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) - II Year

Implemented from

Academic Year 2024-25

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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 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

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						
			T	P	T	P	T	P	T	P	T	P		T/P					
I	I	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	VII	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	VII	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

Year	Semester	Level	Major											Minor		OE	CC	AEC	VEC	Total
			DSC		DSE		SEC		VSC		FP/OJT/IN/CEP		IKS							
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 and Analytical Chemistry Practical-I	02
13.	II	III	5.0	SEC-3	BS-CH234P	Organic and Inorganic Chemistry Practical - I	02
14.	II	III	5.0	FP-01	BS-CH235P	Field Project	02
15.	II	IV	5.0	DSC-9	BS-CH241T	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	Physical and Analytical Chemistry Practical-II	02
18.	II	IV	5.0	VSC-2	BS-CH244P	Organic and Inorganic Chemistry Practical - II	02
19.	II	IV	5.0	CEP-01	BS-CH245P	Project	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 Characterization 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 Chemists	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-CH478P	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 Practical in Bioanalytical Techniques	02
48.	IV	VIII	6.0	RP-02	BS-CH487	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.	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.	Prof. Dr. S. S. Kolekar (Shivaji University,Kolhapur)	Academic Council Nominee
10.	Prof. Dr. P. C. Mhaske (S. P. College, Pune)	Alumni
11.	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)

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 environment friendly policies instead of environmentally hazardous 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 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-III								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-6	BS-CH231T	03	00	03	45	30	70	100

Learning Objectives:

1. Various concepts in chemical kinetics such as rate law, mechanism, order, molecularity and activation parameters.
2. Types of adsorptions, adsorption isotherms and their applications.
3. Expression methods of accuracy and precision, classification and minimization of errors.
4. Types of titrations, indicator theory and various titration curves.

Course Outcomes (COs)

1. Learn the basic concept of elementary reactions in chemical kinetics.
2. Understand various terms involved in surface chemistry.
3. Knowledge of data analysis related to quantitative chemical analysis.
4. Know the different volumetric methods in chemical analysis.

Detailed Syllabus:

Unit I: Chemical Kinetics **(15)**

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, integrated rate laws – zeroth-order reactions, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), half-life period, methods for determination order of a reactions, Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters, reaction dynamics - collision theory and transition-state theory of bimolecular reactions, comparison of the two theories and numerical.

Unit II: Surface Chemistry **(10)**

Introduction, basic terms related to surface chemistry, adsorption, absorption, types of adsorptions, factors affecting adsorption, characteristics of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich adsorption isotherm, introduction to BET theory, application of adsorption and numerical.

Unit III: Errors in Quantitative Analysis **(06)**

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.

Unit IV: Volumetric Analysis (**14)**

Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, equivalents, normality, and oxidation numbers, preparation of standard solutions, primary and secondary standards.

Types of Volumetric Analysis methods:

1. Neutralization titrations: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3 content in washing soda.

2. Complexometric Titrations: Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solo chrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca (II) and Mg (II), total hardness of water.

3. Redox Titrations: Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, Iodometry and Iodimetry, 1,10- phenanthroline as indicator in reduction titration, diphenylamine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2.

4. Precipitation titrations: precipitation reactions, determination of end point (formation of colored ppt, formation of soluble colored compound, adsorption indicator), standard $AgNO_3$ solution, standardization of $AgNO_3$ solution, Potassium chromate indicator, Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

Suggested Readings/Material:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th Edn. Oxford University Press, 2018.
2. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania, 46th Edn. Vishal Publishing Company, 2013.
3. Essentials of Physical Chemistry by Bahl Tuli, Revised Multicoloured Edn., S. Chand and Company Ltd. 2009.
4. Principles of Physical Chemistry by S.H. Maron and C. F. Prutton, 4th Edition, Macmillan, New York, 1964.
5. Vogel's Textbook of Quantitative Chemical Analysis by G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, 5th Edn. Longman Scientific and Technical, 1989.
6. Analytical Chemistry by G. D. Christian, P. K. Dasgupta and K. A. Schug, 7th Edn., Wiley, 2004.

