV	VIII	6.0	RP-02	BS-CH487P	Research Project	08

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 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 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.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Physical and Analytical Chemistry - I								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-1	BS-CH111T	02	00	02	30	15	35	50

Learning Objectives:

1. Able to apply thermodynamic principles to physical and chemical processes.
2. To understand the concept of chemical equilibrium.
3. Students will be acquainted with the fundamentals of Analytical Chemistry.

Course Outcomes (Cos)

1. Calculations of enthalpy, Bond energy, Bond dissociation energy, Resonance energy.
2. Understand the Variation of enthalpy with temperature –Kirchhoff's equation.
3. Chemical equilibrium will make students understand the relation between Free energy and equilibrium, factors affecting equilibrium constant. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant, Van't Haff equation and its applications.
4. Students will learn and master principles of Qualitative Analysis of Organic Compounds.

Detailed Syllabus:

Unit I: Chemical Energetics (08)

Review of thermodynamics, Laws of Thermodynamics. Principles and definitions of thermo chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of Absolute entropies of substances, problems.

Unit II: Chemical Equilibrium (08)

Introduction: Free Energy and equilibrium - Concept, Definition and significance Reaction Gibbs Energy, Exergonic and endergonic reaction. Perfect gas equilibrium, general case of equilibrium, relation between equilibrium constants, Molecular interpretation of equilibrium

constant. Response of equilibria to conditions- response to pressure, response to temperature, Van't Haff equation, Value of K at different temperatures, Problems.

Unit III: Calculations used in Analytical Chemistry (08)

What is analytical Chemistry, the analytical perspectives, Some important units of measurements-SI units, distinction between mass and weight, mole, millimole and Calculations, significant figures Solution and their concentrations- Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, Percent Concentration, part per million, part per billion, part per thousand, Solution –dilatants volume ration, functions , density and specific gravity of solutions, problems Chemical Stoichiometry, Empirical and Molecular Formulas, Stoichiometric Calculations, Problems.

Unit IV: Qualitative Analysis of Organic Compounds (06)

Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures. Analysis: Detection of nitrogen, sulfur, halogen and phosphorous by Lassigne's test. Purification of organic compounds: Introduction, recrystallization, distillation, sublimation.

Suggested Readings/Material:

1. Glasstone Samuel, Thermodynamics for Chemists, Affiliated East West Private Limited.
2. Bahl Arun, Bahl B S, Tuli G D Essentials of Physical Chemistry, S. Chand ,2016
3. Atkins Peter. W., Paula Julio.de, Keeler J., Atkin's Physical Chemistry, 11th Edition, Oxford University Press, 2018.
4. Ball D. W. Physical Chemistry, Thomson Press, Cenagage Learning,2011
5. Castellan G.W. Physical Chemistry ,4th Edition, Narosa ,2008
6. Maron Samuel H. and. Prutton Carl F, Principles of Physical Chemistry, 4th Edition,Collier Macmillan Ltd.
7. Christian G.D., Dasgupta P.K., Schug K. A., Analytical Chemistry, 7th edition, Wiley,2016.
8. Vogel A. I. Qualitative Organic Analysis, 4th edition (ELBS)
9. Skoog D. A, West D. M, Holler F J., Fundamentals of Analytical Chemistry, 9th edition,2009.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Organic and Inorganic Chemistry - I								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-2	BS-CH112T	02	00	02	30	15	35	50

Learning Objectives:

1.To understand electronic Effects and their role in deciding reactivity

2.To understand acid base concept and factors affecting acidity and basicity

3.To understand periodic table and trends in periodic properties for s and p block elements

4.To understand concept of bonding and their types

Course Outcomes (Cos)

1.Understand the fundamental principles of organic chemistry.

2.Learn the concept and trends in organic acids and bases.

3.Understand rules for filling electrons in various orbitals and understand periodicity in properties of elements.

4. Learn types of chemical bonding.

Detailed Syllabus:

Unit I: Fundamentals of Organic Chemistry (08)

Electronic Displacements: Inductive Effect, Resonance and Hyperconjugation. Physical Effects: Steric effect.Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocation, Carbanion, Carbene and Free Radicals. Aromaticity: Benzenoids and Hückel's rule, Antiaromaticity and Homoaromaticity.