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 III								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-	BS-CH232T	03	00	03	45	30	70	100

Learning Objectives:

1. To study the basic concepts of stereochemistry.
2. Study of substitution reactions of aliphatic compounds.
3. Application of molecular orbital theory to explain covalent bonding.
4. Trends in physical and chemical properties of d-block elements.

Course Outcomes (COs)

1. Knowledge of stereochemical relationship and optical isomerism.
2. Prediction of mechanism and stereochemistry of substitution reactions of aliphatic compounds.
3. Knowledge of bond order, stabilization energy and magnetic properties of diatomic and triatomic molecules.
4. Ability to explain of various properties of d-block elements including.

Detailed Syllabus:

Unit I: Stereochemistry (11)

Introduction, classification of isomers, geometrical isomerism, optical activity and symmetry Elements, optical rotation, dextro and laevo rotations, chirality, achiral molecules, asymmetric centre and chiral centre, stereogenic centre and stereocente and pseudoasymmetric centre, Stereoisomers: enantiomers, diastereomers, epimers, conformational isomerism.

Representations of molecules: Flying Wedge, wedge dash projection, Fischer, ball and stick, saw-horse, Newman projections

Nomenclature of optical Isomers: D and L, erythro-threo, meso, R/S nomenclature. Conformational analysis of acyclic hydrocarbons: Ethane, propane, butane. Baeyer Strain theory: postulates and limitations, puckering of cyclohexane.

Unit II: Aliphatic Substitution reactions (12)

A) Aliphatic nucleophilic substitution: (08)

Substitution on sp3 carbon atom:
Nucleophiles and their relative nucleophilicity, Leaving groups, Recapitulation of reaction mechanism of S_N1 and S_N2 and S_Ni reactions, stability of carbocations.
S_N1: stereochemistry, ion–pair mechanism; S_N2 reaction: stereochemistry and S_Ni – stereochemistry.
Comparison of $S_N1$and S_N2; Identification of type of mechanism on the basis of i) structure of the substrate ii) branching at alpha and beta carbon atoms, iii) unsaturation at alpha and beta carbon atom iv) effect of the leaving group, nucleophile and solvent.
Substitution on sp2 carbon atom: S_N1', S_N2' and S_Ni' reactions and their mechanisms.

B) Aliphatic electrophilic substitution reactions: (04)

Types and mechanism of S_E1 S_E2 and S_Ei, allylic rearrangement (S_E1', S_E2' and S_Ei'), stereochemistry, factors affecting rate of reactions – substrate, leaving group and solvent, comparison between S_E1 and S_E2 with examples.

Unit III: Molecular Orbital Theory of Covalent Bonding (14)
Introduction to Molecular Orbital Theory (MOT) and postulates of MO theory, LCAO approximation, s-s, s-p, p-p, p-d and d-d combination of orbitals, non-bonding combination of orbitals, rules for linear combination of atomic orbitals, example of MO treatment for homonuclear diatomic molecules, explanation of following molecules with respect to MO energy level diagram, bond order, stabilization energy and magnetism: H_2 molecule, H_2^+, He_2, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2, O_2^+, O_2^-, O_2^{2-}, F_2 and Ne_2 molecules.
Heteronuclear diatomic molecules: NO, CO, HF.
Heteronuclear triatomic molecules: CO_2, NO_2.

Unit IV: Chemistry of d-block elements (08)

Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t.(i) size of atoms and ions (ii) density (iii) reactivity (iv) catalytic activity (v) oxidation state (vi) complex formation ability (vii) colour (viii) magnetic properties
(ix) melting and boiling points (x) nonstoichiometry

Suggested Readings/Material:

1. Stereochemistry of Organic Compounds: Principles and Applications by D. Nasipuri, 4th Edn. New Age International Publisher, 2020.
2. Stereochemistry: Conformation and Mechanism by P. S. Kalsi, 7th Edn. New Age Publishing Company, 2008.
3. Stereochemistry of Carbon Compounds by E. I. Eliel. Tata McGRAW Hill Edn. 1962.
4. Organic Chemistry by Morrison, R.T. and Boyd, R.N, Prentice Hall of India, Sixth Edn., 2002.
5. Organic Chemistry by Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers -Oxford University Press, USA, 2nd Edn., 2012.
6. Organic Chemistry by Graham Solomon, T.W., Fryhle, C.B. and Dnyder, S.A. John Wiley and Sons 2014.
7. Fundamentals of Organic Chemistry by Mc-Murry, J.E. 7th Edn. Cengage Learning India Edition, 2013.
8. Comprehensive Chemical Kinetics, Vol. 12, by H. Bamford and C. F. H. Tipper, Publisher – Elsevier, 1973.

9. Concise Inorganic Chemistry by J. D. Lee, 5th Edn. Blackwell Science 1996.
10. Inorganic Chemistry by Catherine Housecroft, Alan G. Sharpe, Pearson Prentice Hall, 2008.
11. Basic Inorganic Chemistry by F. A. Cotton and Wilkinson, 3rd Edn., Wiley, 2007.

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 Practical -II								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-8	BS-CH233P	00	02	02	60	15	35	50

Learning Objectives:

1. Practical verification of theoretical concepts of chemical kinetics.
2. Experimental study of adsorption phenomenon.
3. Application of pH metric titrations for acid-base properties.
4. Study of volumetric titrations for quantitative analysis.

Course Outcomes (COs)

1. Interpret the experimental data on the basis of theoretical principles.
2. Verify theoretical principles experimentally.
3. Perform the qualitative and quantitative chemical analysis of substances and explain principles behind it.

Detailed Syllabus:

(Minimum twelve experiments should be performEdn.)

Unit I: Physical Chemistry Experiments: (Any Six)

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 compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kinetics of hydrolysis of methyl acetate.
4. Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.
5. 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
6. To verify the Freundlich and Langmuir adsorption isotherm for adsorption of acetic acid on activated charcoal.
7. Adsorption of oxalic acid on activated charcoal and verification of Freundlich equation and Langmuir equation.
8. Study the adsorption of iodine from alcoholic solution on activated charcoal.

Unit II: Analytical Chemistry Experiment: (Any six)

1. To determine the equivalence point of neutralization of acetic acid by pH-metric titration with NaOH and to find the best indicator for the titration.
2. Determination of dissociation constant of a weak acid by pH-metric titration.
3. To determine the strength of H_2O_2 solution using standardized $KMnO_4$ solution.
4. Estimation of Al (III) from the given aluminium salt solution.
5. To determine the amount of copper from a given solution iodometrically.
6. To determine the amount of calcium in presence of magnesium by complexometric titration.
7. Determination of acetic acid in commercial vinegar by titrating with standard NaOH and measurement of errors (average and standard deviation).
8. To determine the amount of ascorbic acid by redox titration method.

Suggested Readings/Material:

1. Vogel's Textbook Quantitative Chemical Analysis, by G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, 5th Edn. Longman Scientific and Technical, 1989.
2. Experiments in Chemistry by D. V. Jahagirdar, 2nd Edn., Himalaya Publication, 2003.
3. Experimental Physical Chemistry by Athawale and Parul Mathur, New Age International Publication, 2001.
4. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publishing House, 2018.

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 Practical - II								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-3	BS-CH234P	00	02	02	60	15	35	50

Learning Objectives:

1. Quantitative estimation of organic compounds by volumetric method.
2. Synthesis of organic compounds and their purification.
3. Study of optical activity using polarimetry.
4. Hydrolysis reactions of different alkyl halides and relative rates of the reaction.
5. Study of qualitative/quantitative analysis of inorganic compounds.

Course Outcomes (COs)

1. Chemical basis of quantitative analysis of organic compounds.
2. Knowledge of synthetic approaches and purity determination of organic compounds
3. Use of a Polarimeter for studying optical activity.
4. Knowledge of the effect of substrate structure and leaving groups on rate of the
5. substitution reactions.
6. Use of qualitative/quantitative methods for inorganic compounds.

Detailed Syllabus:

(Minimum twelve experiments should be performed)

Unit I: Organic Chemistry Practical: (Any six)

- Any two experiments from experiment number one to four and any two from five to eight should be performEdn.

1. To determine the amount of acetamide in a given solution by volumetric method.
2. To determine the amount of ethyl benzoate in the given solution volumetrically.
3. To determine the amount of glucose in the given solution.
4. To determine the amount of glucose and sucrose in a given mixture.
5. To prepare benzoic acid from ethyl benzoate.
6. To prepare acetanilide using Zn dust, acetic acid and aniline by green approach.
7. To prepare salicylic acid from methyl salicylate.
8. To Prepare of benzoic acid from benzyl chloride.
9. To determine the optical rotation and specific rotation.
   (Experiment should be carried out using enantiomers separately as well as racemic Mixture. **Compulsory**)
10. Comparison of rate of hydrolysis of alkyl halides (**Compulsory)**

a. Primary, secondary and tertiary alkyl bromides.
b. Chloro, Bromo and Iodo alkanes

Unit II: Inorganic Chemistry Practical: (Any six)

- **Any three experiments from one to four should be performEdn.**

1. Estimation of Fe(III) from given solution by redox titration with standard solution of Potassium Dichromate. (A Green Approach)
2. Determination of the amount of carbonate and hydroxide from a given mixture by titrating it against a standard solution of HCl.
3. Separation and identification of metal ions by paper Chromatography.
4. Preparation of aluminium sulphate from scrap aluminium.
5. Inorganic Qualitative Analysis of binary mixtures. (**Minimum three** mixtures without phosphate and borate).

Suggested Readings/Material:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical, 1989.
2. Vogel's Textbook of Practical Organic Chemistry, Furniss, Hannaford, Smith, Tatchel, 5th Edn., Longman Scientific and Technical, 2004.
3. Practical Organic Chemistry by F. G. Mann and B. C. Saunders, Pearson Publications, 4th Edn., 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: Field Project								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
FP-1	BS-CH235P	00	02	02	60	15	35	50

Learning Objectives:

Course Outcomes (COs)

1. abc
2. def
3. ghi
4. jkl
5. mno

Detail Guidelines for Field Project (FP)

Suggested Readings/Material:

1.

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-IV								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-9	BS-CH241T	03	00	03	45	30	70	100

Learning Objectives:

1. Phase rule, phase diagram of one and two component systems.
2. Vapor pressure and boiling point terms for ideal and non-ideal solutions as well as the concept of azeotropic mixtures.
3. Conductivity cell, conductometric titration curves for acids and bases in conductometry.
4. Principle, laws, instrumentation and applications of colorimetry.
5. Principle of chromatography and applications.

Course Outcomes (COs)

1. Understand various terms and expressions involved in phase equilibrium.
2. Know the concepts of Raoult's, Henry's laws of ideal and real solutions. Knowledge of basic terms in conductometry and conductometric titrations.
3. Learn various laws and applications of colorimetry.
4. Understand principle and application of column chromatography.

Detailed Syllabus:

Unit I: Phase equilibrium **(10)**

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, two-component systems-lead and silver and numerical

Unit II: Ideal and real solutions **(10)**

Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions - Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems: liquids - vapor pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids and numerical.

Unit III: Conductometry (08)

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Wheatstone Bridge, determination of cell constant, conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and numerical.

Unit IV: Colorimetry (09)

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lambert's Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: Principle, Construction and components, Working. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocyanate method and numerical.

Unit V: Column Chromatography (08)

Introduction, Principle of Column Chromatography, Ion Exchange Chromatography: Ion exchange resins, action of ion exchange resin (Ion exchange equilibria, Ion exchange capacity), Experimental technique.