Unit II: Strength of Organic Acids and Bases (07)

Introduction, Acids: Origin of Acidity in Organic Compounds, the influence of the solvent, simple saturated and unsaturated aliphatic carboxylic acids, substituted aliphatic acids, phenols, aromatic carboxylic acids, dicarboxylic acids, pKa and temperature, Bases: Aliphatic bases, Aromatic bases, heterocyclic bases.

Specific and General Acid – Base Catalysis: Specific and General Acid Catalysis, Specific and General Base Catalysis.

Unit III: Periodic Table and Periodicity of Elements (08)

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 IV: Chemical Bonding (07)

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) ClF3 ii) Cl2O iii) BrF5 iv) XeO3 v) XeOF4

Suggested Readings/Material:

1. Jonathan Clayden, Nick Greeves, and Stuart Warren, Organic Chemistry, 2nd edition, Oxford University Press, 2012
2. McMurry J.E. Fundamentals of Organic Chemistry, 9 th edition, Cengage LearningUK**,** 2016.
3. Bruice Paula, Organic Chemistry, 8 th Edition, Pearson Education, USA, 2016.
4. Vollhardt P., Schore N.Organic Chemistry, Macmillan Learning,8 th Edition, 2018.
5. Solomon T.W.G., Fryhle Craig B, Organic Chemistry, Wiley, 12 th Edition ,2016.
6. Loudon Marc, Parise Jim, Organic Chemistry,Macmillan Learning, 8th Edition,2016.
7. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
8. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd edition, Wiley.

9. Douglas, B.E., McDaniel, D.H., Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
10. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Physical Chemistry Practical - I								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-3	BS-CH113P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn Thermochemistry.
2. Atomic orbital drawing.
3. To understand Ionic Equilibrium.

Course Outcomes (Cos)

The practical course is in relevance to the theory courses to improve the understanding of the concepts.

1. It would help in development of practical skills of the students.
2. Use of microscale techniques is encouraged.
3. Techniques of enthalpy measurements.
4. To understand concept of Ionic equilibrium.
5. Orbital drawing.

Detailed Syllabus:

Unit-I Thermochemistry

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.

Unit-II Ionic Equilibria

6. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH meter.

7. Measurement of the pH of buffer solutions: Preparation of Sodium acetate- acetic acid buffer solutions and determine its buffer capacity.

8. Determine solubility of benzoic acid at different temperature and to determine ΔH of dissociation process.

Unit-III

9. To draw polar plots of s orbitals.

10. To draw polar plots of p orbitals.

Unit-IV

11. To study the variation of mutual solubility temperature with % concentration for the phenol - water system

12. To study the effect of added electrolyte on the critical solution temperature of phenol-water system and to determine the concentration of the given solution of electrolyte.

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.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

Syllabus

B.Sc. Chemistry (Major)

Title of the Course: Organic Chemistry Practical - I								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-1	BS-CH114P	00	02	02	60	15	35	50

Learning Objectives:

1.Purification of organic compounds

2.Preparations and mechanism of reactions involved

3. Practice of Lassigne's Test

4. Preparation by using principles of green synthesis

Course Outcomes (Cos)

1. Learn purification techniques in organic chemistry.

2. Learn and practice for type determination and Lassigne,s test

3. Develop skills for simple organic preparations

4. Understand importance of derivatization techniques

Detailed Syllabus:

Unit -I - Organic Purification Techniques (Any two)

Purification of organic compounds by

1. Crystallization (from water and alcohol)
2. Distillation (Two Compounds)
3. Sublimation (micro technique)

Unit - II Organic Qualitative Analysis (Four compounds)

To determine type and detection of extra elements (N, S, X) in organic compounds.

Unit - III Organic preparations

1. Bromination of acetanilide using KBr and CAN (Green Chemistry Approach)
2. Preparation of p-nitroacetanilide from acetanilide.(Nitration reaction)
3. Bromination of cinnamic acid by Green Chemistry Approach.
4. Preparation of Quinone from hydroquinone.(Oxidation reaction)

Unit - IV Derivatives of Functional group (Any Two)

1. Semicarbazone derivatives of aldehyde /ketone
2. Oxime derivative of aldehyde/ketone
3. 2,4-dinitrophenylhydrazone derivative of aldehyde/ketone.