Application: i) Separation of Metal ions / non-metal ions on Ion Exchange Chromatography (Zn(II) and Mg(II), Cl^- and Br^-), ii) Purification of water, Adsorption Chromatography– Liquid solid chromatography: Introduction, the technique of conventional chromatography, column packing materials, Selection of solvent for adsorption chromatography, Adsorption column preparation and loading, Application – Purification of anthracene, Size Exclusion Chromatography.

Suggested Readings/Material:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula and James Keeler,11th Edn., Oxford University Press, 2018.
2. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, 46th Edn. Vishal Publishing Company, 2013.
3. Essentials of Physical Chemistry by Bahl and Tuli-Revised Multicoloured Edn., S. Chand and Company Ltd., 2009.
4. Principles of Physical Chemistry by S.H. Maron and C. F. Prutton. 4th Edn.1965.
5. Vogel's Textbook of Quantitative Chemical Analysis by G. H. Jeffry, J. Basset, J. Mendham and R. C. Denney, Longman Scientific and Technical, 5th Edn., 1989.

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 IV								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	BS-CH242T	03	00	03	45	30	70	100

Learning Objectives:

1. To study substitution reactions of homonuclear aromatic compounds.
2. Types of addition reactions of multiple bonds.
3. Study of coordination compounds including nomenclature, isomerism.
4. Bonding in coordination compounds on the basis of valence bond theory.
5. Study of metal carbonyls and their catalytic applications.

Course Outcomes (COs)

1. Knowledge of electrophilic and nucleophilic substitution reactions of homonuclear aromatic compounds.
2. Mechanisms of addition reactions of multiple bonds and explanation of product formation.
3. Differentiation in properties of coordination compounds and simple salts, nomenclature, formation, stability, isomerism and applications of coordination compounds.
4. Application of valence bond theory to explain hybridization, geometry and magnetic properties of coordination compounds.
5. Knowledge of structures and use of metal carbonyls in homogeneous catalysis.

Detailed Syllabus:

Unit I: Substitution Reactions of Homonuclear Aromatic Compounds (10)

(Benzene, Naphthalene and Anthracene)

A) Aromatic Electrophilic Substitution Reactions: -

i) Introduction and Arenium ion Mechanism

ii) Effect of substituent group (Orientation, o/p directing and meta directing groups)

iii) Classification of substituent groups (activating and deactivating groups)

iv) Mechanism of following reactions – a) Nitration b) Sulphonation c) Halogenation d) Fridel-Craft's reactions e) Diazo Coupling reactions.

B) **Aromatic Nucleophilic Substitution Reactions: -** Introduction, SNAr, Aryne intermediate, IPSO substitution.

Unit II: Addition Reactions (12)

Types of addition reactions.

A) Electrophilic Addition Reactions:

i) Reactions of Carbon-Carbon double bond. Concept of addition reactions. Mechanism of electrophilic addition to C=C bond, Orientation and reactivity, Rearrangements (Support for formation of carbocation). Addition of hydrohalogen, Anti-Markovnikov's addition (peroxide effect). Addition of halogens (*dl* pairs and meso isomers), Addition of Hypohalous acids (HOX), Oxymercuration–demercuration, Hydroxylation (formation of cis and trans 1,2-diols with mechanism), Hydroboration Oxidation (Formation of alcohol), Hydrogenation (Formation of alkane), Ozonolysis (formation of aldehyde and ketones).

ii) Reactions of Carbon –Carbon triple bond-addition of hydrogen, halogens, halogen acids, water and formation of metal acetylides and its application.

B) Nucleophilic Addition Reactions:

Reactions of Carbon –Oxygen double bond: Introduction, Structure of carbonyl group, reactivity of carbonyl group, addition of Hydrogen cyanide, alcohols, thiols, water, ammonia derivatives, Cannizzaro reaction and Reformatsky reaction with mechanism.

Unit III: Introduction to Coordination chemistry (12)

Terms involved in coordination chemistry: Double salt and coordination compound, coordinate bond, central metal ion, ligand and its types, chelate, coordination number, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio.

Werner's coordination theory, effective atomic number, equilibrium constant, chelate effect, IUPAC nomenclature.

Isomerism in coordination complexes: Structural: ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism and polymerization isomerism. Stereoisomerism: geometrical isomerism and optical isomerism**.**

Unit IV: Valence Bond Theory of Coordination Compounds (05)

Need of VBT, need of hybridization, aspects and assumptions of VBT, Applications of VBT on the basis of hybridization to explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN_4)]^{2-}$, $[Cr(H_2O)_6]^{3+}$,$[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$, inner and outer orbital complexes. Use of observed magnetic moment in deciding the geometry in complexes with C.N.4, Limitations of VBT.

Unit IV: Organometallic Chemistry (06)

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, molecular and electronic structures (18 electron rule) of metal carbonyls, methods of synthesis; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis.

Homogenous Catalysis: - Hydroformylation (Oxo Process), Wacker Process and Monsanto process (Cativa process).

Suggested Readings/Material:

1. Organic Chemistry by Morrison R. T. and Boyd R. N., Prentice Hall of India, 6th Edn., 2002.
2. Organic Chemistry by Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers Oxford University Press, USA, 2nd Edn., 2012.
3. Organic Chemistry by Graham Solomon, T.W., Fryhle, C.B. and Dnyder, S.A. John 12th Edn. Wiley and Sons, 2016.
4. Fundamentals of Organic Chemistry by Mc Murry J.E. 7th Edn., Cengage Learning India Edn., 2013.
5. Concise Inorganic Chemistry by J. D. Lee, 5th Ed, Blackwell Science,1996.
6. Inorganic Chemistry by James E. House, Academic Press Elsevier, 2008.
7. Inorganic Chemistry by Miessler and Tarr, 3rd Edn. Pearson Publications, 2010.
8. Basic Inorganic Chemistry by Cotton and Wilkinson 3rd Edn., Wiley, 2007.
9. Inorganic Chemistry by Shriver Atkin, 5th Edn., OUP Oxford, 2010.

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 Practical-II								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	BS-CH123P	00	02	02	60	15	35	50

Learning Objectives:

1. Study the concept of phase equilibria.
2. The properties of ideal and real solutions and their applications
3. Experimental verification of conductometric analysis.
4. Study of various absorption laws and their colorimetric verification.
5. Practical application of chromatographic techniques for separation of mixtures.

Course Outcomes (COs)

1. Verify theoretical principles experimentally
2. Write a balanced equation for all the chemical reactions performed in the laboratory.
3. Set up the apparatus properly for the designed experiments.
4. Perform the quantitative chemical analysis of substances and be able to explain principles behind it.

Detailed Syllabus:

(**Minimum twelve experiments should be performed**)

Unit I: Physical Chemistry Practical: (Any six)

1. To obtain the temperature-composition phase diagram for a two-component liquid system maximum (or minimum) boiling point and to determine the maximum (or minimum) boiling point and composition.
2. Separation of mixture of organic solvent using physical method. (Distillation)
3. To determine molecular weight of solute by freezing point depression. (Sulphur).
4. To determine dissociation constant of oxalic acid by pH metric titration with strong base.
5. Determine the percentage of two optically active substances (D-sucrose and L-Tartaric acid) in a mixture using polarimetry.
6. Study of the effect of addition of electrolyte (NaCl, KCl or Na_2SO_4) on the solubility of monobasic organic acid.
7. Determination of the solubility of salicylic acid over a range of temperature and its heat of solution.
8. Determination of solubility of a sparingly soluble salt. (Lithium carbonate)

Unit II: Analytical Chemistry Practical: (Any six)

1. To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.
2. To investigate the conductometric titration of any one of the following a) Strong acid against strong base b) Strong base against weak acid.
3. Estimate the amount of lead present in a solution of lead nitrate by conductometric titration with sodium sulfate.
4. To determine the concentration of a given unknown titanium solution using H_2O_2 at 440 nm by colorimetric method.
5. To determine the concentration of given unknown solution of Fe(III) using ammonium thiocyanate at 540 nm by colorimetric method.
6. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose (Co + Al, Cu + Mg, Zn + Mg). Separation of cations must be confirmed by a qualitative test. (**any two mixtures**)
7. Separation of amino acids by paper chromatography.