Suggested Readings/Material:

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

2. Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell., Vogel's Textbook of Practical Organic Chemistry, John Wiley and Sons, New York,5th edition, 2005.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: History of Indian Chemistry								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
IKS-1	BS-CH115P	02	00	02	30	15	35	50

Learning Objectives:

1.Students will be able to know ancient chemistry.

2.Student will acquire the knowledge of ancient acid base concept.

3.Student will understand history of textile and pyro technology.

4.Student will understand the ancient metallurgical concept.

Course Outcomes (Cos)

1.To know ancient chemistry.

2.To acquire the knowledge of ancient acid base concept.

3.To understand history of textile and pyro technology.

4.To learn the ancient metallurgical concept.

Detailed Syllabus:

UNIT I: History of Chemistry:

Chemistry in practice as gleaned from the medical schools of ancient India, Qualities of compounds; formation of molecular properties in chemical compounds, Chemistry of colors, measures of weight and capacity, size of the minimum visible, Ideas of chemistry as in bṛhatsaṁhitā

UNIT II: Ancient Metallurgy

Arthaśāstra as the earliest text describing gold, silver, and other metals;

Processing of Gold, Silver, Copper, Iron, Tin, Mercury, and Lead as mentioned in the Indian texts in the ancient and Medieval Period

Zinc distillation as mentioned in *Rasārṇava* and *Rasaratnasamukāyā*

UNIT III : Textile Chemistry& Pyro Technology

Textile and Dyeing- Indian Specialities (Kutchi Embroidery, Cotton Textile etc.)

Ceramic Technology, Stone (Lapidary), Shell, Ivory, Faience & Glass Technology

UNIT IV: Acids and Bases

Concepts of acid and bases in Indian chemistry from organic fruit, vegetable-based. Acids, plant-ash-based bases to mineral acids of the medieval period

Suggested Readings/Material:

1.The Positive Sciences of the Ancient Hindus; BrijendraNath Seal; 4th Edition; 2016

- Fine Arts & Technical Sciences in Ancient India with special reference to Someśvara's Mānasollāsa; Dr. Shiv Shekhar Mishra, Krishnadas Academy, Varanasi 1982

2. Mints and Minting in India; Upendra Thakur; Chowkhanba Publication; 1972

- A Concise History of Science in India, ed. D M Bose, S N Sen and B V Subbarayappa; INSA; 2009

3.Science and Technology in Medieval India - A Bibliography of Source Materials in Sanskrit, Arabic and Persian by A Rahman, M A Alvi, S A Khan Ghori and K V Samba Murthy; 1982.

4.Science and Technological Exchanges between India and Soviet Central Asia (Medieval Period), ed B V Subbarayappa;1985

5.Scientific and Technical Education in India, 1781-1900 by S N Sen; 1991

- History of Technology in India, Vol. I, ed. A K Bag (1997); Vol III, ed. K V Mital (2001);Vol-II by Harbans Mukhia (2012).

6.'Knowledge traditions and practices of India', Kapil Kapoor, Michel Danino, CBSE, India.

7.A history of Hindu Chemistry, Prafulla Chandra Ray,Kurukshetra Prakashan.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Physical and Analytical Chemistry - II								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-4	BS-CH121T	03	00	03	45	30	70	100

Learning Objectives:

1. Able to apply mathematical concept to chemical processes.
2. To understand the concept of ionic equilibrium.
3. Students will be acquainted with the atomic structure and chromatographic techniques.

Course Outcomes (Cos)

1. To learn basics of chemical mathematics.
2. To understand concept to ionization process occurred in acids, bases.
3. To understand the fundamentals of analytical chemistry.
4. To learn principles of chromatographic techniques.

Detailed Syllabus:

Unit I: Chemical Mathematics (10)

Logarithm: - Rules of logarithm, Characteristic and mantissa, Change of sign and base, Problems based on pH and pOH. Graphical representation of equations: Rules for drawing graph co-ordinates etc., Equation of straight line, slope and intercept, plotting the graph from the data of chemical properties and problems. Derivative: - Rules of differentiation and partial differentiation, Algebraic, logarithmic and exponential functions and problems. Integration: - Rules of integration, Algebraic and exponential functions and problems.

Unit II: Ionic Equilibria (13)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis - calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Unit III: Atomic Structure (12)

Origin of Quantum Mechanics: Why study quantum mechanics? Quantum mechanics arose out of interplay of experiments and Theory Energy quantization- i) Black body radiation ii) The photoelectric effect iii) Wave particle duality-a) The particle character of electromagnetic

radiation b) the wave character of particle, iv) diffraction by double slit v) atomic spectra, Bohr's theory and its limitations, Heisenberg Uncertainty principle.
Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it, Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular nodes and their significance. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number and magnetic spin quantum number.

Unit IV: Chromatographic Techniques Paper and Thin Layer Chromatography (10)

Introduction to chromatography, IUPAC definition of chromatography. History of Chromatography- Paper chromatography, Thin Layer Chromatography, Thin Layer Chromatography: Theory and principles, outline of the method, surface adsorption and spot shape, Comparison of TLC with other forms of chromatography, adsorbents, preparation of plates, application of samples, development. Paper Chromatography- Origin, overview of technique, sample preparation, types of Paper, solvents, equilibrium, development, sample application and detection, Identification, Quantitative methods, applications of paper chromatography. Column Chromatography: Theory and principles, outline of the method, sample preparation, column preparation, solvents, equilibrium, sample application, development and detection, Identification.

Suggested Readings/Material:

1. Mathematical preparation for physical Chemistry By F. Daniel, Mc. Graw Hill publication.
2. Glasstone Samuel, Thermodynamics for Chemists, Affiliated East West Private Limited.
3. Bahl Arun, Bahl B S, Tuli G D Essentials of Physical Chemistry, S. Chand ,2016
4. Atkins Peter. W., Paula Julio.de, Keeler J., Atkin's Physical Chemistry, 11th Edition, Oxford University Press, 2018.
5. A. Braithwaite and F. J. Smith, Chromatographic methods, 5th edition, Kluwer Academic Publishers, 1996.
6. Christian G.D., Dasgupta P. K., Schug K. A., Analytical Chemistry, 7th edition, Wiley , 2016.
7. Skoog D. A, West D. M, Holler F J., Fundamentals of Analytical Chemistry, 9th edition,2009.
8. Fifield F.W., Kealey D., Principles and Practice of Analytical Chemistry, Fifth Edition, Blackwell Science, 2000.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Organic and Inorganic Chemistry - II								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-5	BS-CH122T	03	00	03	45	30	70	100

Learning Objectives:

1. The students will understand the fundamental principles in chemistry.
2. To familiarize with current and recent developments in chemistry.
3. To create interest in research.

Course Outcomes (Cos)

1. Know the types of organic reactions and basics of organometallic compounds.
2. Understand nucleophilic substitution reactions.
3. Aquent the concept of oxidation, reduction and redox reactions.
4. Understand Acid -Base concepts according to different theories and introductory ideas of chemical toxicology.

Detailed Syllabus:

Unit I: A - Types of Organic Reactions (12)

Types of organic reactions: 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.

B - Organometallic compounds

Organomagnesium compound: Structure, preparation, reactions with aldehyde, ketone, ester, amide, acid chloride, nitrile, epoxide, carbon dioxide.

Organocopper compound: Structure, preparation, reaction with alkyl halide, aldehyde, ketone, acid chloride, α, β unsaturated carbonyl compound, epoxide.

Unit II: Substitution Reactions (12)

Definition, types: Aliphatic and Aromatic substitution reaction with examples, subtypes:

i) Aliphatic Electrophilic and Aliphatic Nucleophilic Substitution,
ii) Aromatic Electrophilic and Aromatic Nucleophilic Substitution with examples.
Aliphatic Nucleophilic Substitution Reaction: Nucleophile, nucleophilicity trends, leaving group and its types, Solvents: Polar and Nonpolar, Polar Protic and Polar Aprotic solvents, Mechanism of Nucleophilic Substitution, Types: SN1, SN2, SNi.

SN1: Kinetics,Mechanism,Energy profile diagram, carbocation: geometry, hybridization, electron donating and electron withdrawing group, inductive, resonance, hyperconjugation effect in stability of carbocation.

SN2:Kinetics,Mechanism, Energy profile diagram, transition state: geometry, hybridization.
SNi: Kinetics,Mechanism.

Unit III: Redox Reactions (12)

Introduction, definition of terms like oxidation, reduction, oxidizing agent and reducing agent. Balancing of redox reaction using ion electron method and oxidation number method. Rules to find oxidation number, Problems based on equivalent weight of oxidant and reductants.

Unit IV: A) Acids Bases Theory (09)

Definition of acids and bases, Arrhenius theory, Lowry Bronsted theory, Lewis concept, Lux-flood theory, strength of acids and bases,Concept of neutralization, Trends in strength of hydracids and oxyacids, Lewis acid- base character, protonic acidity, Hard & soft acids and bases.

B) Chemical Toxicology

Definition,toxic chemicals in the environment, Biochemical effects of Arsenic,Cadmium,Lead and Mercury,Biological methylation, Antidotes for poisoning.

Suggested Readings/Material:

1. Jonathan Clayden, Nick Greeves, and Stuart Warren, Organic Chemistry, 2nd edition, Oxford University Press, 2012

2. McMurry J.E. Fundamentals of Organic Chemistry, 9 th edition, Cengage Learning UK,20188.

3. Bruice Paula, Organic Chemistry, 8 th Edition, Pearson Education, USA, 2016.

4. Vollhardt P, Schore N. Organic Chemistry, Macmillan Learning, New York,8 th edition

5. Lee J. D. Concise Inorganic Chemistry, ELBS, 1991.
6. Solomon T.W.G., Fryhle Craig B, Organic Chemistry, Wiley, USA ,12 th Edition ,2016.
7. Loudon Marc, Parise Jim, Organic Chemistry, Macmillan Learning, New York, 8th edition,2016.
8. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd edition, Wiley.

9. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts andModels in Inorganic Chemistry, John Wiley & Sons.
10. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Inorganic Chemistry Practical - I								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-2	BS-CH123P	00	02	02	60	15	35	50

Learning Objectives:

1.Synthesis of Inorganic compounds

2.Understanding chemical principles and role of reagents in synthesis

3. Practice safe working procedures

4.Importance and use of MS DS sheets and safety symbols

Course Outcomes (Cos)

1. Importance of chemical safety and Lab safety in laboratory.

2. Understand the meaning of laboratory safety symbols.

3. Precautions in handling hazardous substances in laboratory

4. Learn fundamentals of simple inorganic preparations

Detailed Syllabus:

Unit I: Chemical and Lab Safety

1. Toxicity of compounds used in chemistry laboratories.
2. Safety symbol on labels of pack of chemicals and its meaning
3. What are MSDS sheets? Find out MSDS sheets of at least 3 hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
4. Precautions in handling hazardous substances in laboratory (like Conc. acids, ammonia, organic solvents etc.)

Unit II: Synthesis of commercially important inorganic compounds

1. Synthesis of Potash Alum from scrap Aluminum metal
2. Synthesis of Mohr's Salt [$(FeSO_4)$ $(NH_4)_2SO_4$]•$6H_2O$
3. Preparation of Dark Red inorganic pigment: Cu_2O
4. Synthesis of ferrous sulfate heptahydrate
5. Preparation of potassium trioxalatoferrate(III)
6. Preparation of Hexammine nickel(II)Chloride
7. Preparation of Tetraammine copper (II) sulphate monohydrate.
8. Preparation of chloropentaammine cobalt chloride.

Suggested Readings/Material:

1. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, DOI 10.17226/12654, National Academies Press Washington.
2. Hill Robert H. Jr., Finster David C. Laboratory Safety for Chemistry Students, 2nd Edition, Wiley, 2016
3.Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
4. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Chemistry (Major)

Title of the Course: Analytical Chemistry Practical - I								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-1	BS-CH124P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn volumetric estimation.
2. Analysis of commercial product.
3. To understand chromatographic technique.

Course Outcomes (Cos)

The practical course is in relevance to the theory courses to improve the understanding of the concepts.

1. It would help in development of practical skills of the students.
2. Use of microscale techniques is encouraged.
3. Techniques of volumetric analysis.
4. Commercial product analysis.
5. Chromatographic Techniques for separation of constituents of mixtures.

Detailed Syllabus:

Unit-I Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of basicity of oxalic acid hence determination equivalent weight.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

Unit-II Analysis of commercial products

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 acetic acid in commercial vinegar by titrating with standard NaOH.
9. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method.

Unit-III Chromatographic Technique.

10. Separation of ink by paper chromatography.
11. Separation of leaves pigment by paper chromatography.
12. Separation of metal ions by column chromatography.

Suggested Readings/Material:

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