Suggested Readings/Material:

1. Vogel's Textbook Quantitative Chemical Analysis by G. H. Jeffry, J. Basset, J. Mendham and R. C. Denney, 5th Edn. Longman Scientific and Technical, 1989.
2. Experiments in Chemistry by D. V. Jahagirdar, 2nd Edn., Himalaya Publication, 2003.
3. Colorimetric Determination of the Iron (III)-Thiocyanate Reaction Equilibrium Constant with Calibration and Equilibrium Solutions Prepared in a Cuvette by Sequential Additions of One Reagent to the Other, Journal of Chemical Education, Vol.88, No.3, March 2011.
4. Spectrophotometric study of complex formation between Fe (III) and salicylic acid, Kinya Ogawa, Nobuko Tobe, Bulletin of Chemical Society of Japan, 39, 227-232, 1966.

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 Practical-II								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-2	BS-CH244P	00	02	02	60	15	35	50

Learning Objectives:

1. To study substitution reactions of aromatic compounds.
2. Qualitative analysis of various organic compounds.
3. Concepts of coordination chemistry via synthesis of coordination compounds.
4. Application of theoretical concepts of colourimetry.

Course Outcomes (COs)

1. Knowledge of various reaction conditions for aromatic substitution reactions.
2. Knowledge of various chemical tests for identification of type and functional groups of organic compounds.
3. Ability to explain the properties of coordination compounds
4. Use of colorimetry for qualitative and quantitative analyses.

Detailed Syllabus:

(Minimum twelve experiments should be performEdn.)

Unit I: Organic Chemistry Practicals: (any six)

- **Any three experiments from experiment no. one to five should be performed.**

1. Preparation of m-dinitrobenzene.
2. Preparation of p-iodonitrobenzene from p-nitroaniline.
3. Preparation of p-bromonitrobenzene.
4. Sulphonation of Naphthalene.
5. Preparation of azodye from substituted aniline.
6. **Organic Qualitative analysis (Three mixtures):** Type determination and separation, individual analysis including preliminary tests, determination of elements, functional groups and physical constants. **(only solid-solid mixtures)**

Unit II: Inorganic Chemistry Practicals: (any six)

1. Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co(II) salt and $NaNO_2$ salts. (Comment on color and magnetic properties of the complex).
2. Synthesis of potassium Trioxalatoaluminate (III) using Scrap aluminium. (Comment on colour and magnetic properties of the complex).

3. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acetylacetone. (Comment on color and magnetic properties of the complex).
4. Synthesis of Tris(ethylenediamine)nickel(II) from Ni(II) salt, ethylenediamine and sodium thiosulfate. (Comment on color and magnetic properties of the complex).
5. Synthesis of Tri (thiourea)-cuprous sulphate, dihydrate. (Comment on color and magnetic properties of the complex).
6. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration.
7. Prepare solution of Fe(III) and SCN^- in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex
8. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportions and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex.

Suggested Readings:

1. Vogel Textbook of Quantitative Chemical Analysis by G. H. Jeffry, J. Basset, J.
2. Mendham, R. C. Denney, 5th Edn. Longman Scientific and Technical, 1989.
3. Vogel's Textbook of Practical Organic Chemistry, Furniss, Hannaford, Smith and Tatchel, 5th Edn., Longman Scientific and Technical, 2004.
4. Practical Organic Chemistry by F. G. Mann and B. C. Saunders, Pearson Publications, 4th Edn., 2009.
5. Advanced Practical Organic Chemistry by O. P. Agarwal 20th Edn., Krishna Prakashan, 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: Community Engagement Project								
Year: II					**Semester: IV**			
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
CEP-1	BS-CH245P	00	02	02	60	15	35	50

Learning Objectives:

Course Outcomes (COs)

1. abc
2. def
3. ghi
4. jkl
5. mno

Detail Guidelines for Field Project (FP)

Suggested Readings/Material: