



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. II Chemistry**

**Under
Faculty of Science and Technology
(As per NEP 2020)**

With effect from Academic Year 2025-2026

Syllabus for B.Sc. Part–II Chemistry

PREAMBLE:

This updated syllabus is prepared for second year undergraduate students. At this level, to develop their interest towards chemistry as a basic science and also to prepare them for the academic and industrial exposure as per NEP 2020. Introduction of instrumental techniques with the regular chemistry exercises will help to enhance analytical thinking of the students. The interdisciplinary approach with vigour and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.

GENERAL OBJECTIVES OF THE COURSE:

1. To develop the content of the syllabus according to the UGC norms.
2. To inculcate fundamental principles of chemical sciences in students.
3. To establish the link between theory and laboratory practice by conducting laboratory experiments which help students to improve the understanding of the concepts.
4. To enhance student's sense of enthusiasm for chemistry and to involve them in an intellectually stimulating experience of learning in a supportive environment.

PROGRAMME OUTCOMES

After completing the B.Sc. program, graduates will...

1. possess a strong foundation of knowledge in their chosen field of study.
2. develop a scientific mindset, becoming open-minded, critical, and curious, which will support their entry into research and innovation.
3. be skilled in practical work, experiments, and the use of laboratory materials.
4. be eligible to pursue higher studies in their field, both in India and abroad.
5. qualify to appear for examinations for jobs in government organizations.
6. meet the minimum eligibility requirements for various science-related job opportunities.
7. be prepared to establish their own entrepreneurial ventures.
8. enhance critical thinking, develop a scientific attitude, solve problems, improve practical skills, boost communication abilities, and strengthen social interactions.

PROGRAMME SPECIFIC OUTCOMES

After completing the B.Sc. (Chemistry) program, students will...

1. understand basic concepts, principles, and theories in Chemistry.
2. apply knowledge of Chemistry in academic, industrial, and research fields.
3. gain hands-on experience in chemical experiments and instrumentation.
4. develop problem-solving skills through chemical reasoning.
5. acquire awareness of environmental and sustainability issues in chemistry.
6. enhance communication skills through scientific reporting and discussions.
7. understand safety practices and regulations in laboratories.
8. cultivate ethical and professional behavior in scientific practices.
9. prepare for higher education, competitive exams, and diverse career options.
10. foster a spirit of scientific inquiry and lifelong learning.

1. TITLE: **Chemistry**
2. YEAR OF IMPLEMENTATION: **2025-2026**
3. DURATION: **01 year**
4. PATTERN: **Semester Examination**
5. MEDIUM OF INSTRUCTION: **English**
6. Eligibility of the Student: **B. Sc. I**
7. Eligibility of the core faculty: **As per the rule and regulation of the UGC and Govt. of Maharashtra**
8. STRUCTURE OF COURSE: **As per NEP-2020 (2.0)**

Level	Sem	Course 1 (Major)		Course 2 (Minor)		OE	VSC/SEC		AEC/VEC/IKS			Total
		T	P	T	P	P	VSC	SEC	AEC	VEC	IKS	
5	III	4	2	4	2	2	2	2	2		2	22
	IV	4	2	4	2	2	2	2	2	2	-	22

[OE- Open Elective, VSC- Vocational Skill Course, SEC- Skill Enhancement Course,
AEC- Ability Enhancement course, VEC- Value Education Course, IKS- Indian Knowledge System]

Third Semester (Level 5.0)

Sr. No.	Course	Course Code	Title of Course	No. of lectures/practical per week	Credits
1	Major	BCT 231	Organic Chemistry	2	2
2		BCT 232	Analytical Chemistry	2	2
3		BCP 233	Major Practical-III (Practicals Based on Course BCT 231 & 232)	1	2
4	Minor	BCT 234	Principles of Organic Chemistry	2	2
5		BCT 235	Principles of Analytical Chemistry	2	2
6		BCP236	Minor Practical-III (Practicals Based on Course BCT 234 & 235)	1	2
7	OE	BCPOE III	Industrial Pollution / Scientific Philosophy / Logic & Reasoning	1	2
8	VSC	BCPVSC I	Food Quality Analyst	1	2
9	SEC	BCPSEC I	Water Quality Analyst	1	2
10	AEC	BCTAEC I	English for Communication	2	2
11	IKS	BCTIKS II	Chemistry in Ayurveda	2	2

Forth Semester (Level 5.0)

Sr. No.	Course	Course Code	Title of Course	No. of lectures/practical per week	Credits
1	Major	BCT 241	Physical Chemistry	2	2
2		BCT 242	Inorganic Chemistry	2	2
3		BCP 243	Major Practical-IV (Practicals Based on Course BCT 241 & 242)	1	2
4	Minor	BCT 244	Principles of Physical Chemistry	2	2
5		BCT 245	Principles of Inorganic Chemistry	2	2
6		BCP 246	Minor Practical-IV (Practicals Based on Course BCT 244 & 245)	1	2
7	OE	BCPOE IV	Industrial Pollution / Environmental Studies / Instrumentation Studies	1	2
8	VSC	BCPVSC II	Fertilizer Quality Analyst	1	2
9	SEC	BCPSEC II	Soil Quality Analyst	1	2
10	AEC	BCTAEC II	English for Communication	2	2
11	IKS	BCTVEC II	Environmental Awareness for Chemistry	2	2

Note:- For practical number of students per batch= 16 students

7. EVALUATION STRUCTURE: Semester III

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major	T	BCT 231	10	10	10	30	50	02
	T	BCT 232	10	10	10	30	50	02
	P	BCP 233	20			30	50	02
Minor	T	BCT 234	10	10	10	30	50	02
	T	BCT 235	10	10	10	30	50	02
	P	BCP 236	20			30	50	02
OE	P	BCPOE 3 (For IDS Courses)	20			30	50	02
VSC	P	BCPVSC 1	20			30	50	02
SEC	P	BCPSEC 1	20			30	50	02
AEC I	T	BCTAEC 1	10	10	10	30	50	02
IKS II	T	BCTIKS 2	10	10	10	30	50	02
Total							550	22

Semester IV

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major	T	BCT 241	10	10	10	30	50	02
	T	BCT 242	10	10	10	30	50	02
	P	BCP 243	20			30	50	02
Minor	T	BCT 244	10	10	10	30	50	02
	T	BCT 245	10	10	10	30	50	02
	P	BCP 246	20			30	50	02
OE	P	BCPOE 4 (For IDS Courses)	20			30	50	02
VSC	P	BCPVSC 2	20			30	50	02
SEC	P	BCPSEC 2	20			30	50	02
AEC II	T	BCTAEC 2	10	10	10	30	50	02
VEC II	T	BCTVEC 2	10	10	10	30	50	02
Total							550	22

*Note:-Best two scores of CCE will be considered out of three.

8. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in institute and departmental library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board, interactive panel

b) Laboratory Equipment:

- | | |
|-----------------------------|------------------------|
| 1. Magnetic stirrer | 2. Hot Air Oven |
| 3. Digital weighing balance | 4. Muffle Furnace |
| 5. pH meter | 6. Fume hood |
| 7. Spectrophotometer | 8. Conductometer |
| 9. Parallel synthesizer | 10. Microwave oven |
| 11. Potentiometer | 12. Colorimeter |
| 13. Ultrasonicator | 14. Centrifuge machine |
| 15. Suction pump | 16. Refractometer |
| 17. Thermostat | 18. Ice Flaker |
| 19. Turbidometer | |

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: Major-V	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCT – 231: Organic Chemistry		
Course Objectives: Students should be able to... 1) understand the fundamental principles underlying organic reaction mechanism. 2) study the preparation and reactions of amines and diazonium salts. 3) learn the classification, structures, of conformational isomerism. 4) examine the structure and properties of amino acids, including chirality and acid-base behavior.		
Course Outcomes: After completion of the course, students will be able to... 1) draw the mechanism of various name reactions. 2) explain the synthetic methods and applications of amines and diazonium salts. 3) analyze stereo chemical aspects of compounds 4) classify the various carbohydrates and explore the structures of amino acids, proteins and nucleic acids and their synthetic methods.		
Module	Title and Contents	Hrs
Module-1	Organic Name Reactions 1.1 Perkin reaction 1.2 Reformatsky Reaction 1.3 Knoevenagel Condensation 1.4 Claisen condensation 1.5 Mannich Reaction 1.6 Pinacol – Pinacolone Reaction 1.7 Reimer – Tiemann reaction.	08
Module-2	Amines and Diazonium Salts 2.1 Amines -Introduction, classification, nomenclature 2.2 Methods of Preparation: from alkyl halides by ammonolysis Reduction of nitrile or cyanide, from unsubstituted amides (Hofmann Degradation), Gabriel's Phthalimide synthesis 2.3 Reactions of amines: Carbylamine reaction, Hinsberg test, Schotten Baumann reaction 2.4 Diazonium salts: Preparation: from aromatic amines. Reaction: conversion to benzene, phenol, synthesis of Congo Red dye, Sandmeyer's reactions	08
Module-3	Stereochemistry 3.1 Conformational isomerism – Introduction. 3.2 Representation of conformations of ethane using Sawhorse, Fischer (dotted line wedge) and Newman's projection formulae. 3.3 Conformations and conformational analysis of ethane and n-butane using Newman's Projection formula with the help of energy profile diagrams.	04

Module-4	Chemistry of Biomolecules 4.1 Carbohydrates: 4.1.1 Classification based on chemical constitution with suitable example; open chain and ring structure of carbohydrate containing five and six carbon atoms 4.1.2 Interconversion of glucose and fructose 4.1.3 Determination of configuration of glucose, Muta-rotation, 4.1.4 Reactions of glucose: acetylation, Osazone, methylation, reduction and oxidation 4.1.5 Chain-lengthening and chain-shortening reaction. 4.2 Amino acids, Proteins and Nucleic acids: 4.2.1 General structure of amino acid, isoelectric point, 4.2.2 Synthesis of an amino acid- amination of halo acids, azalactone, Curtius method, Gabriel method. 4.2.3 Synthesis of polypeptide Solid phase synthesis, structure of protein, 4.2.4 Nucleic acid: classification, structure of nucleosides & nucleotides.	10
Reference Books: - 1) Ahluwalia, V. K., Parashar, R. K., Organic Reaction Mechanism. 4th Edition, Narosa Publishing House, 2010. 2) March J., Advanced Organic Chemistry: Reactions, Mechanism and Structure. 4th Edition, Wiley, 1992. 3) Kalasi, P. S., Stereochemistry: Conformation and Mechanism. New Age International, 2008. 4) Madan, R. L., Chemistry for Degree Students. 2016. 5) Morrison, R. T., Boyd, R. N., Organic Chemistry. 6th Edition, Pearson Education, Prentice Hall of India, 2002.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation (20 Marks): • CCE-I : Compulsory home assignment (10 Marks) • CCE-II : Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III : Compulsory MCQ test (Each question for 1Mark) 10 Marks Note: - Best two scores of CCE will be considered out of three.	End Semester Examination (30 Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10M • Question-2: Attempt any two questions (three questions of 10 marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: Major- VI	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCT–232: Analytical Chemistry		
Course Objectives: Students should be able to... 1) understand the basic principles of spectroscopy. 2) acquire the knowledge of electroanalytical methods of analysis 3) develop a fundamental understanding of qualitative and quantitative analysis. 4) gain knowledge of the applications of analytical techniques in environmental, pharmaceutical, industrial, and research laboratories.		
Course Outcomes: After completion of the course, students will be able to... 1) describe the electroanalytical methods of analysis. 2) apply fundamental methods of qualitative analysis to organic and inorganic compounds. 3) analyze the unknown compounds quantitatively. 4) perform quantitative chemical analysis using volumetric, gravimetric, and instrumental techniques with accuracy and precision.		
Module	Title and Contents	Hrs
Module-1	Optical Methods of Analysis 1.1 Introduction 1.2 Fundamental laws of spectroscopy and selection rules, Beer-Lambert law, and its validity 1.3 UV–Visible Spectroscopy: Basic principles, instrumentation: choice of source, monochromators and detectors for single-beam and double-beam instrument. 1.4 Infra-red Spectroscopy: Basic principles, instrumentation: choice of source, monochromators & detectors for single and double beam instrument; sampling techniques.	08
Module-2	Electroanalytical Methods 2.1 Classification of electro analytical methods; Basic principle of i] pH meter ii] Potentiometer and iii] Conductometer. 2.2 Conductance measurement: Direct-reading conductivity bridge, conductivity cell and cell constant 2.3 Conductometric Titrations: Introduction and instrumentation 2.4 Types of conductometric titrations, Advantages and disadvantages of conductometric titrations.	07
Module-3	Qualitative Analysis 3.1 Qualitative Analysis-Principle of qualitative analysis 3.2 Classification of organic and inorganic qualitative analysis 3.3 Organic Qualitative Analysis: Identification of compounds, functional group analysis 3.4 Inorganic Qualitative Analysis: application of the solubility product and common-ion effect, separation of cation into groups; Application of complex formation, and oxidation–reduction reactions in inorganic qualitative analysis.	08

Module-4	Quantitative Analysis 4.1 Quantitative Analysis-Definition & types of Quantitative analysis 4.2 Volumetric Analysis: Basic terms related to titrimetric; types of titrations 4.3 Gravimetric Analysis: Introduction, types of gravimetric analysis 4.4 Steps in Gravimetry: Precipitation technique and theory, Solubility considerations; common-ion effect; diverse-ion effect; effect of pH temperature and nature of solubility, digestion, nucleation, co- precipitation & post-precipitation, filtration & washing, drying & ignition.	07
Reference Books: - 1) Chatwal, G. R., Anand, S. Instrumental Methods of Chemical Analysis, Himalaya Publishing House, 2011. 2) Khopkar, S. M., Basic Concepts in Analytical Chemistry, New Age International Ltd., 2017. 3) Mendham, J., Sivasankar, B., Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education India, 2009. 4) Sharma, B. K., Industrial Chemistry, Goel Publishing House, Meerut, 2000. 5) Svehla, G., Sivasankar, B., Vogel's Text Book of Qualitative Inorganic Analysis. Pearson Education India, 2012.		
Evaluation Pattern: 60: 40		
Total Marks: 50		
Continuous Comprehensive Evaluation (20Marks): • CCE-I : Compulsory home assignment (10 Marks) • CCE-II : Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III : Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks	

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	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: Major Practical III	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCP-233: Major Practical-III (Practicals Based on Course BCT 231 & 232)		
Course Objectives: Students should be able to...		
1) gain knowledge of volumetric estimation and its application. 2) recall the preparation of organic compounds and their reaction mechanism. 3) understand the qualitatively and quantitatively for methods for unknown samples. 4) learn the handling of various analytical instruments for analysis.		
Course Outcomes: After completion of the course, students will be able to...		
1) identify unknown organic compounds and their structures. 2) estimate the unknown compound's concentration quantitatively. 3) perform the preparations of industrially important compounds. 4) operate analytical instruments used in chemical analysis.		
Title and Contents (Any 15 of the following)		Hrs
Organic Chemistry Section: 1. Organic Qualitative Analysis (Any 10 compounds) Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, succinic acid, oxalic acid, Phenols: Naphthol, resorcinol, p-nitro phenol, Bases: p-Nitroaniline, o-Nitroaniline, m-Nitroaniline, diphenylamine. Neutrals: Acetanilide, ethyl methyl Ketone, Acetophenone, Benzophenone, Benzaldehyde, methyl acetate, Chlorobenzene, bromobenzene, Nitrobenzene, m-Dinitrobenzene, naphthalene, thiourea etc. 2. Organic Estimations 1. Determine the amount of acetone in the given solution. 2. Determine the amount glycine in the given solution. 3. Organic Preparations (Any 3) 1. Preparation of benzoic acid from benzamide. 2. Preparation of p-nitroacetanilide from acetanilide. 3. Preparation of phthalimide from Phthalic anhydride. 4. Preparation of Orange II dye from sulphanilic acid.		60
Analytical Chemistry Section: 4. Thin-layer chromatography (TLC): Demonstration of separation, identification, and determination of R _f values. 5. Colorimetry- Determination of unknown concentration of a given solution of KMnO ₄ by colorimetry (Verification of Beer- Lambert law). 6. pH Metry- Determination of buffer capacity of pH of buffer solution by pH metry. 7. Estimations (Any two) 7.1 Determination of Percentage purity of boric acid using supplied sodium hydroxide. 7.2 Determination of nitrogen content in Urea fertilizer sample. 7.3 Estimate the amount of calcium present in the given calcium chloride solution.		

Reference Books: -

- 1) Furniss, B. S., Hannaford, A. J., Smith, P. W. G. , Tatchell, A., Vogel's Practical Organic Chemistry. 5th Edition, Longman Scientific & Technical, 1989.
- 2) Khopkar, S. M., Basic Concepts in Analytical Chemistry. New Age International Ltd., 2017.
- 3) Mendham, J., Sivasankar, B. Vogel's Text Book of Quantitative Chemical Analysis. Pearson Education India, 2009.
- 4) Pandey, O. P., Bajpai, D. N., Giri, S., Practical Chemistry: For B.Sc. I, II and III Year Students of All India Universities, 2010.
- 5) Sharma, B. K., Industrial Chemistry. Goel Publishing House, Meerut, 2000.
- 6) Venkateswaran, V., Basic Principles of Practical Chemistry. Sultan Chand and Sons, 2012.
- 7) Verma, N. K., Vermani, B. K., Verma, N., Comprehensive Practical Chemistry. Laxmi Publication (P) Ltd., 2010.
- 8) Vogel, Arthur, Vogel's Text Book of Quantitative Analysis. Longman, 1989.

Evaluation Pattern: 60:40**Total Marks: 50****Continuous Comprehensive Evaluation (20 marks)**

- Journal: 10 Marks
- Students Performance & attendance: 10 Marks

End Semester Evaluation: (30 Marks)

- Experiment 1: 20 Marks
- Experiment 2: 10 Marks

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	Board of Studies in Chemistry		
	Programme: B. Sc. II	Semester- III	
	Type: Minor-V	Marks: 50	
	Credits: 2	From: A. Y. 2025-26	
Name of the Course: BCT–234: Principles of Organic Chemistry			
Course Objectives: Students should be able to...			
1) understand the fundamental principles underlying organic reaction mechanisms. 2) study the preparation and reactions of amines and diazonium salts. 3) learn the three-dimensional structure and properties of organic molecules. 4) examine green chemistry techniques			
Course Outcomes: After completion of the course, students will be able to...			
1) draw the mechanism of various named organic reactions. 2) explain the synthetic methods and applications of amines and diazonium salts. 3) represent the conformations of organic compounds by using various methods. 4) explore the greener methods in synthesis			
Module	Title and Contents		Hrs
Module-1	Carbonyl Compounds- Aldehydes and Ketones 1.1 Introduction; Nomenclature of aliphatic and aromatic aldehydes and ketones. 1.2 Structure and reactivity of Carbonyl group. Reactions of Carbonyl Compounds- Mechanism and applications of i) Aldol condensation, ii) Claisen Condensation, iii) Perkin reaction, iv) Knoevenagel condensation		09
Module-2	Amines and Diazonium Salts: 2.1 Aliphatic and Aromatic amines: (Up to five carbon atoms) Preparation: from alkyl halides, Gabriel’s Phthalimide synthesis, and Hofmann bromamide reaction. 2.2 Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, Reaction with HNO ₂ , Schotten – Baumann reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. 2.3 Diazonium salts: Preparation: from aromatic amines. Reaction: conversion to benzene, phenol, and azo dyes.		09
Module-3	Stereochemistry 3.1 Conformational isomerism – Introduction. 3.2 Representation of conformations of ethane by using Sawhorse, Fischer (dotted line wedge) and Newmans projection formulae. 3.3 Conformations and conformational analysis of ethane and n-butane using Newmann’s Projection formula with the help of energy profile diagrams.		05
Module-4	Green Chemistry 4.1 Introduction, principles of green chemistry 4.2 Green methods for organic synthesis 4.3 Green solvents: introduction and examples 4.4 Synthesis of two organic compounds using greener methods		07

References Books: 1) Ahluwalia V. K., Parashar R. K., Organic Reaction Mechanism: Narosa Publishing House, 4 th Edition, 2010 2) March J., Advanced Organic Chemistry: Reactions, Mechanism and Structure: Wiley, 4 th Edition, 1992. 3) Madan R. L., Chemistry for Degree students: S. Chand. 2016. 4) Morrison, R. T., Boyd, R. N., Organic Chemistry: Pearson Education, Prentice Hall of India, 6 th Ed., 2002.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20Marks): • CCE-I : Compulsory home assignment (10 Marks) • CCE-II : Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III : Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks

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	Board of Studies in Chemistry		
	Programme: B. Sc. II		Semester- III
	Type: Minor-VI		Marks: 50
	Credits: 2		From: A. Y. 2025-26
Name of the Course: BCT– 235: Principles of Analytical Chemistry			
Course Objectives: Students should be able to...			
1) learn the various units of concentration.			
2) absorb the knowledge of electroanalytical methods of analysis.			
3) acquire the fundamental knowledge of qualitative analysis.			
4) understand the methods of quantitative analysis.			
Course Outcomes: After completion of the course students will be able to...			
1) explain the various units of concentration.			
2) describe the electroanalytical methods of analysis.			
3) apply fundamental methods of qualitative analysis to organic and inorganic compounds.			
4) analyze the unknown compounds quantitatively.			
Module	Title and Contents		Hrs
Module-1	Analytical Approaches 1.1 Types of errors 1.2 precision & accuracy 1.3 Absolute and relative uncertainty 1.4 Significant figures; significant figures in Arithmetic 1.5 Addition, subtraction, multiplication and division. Mean and standard Deviation.		07
Module-2	Electroanalytical Methods 2.1 Classification of electro analytical methods, Basic principle of i] pH meter ii] Potentiometer and iii] Conductometer. 2.2 Conductance measurement: Direct-reading conductivity bridge, conductivity cell and cell constant 2.3 Conductometric Titrations: Introduction and instrumentation 2.4 Types, advantages and disadvantages of conductometric titrations.		08
Module-3	Qualitative Analysis 3.1 Qualitative Analysis-Principle of qualitative analysis 3.2 Classification of organic and inorganic qualitative analysis 3.3 Organic Qualitative Analysis-Identification of compounds, functional group analysis. 3.4 Inorganic qualitative analysis: application of the solubility product and common-ion effect; separation of cations into groups; application of complex formation.		08
Module-4	Quantitative Analysis 4.1 Quantitative Analysis-Definition & types of Quantitative analysis 4.2 Volumetric Analysis: Basic definitions, Types of titrations 4.3 Gravimetric Analysis: Introduction, types of gravimetric analysis 4.4 Steps in gravimetric analysis: precipitation techniques and theory; solubility considerations; common-ion effect; diverse-ion effect; effects of pH, temperature, and the nature of solubility; digestion; nucleation; co-		07

	precipitation and post-precipitation; filtration and washing; drying and ignition.	
References Books: 1) Chatwal G. R., Anand S., Instrumental Methods of Chemical Analysis: Himalaya Publishing House, 2011. 2) Khopkar S. M., Basic Concepts in Analytical chemistry: New Age International Ltd., 2017. 3) Mendham J., Sivasankar B., Vogel's Text Book of Quantitative Chemical Analysis: Pearson Education India, 2009. 4) Sharma B. K., Industrial Chemistry: Goel publishing House, Meerut, 2000. 5) Svehla G., Sivasankar B., Vogel's Text Book of Qualitative Inorganic Analysis: Pearson Education India, 2012.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation (20Marks): • CCE-I : Compulsory home assignment (10 Marks) • CCE-II : Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III : Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:- Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks	

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: Minor Practical III	Marks: 50
	Credits: 2	From: A. Y. 2025-26
	Name of the Course: BCP – 236: Minor Practical-III (Practicals Based on Course BCT 234 & 235)	
Course Objectives: Students should be able to...		
1) gain the knowledge of volumetric estimation and its application. 2) know the preparation of organic compounds and its mechanism. 3) analyze the unknown samples qualitatively and quantitatively. 4) learn the handling of various analytical instruments for analysis.		
Course Outcomes: After completion of the course, students will be able to...		
1) identify the unknown organic compounds and their structures. 2) estimate the unknown compound's concentration quantitatively. 3) perform small step preparations of industrially important compounds. 4) handle the various instruments for analysis.		
Title and Contents (Any 15 of the following)		Hrs
Organic Chemistry Section: 1. Organic Qualitative Analysis (Any 10 compounds) Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, succinic acid, oxalic acid, Phenols: Naphthol, resorcinol, p-nitrophenol, Bases: p-nitroaniline, o-nitroaniline, m-nitroaniline, diphenylamine. Neutrals: Acetanilide, ethyl methyl Ketone, Acetophenone, Benzophenone, Benzaldehyde, methyl acetate, Chloro-benzene, bromo benzene, Nitrobenzene, m-dinitrobenzene, naphthalene, thiourea etc. 2. Organic Estimations 1. Determine the amount of acetone in the given solution. 2. Determine the amount glycine in the given solution. 3. Organic Preparations (Any 3) 3.1 Preparation of benzoic acid from benzamide. 3.2 Preparation of p-nitroacetanilide from acetanilide. 3.3 Preparation of phthalimide from Phthalic anhydride. 3.4 Preparation of dihydropyrimidone from benzaldehyde, ethyl acetoacetate and Urea. 3.5 Preparation of Dibenzalpropanone from benzaldehyde and acetone. 3.6 Preparation of Orange II dye from sulphanilic acid. Analytical Chemistry Section: 4. Thin-layer chromatography (TLC): Demonstration of the separation and identification of compounds, and determination of R _f values. 5. Colorimetry- Determination of unknown concentration of a given solution of KMnO ₄ by colorimetry (Verification of Beer- Lambert law). 6. pH Metry- Determination of pH of given water / soil samples. 7. Estimations- (Any three) 7.1. Determination of titrable acidity in the given sample of milk/lassi using supplied sodium hydroxide. 7.2. Determination of the percentage purity of boric acid using supplied NaOH. 7.3. Determination of nitrogen content in a urea fertilizer Sample.		60

7.4. Determination of the value of chemical oxygen demand (COD) of a given water sample.	
References Books: 1) Furniss, B. S., Hannaford, A. J., Smith, P. W. G. , Tatchell, A., Vogel's Practical Organic Chemistry. 5th Edition, Longman Scientific & Technical, 1989. 2) Khopkar, S. M., Basic Concepts in Analytical Chemistry. New Age International Ltd., 2017. 3) Mendham, J., Sivasankar, B. Vogel's Text Book of Quantitative Chemical Analysis. Pearson Education India, 2009. 4) Pandey, O. P., Bajpai, D. N., Giri, S., Practical Chemistry: For B.Sc. I, II and III Year Students of All India Universities, 2010. 5) Sharma, B. K., Industrial Chemistry. Goel Publishing House, Meerut, 2000. 6) Venkateswaran, V., Basic Principles of Practical Chemistry. Sultan Chand and Sons, 2012. 7) Verma, N. K., Vermani, B. K., Verma, N., Comprehensive Practical Chemistry. Laxmi Publication (P) Ltd., 2010. 8) Vogel, Arthur, Vogel's Text Book of Quantitative Analysis. Longman, 1989.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 marks) • Journal:10Marks • Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) • Experiment 1: 20 Marks • Experiment 2: 10 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: VSC	Marks: 50
	Credits: 02	From: A. Y. 2025-26
Name of the Course: BCPVSC – I: Food Quality Analyst		
Course Objectives: Students should be able to... 1) collect and handling the various food samples. 2) study the different quality parameters of food adulteration and analysis. 3) understand the chemistry involved in the properties and reactions of various foods and its components. 4) learn analytical results and apply quality control techniques to ensure the safety and quality of food products.		
Course Outcomes: After completion of the course, students will be able to... 1) handle the various samples of food for their safety analysis. 2) measure the adulteration of food using qualitative and quantitative methods of analysis. 3) demonstrate the properties of different food components and interactions among these components modulate the specific quality attributes of food systems. 4) apply standard laboratory techniques and analytical instruments for food quality testing and quality assurance.		
Title and Contents		Hrs
1. Collection and preservation of food samples for routine analysis. 2. Determination of titratable acidity of milk. 3. Determination of titratable acidity of lassi. 4. Determination of SAP value in given oil samples. 5. Determination of moisture content in biscuits. 6. Determination of moisture content in bread. 7. Determination of the Iodine Value of oil. 8. Determination of ash content and acid-insoluble ash of turmeric. 9. Determination of acid value of given an oil samples. 10. Determination of specific gravity of given oil samples. 11. Determination of refractive index of given oil samples. 12. Determination of Vitamin C by titration method. 13. Qualitative detection of adulterants in Atta, Maida, Besan, Biscuit, Black pepper, Butter, Ghee, Chilli, Powder, Honey, Tea, Turmeric powder, soft drink. 14. Test for adulterants in Sugar, Jaggery, Honey, Milk, Ghee, plantation crops (Tea, coffee), Turmeric, spices (Cardamom, cloves, pepper) 15. Determination of titratable acidity in fruit juice		60
References Books: 1) AOAC, Official methods of Analysis, 18 th Ed, Gaithersburg, Mary Land, 2007. 2) Pingale S.V. Storage facilities, Foodgrain Technologists' Research Association of India, 1970 Ranganna S., Hand book of analysis and quality control for fruit & vegetable products, Tata McGraw-Hill, 1986 3) Swaminathan M., Advanced Text Book on Food & Nutrition, The Bangalore Printing & Publishing Co. Ltd, Vol. II, 2020 4) Nielsen S. S., Food Analysis, 5th Edition, Springer International Publishing, Cham, Switzerland, 2017.		

Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 marks) • Journal:10Marks • Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) • Experiment 1: 20 Marks • Experiment 2: 10 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: SEC	Marks: 50
	Credits: 02	From: A. Y. 2025-26
Name of the Course: BCPSEC-I: Water Quality Analyst		
Course Objectives: Students should be able to... 1) study the collection and handling the various water samples. 2) learn the preparation of water samples for analysis. 3) know the different quality parameters of water analysis. 4) acquire practical skills in sampling, preservation, and analysis of drinking water, surface water, groundwater, and wastewater.		
Course Outcomes: After completion of the course, students will be able to... 1) handle the various samples of water for analysis. 2) measure the quality parameters of water such as pH, conductance, BOD, COD, TDS, Hardness etc. 3) perform the experiments using qualitative and quantitative methods of analysis. 4) prepare technical reports and implement quality assurance and quality control (QA/QC) practices in water quality monitoring laboratories.		
Title and Contents (Any 15 of the following)		Hrs
1. Determination of odour and temperature of water samples. 2. Determination of pH of water samples. 3. Determination of redox potential of water samples. 4. Determination of electrical conductivity of water samples. 5. Determination of turbidity of water samples. 6. Determination of total suspended solids of water samples. 7. Determination of total dissolved solids of water samples. 8. Determination of salinity of water samples. 9. Determination of total acidity of water samples. 10. Determination of total alkalinity of water samples. 11. Determination of total hardness of water samples. 12. Determination of sodium content of water samples. 13. Determination of calcium content of water samples. 14. Determination of potassium content of water samples. 15. Determination of aluminium in water samples. 16. Determination of COD of water samples. 17. Field Visit and project.		60
References Books: 1) Gopinath V. R., Vanitha G., Systematic Methods of Water Quality Parameters Analysis: Analytical Methods: Partridge Publishing Singapore, 2021. 2) Wagh G. S., Experimental Methods for Water Analysis: Nirali Prakashan, 2nd Ed., 2017. 3) Sawyer C. N., McCarty P. L. and Parkin G. F., Chemistry for Environmental Engineering and Science, 5th Ed., McGraw-Hill Education, New York, 2003. 4) Patnaik P., Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil and Solid Wastes, 2nd Ed., CRC Press, Boca Raton, 2004.		

Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 marks) • Journal:10Marks • Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) • Experiment 1: 20 Marks • Experiment 2: 10 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- III
	Type: IKS	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCTIKS II : Chemistry in Ayurveda		
Course Objectives: Students should be able to...		
1) understand the historical background and fundamental principles of Ayurveda. 2) learn modern extraction techniques and the importance of standardizing herbal extracts. 3) know major classes of phyto chemicals and their therapeutic actions. 4) Gain the knowledge of basic methods for analyzing and ensuring the quality of Ayurvedic formulations.		
Course Outcomes: After completion of the course students will be able to...		
1) get an elementary idea about the origin of Ayurveda. 2) use various chemical context of ayurvedic formulations 3) apply major classes of phyto chemicals and their therapeutic actions. 4) perform the various extractions, distillation and other modern methods and test parameters.		
Module	Title and Contents	Hrs
Module-1	Introduction 1.1 History and overview of Ayurveda 1.2 Classification of Ayurvedic Drugs, Plant parts used in Ayurveda 1.3 Good Agricultural Practices 1.4 Drug Development for Ayurveda and Siddha medicines	07
Module-2	Modern extraction methods and standardization of extracts 2.1 Extraction: Conventional methods vs new techniques, Decoction, Forced Extraction. 2.2 Counter current extraction, Microwave-assisted extraction (MAE), Ultrasonic Extraction (UAE), Supercritical fluid extraction (SFE), Drying of extracts, Strength and limitation of various extraction techniques. 2.3 Standardization: Importance of natural configuration of compounds. 2.4 Understanding the concept of standardization, Extract equivalency & dosage	08
Module-3	Pharmacological actions of chemical constituents 3.1 Alkaloids, Flavonoids, Terpenoids. 3.2 Bitters, plant steroids, Cardioactive glycosides. 3.3 Anthraquinones, Coumarins, Saponins, Essential oils.	08
Module-4	Analysis of Ayurveda medicines 4.1 Qualitative and quantitative checking of phytochemical constituents in Ayurvedic formulations. 4.2 Test parameters for Raw Plant Material, Plant Extract, 4.3 Arka/ Distillates, Asava and Arishta (Fermented Liquids), Chewing Candy, Chuma/Choomam (Fine Powder) / Kvatha Chuma/ Kudinir Choomam (Corase Powder for Decoction), Lepa/Malhara/Kalimbu/Pasai/Medicated Wax/Cream/Poultice	07
Reference Books:		
1) Caldecott Todd, Ayurveda: The divine science of life, Elsevier, 2006 2) General guidelines for drug development of ayurvedic formulations vol. I, central council for research in ayurvedic sciences, ministry of ayush, Govt, of India, JK Offset Graphics Pvt. Ltd., 2018.		

- 3) Khare C. P., Chandra Kant Katiyar, The Modern Ayurveda Milestones Beyond the Classical Age, CRC Press Taylor & Francis Group, 2012.
- 4) Khare C. P., Evidence-based Ayurveda Defining a New Scientific Path, 2020.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks): • CCE-I: Compulsory home assignment (10 Marks) • CCE-II: Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. II		Semester- IV
	Type: Major- VII		Marks: 50
	Credits: 2		From: A. Y. 2025-26
Name of the Course: BCT 241: Physical Chemistry			
Course Objectives: Students should be able to...			
1) understand the basic concepts related to conductance. 2) learn the Galvanic cell, its types and applications of EMF measurement. 3) know the properties of liquids. 4) study the theories of reaction rates.			
Course Outcomes: After completion of the course, students will be able to...			
1) describe the conductance and related terms. 2) construct the Galvanic cell and derives equation for emf of cells. 3) explain physical properties of liquids. 4) find rate of chemical reactions.			
Module	Title and Contents		Hrs
Module-1	Electrochemistry Part I: Electrolytic Conductance and Transference 1.1 Electrolysis and Faraday’s laws of Electrolysis, Conduction of electricity, and Types of conductors: Electronic and Electrolytic. 1.2 Explanation of the terms: Specific, equivalent and molar conductance, relation between specific and equivalent conductance, variation of conductance with dilution, equivalent conductance at infinite dilution. 1.3 Migration of ions, Hittorf’s rule, Transport number, Determination of transport number by Moving boundary method, Factors influencing transport number: Nature of electrolyte, Concentration, Temperature, Complex formation, Abnormal transport number, Degree of hydration 1.4 Kohlrausch law and application of conductance measurement: (1) Relationship between ionic conductance, ionic mobility and transport number. (2) Determination of equivalent / molar conductance at infinite dilution for weak electrolytes. (3) Determination of degree of dissociation. (4) Determination of ionic product of water. (5) Determination of solubility and solubility product of sparingly 1.5 Numerical problem		08
Module-2	Electrochemistry Part II: Electromotive Force: 2.1 Galvanic cells: Concept of EMF of a cell, Measurement of EMF of a Cell, Standard electrode potential 2.2 Nernst equation and its importance 2.3 Types of electrodes: Metal/Metal ion electrode, Amalgam electrode, Gas electrode, Metal insoluble salt electrode, Oxidation reduction Electrode. 2.4 Calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data, pH determination using hydrogen electrode and quinhydrone electrode.		08

Module-3	Physical Properties of Liquids 3.1 Classification of physical properties. 3.2 Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's Viscometer. 3.3 Refractive index, measurement of refractive index by Abbe's refractometer, specific and molecular refraction, molecular refractivity. 3.4 Surface Tension: Surface tension and its determination using Stalagmometer and differential capillary rise method. 3.5 Numerical problems	07
Module-4	Chemical Kinetics 4.1 Third order reactions – derivation of rate constant, Characteristics of Third-order reactions, Examples of third order reaction. 4.2 Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation. Effect of catalyst 4.3 Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions (only quantitative aspect, derivation not expected) 4.4 Numerical problems	07
Reference Books: - 1) Atkins P. W., Paula Julio de, Elements of Physical Chemistry: Oxford University Press., 2012 2) Bahl B. S., Tuli G. D., Essentials of Physical Chemistry, 2010 3) Dash U. N., Darmarha U. N., Soni P. L., Text Book of Physical Chemistry: S. Chand & Sons., 2016 4) Dogra S. K., Dogra D., Physical Chemistry through Problems, Wiley Eastern Ltd., 1984 5) Puri B. R., Sharma L. R., Pathania M. S., Principles of Physical Chemistry: Vishal Publishing Company, 4 th edition., 2013.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation (20Marks) • CCE-I: Compulsory home assignment (10 Marks) • CCE-II: Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.		End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. II		Semester- IV
	Type: Major-VIII		Marks: 50
	Credits: 2		From: A. Y. 2025-26
Name of the Course: BCT 242: Inorganic Chemistry			
Course Objectives: Students should be able to...			
1) study the periodic properties of transition elements. 2) know the characteristic properties of Lanthanides and Actinides. 3) understand the difference between co-ordinate bond, double salts and complex salt. 4) learn the chelating agent and its application.			
Course Outcomes: After completion of the course, students will be able to...			
1) explain the characteristic properties of transition elements. 2) draw the electronic configuration of lanthanides and actinides. 3) differentiate between double salt and complex salt. 4) classify the various chelating agents and complexes.			
Module	Title and Contents		Hrs
Module-1	Elements of First Transition Series 1.1 Position of elements in the periodic table 1.2 Characteristics of d-block elements, with special reference to atomic size, reactivity, catalytic activity, density, melting and boiling point, 1.3 Electronic structure, Oxidation states, Magnetic character, Colored ions and Complex formation.		07
Module-2	Lanthanide and Actinides 2.1 Introduction of lanthanides, Objectives 2.2 General Features-electronic configuration, oxidation states & ionic radii 2.3 Lanthanide contraction, Separation of Lanthanide. 2.4 Introduction to Actinides 2.5 General features- electronic configuration, oxidation states & ionic radii		07
Module-3	Co-ordination Chemistry 3.1 Introduction-Definition and formation of coordinate covalent bond. 3.2 Distinction between double salt and complex salt 3.3 Werner's theory-Postulates and its applications to cobalt amines viz. $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$. 3.4 Description of the terms- ligand, coordination number, coordination sphere, Effective atomic number, 3.5 IUPAC nomenclature of coordination compounds 3.6 Valence bond theory of transition metal complex w.r.t C.N.4, complexes of Cu and Ni, C.N. 6 complexes of Fe and Co 3.7 Crystal field splitting of d-orbital in octahedral, tetrahedral & square planar complexes. Factors affecting to the Crystal field parameters, High spin & low spin octahedral complexes of Co (II), 3.8 Crystal field stabilization energy (CFSE), Limitations of CFT.		09

Module-4	Chelation 4.1 A brief introduction with respect to ligands, chelating agent, chelation and metal chelates. 4.2 Structural requirements of chelate formation, Difference between metal chelate and metal complex. 4.3 Classification of chelating agents (with specific illustration of bidentate chelating agents). 4.4 Application of chelation with respect to chelating agents- EDTA and DMG.	07
Reference Books: - 1) Gopalan R, Ramalingam V. Concise Co-ordination Chemistry, Vikas Publishing House Pvt. Ltd., 2001. 2) Kaur H., Instrumental Methods of Chemical Analysis: Pragati Prakashan, Meerut, 2016. 3) Lee J. D., Concise Inorganic Chemistry: Oxford University Press, 2008. 4) Puri B.R., Sharma L.R., Kalia K.C., Principles of Inorganic Chemistry: Vishal Publishing Company, 2020. 5) Sharma B. K., Industrial Chemistry: Goel publishing House, Meerut, 2016.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation (20Marks): • CCE-I: Compulsory home assignment (10 Marks) • CCE-II: Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- IV
	Type: Major Practical IV	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCP – 243: Major Practical-III (Practicals Based on Course BCT 241 & 242)		
Course Objectives: Students should be able to... 1) study physical properties of liquid like viscosity, refractive index and conductance etc. 2) understand the reaction rate equation and reaction rate constant, as well as the relationship between chemical reaction rates and reactant concentrations. 3) know preparation methods of various inorganic compounds specially the coordination complex. 4) learn the qualitative, quantitative estimations and inorganic semi-micro qualitative analysis.		
Course Outcomes: After completion of the course, students will be able to... 1) find viscosity, Refractive index and conductance etc. of given liquid samples. 2) recognize the order of reaction and calculate the rate constant. 3) estimate the amount of metal by gravimetric method. 4) prepare inorganic coordination complex compounds and identify the unknown radicals present in inorganic binary mixtures.		
Title and Contents (Any 15 of the following)		Hrs
Section I-Physical Chemistry: Instrumental 1. Viscosity: Determination of percentage composition of a given liquid mixture by viscosity method (Density data to be given). 2.Refractometry: Determination of specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer & hence determination of the refraction of -CH ₂ - group (Methylene group) 3.Conductometry: 3.1 Determination of cell constant of a conductivity cell using standard KCl (N/10 or N/50) solutions 3.2 Determination of degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically. 3.3 Determination of the normality of the given strong acid by titrating it against strong alkali conductometrically. 3.4 Determination of the normality of the given weak acid by titrating it against strong alkali conductometrically. Non-Instrumental 4.Chemical Kinetics 4.1 Study the hydrolysis of methyl acetate in presence of HCl and H ₂ SO ₄ and to determine the relative strength of acids. 4.2 Study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester. 4.3 Study the kinetics of the reaction between K ₂ S ₂ O ₈ and KI in solution with unequal initial concentration of the reactants 4.4 Study the reaction between potassium bromate and potassium iodide (KBrO ₃ & KI) in solution and hence to determine the order of the reaction.		60

Section II-Inorganic Chemistry: 5. Gravimetric Analysis: 5.1 Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid. 5.2 Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid. 6. Inorganic Preparations: 6.1 Preparation of ferrous ammonium sulphate (Mohr's salt) 6.2 Preparation of tetrammonium copper (II) sulphate 6.3 Preparation of chloropentammine cobalt (III) chloride 7. Titrimetric Estimations: 7.1. Determination of percentage purity of given sample of soda ash 7.2. Determination of total hardness of water using 0.01M EDTA solution 7.3. Determination of Percentage purity of tetrammine copper (II) Sulphate 8. Inorganic Semi-micro Qualitative Analysis: Analysis of Inorganic binary mixture : (Any five mixtures) Anions: Cl^- , Br^- , NO_3^- , NO_2^- , SO_4^{2-} , CO_3^{2-} Cations: Cd^{+2} , Fe^{+2} , Al^{+3} , Cr^{+3} , Zn^{+2} , Mn^{+2} , Co^{+2} , Mg^{+2} , K^+ , NH_4^+ , Ba^{+2} , Cu^{+2}	
Reference Books: 1) Arora C., Bhattacharya S., Advanced Physical Chemistry Practical Guide, 2022. 2) Chand S., Venkateswaran V., Basic Principles of Practical Chemistry: Sultan Chand and Sons., 2012. 3) Pandey O. P., Bajpay D. N., Giri S., Practical Chemistry: For B. Sc. I, II and III year students of all India Universities, 2010. 4) Verma N. K., Vermani B. K., Verma N., Comprehensive Practical Chemistry: Laxmi Publication (P) LTD., 2010 5) Vogel Arthur, Bassett John., A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumentation Analysis: Longman Sc and Tech., 1980. 6) Vogel Arthur., Vogel's Text Book of Quantitative Analysis: Longman, 1989.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 marks) - Journal: 10 Marks - Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) - Experiment 1: 20 Marks - Experiment 2: 10 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. II	Semester- IV	
	Type: Minor -VII	Marks: 50	
	Credits: 2	From: A. Y. 2025-26	
Name of the Course: BCT 244: Principles of Physical Chemistry			
Course Objectives: Students should be able to...			
1) understand the basic concepts related to conductance.			
2) learn the process of distribution of solute.			
3) know the properties of liquids.			
4) study application of first law of thermodynamics to chemical reactions.			
Course Outcomes: After completion of the course, students will be able to...			
1) describe the conductance and related terms.			
2) explain the distribution phenomenon and its applications.			
3) find physical properties of liquids.			
4) discuss the applications of first law of thermodynamics to the reactions.			
Module	Title and Contents		Hrs
Module-1	Electrochemistry 1.1 Electrolysis and Faraday’s laws of Electrolysis, Conduction of electricity, and Types of conductors: Electronic and Electrolytic. 1.2 Explanation of the terms: Specific, equivalent and molar conductance, relation between specific and equivalent conductance, variation of conductance with dilution, equivalent conductance at infinite dilution. 1.3 Migration of ions, Hittorf’s rule, Transport number, Determination of transport number by Moving boundary method, Factors influencing transport number: Nature of electrolyte, Concentration, Temperature, Complex formation, Abnormal transport number, Degree of hydration 1.4 Kohlrausch law and application of conductance measurement: 1. Relationship between ionic conductance, ionic mobility and transport number. 2. Determination of equivalent / molar conductance at infinite dilution for weak electrolytes. 3. Determination of degree of dissociation. 1.5 Numerical problem		08
Module-2	Distribution Law 2.1 Introduction, Nernst’s distribution law and its limitations, 2.2 Modifications of distribution law with respect to change in molecular state of solute, 2.3 Applications of distribution law (i) the process of extraction (ii) determination of solubility of solute in particular solvent (iii) distribution indicators (iv) determination of molecular weight of solute in different solvents. 2.4 Numerical Problems		08
Module-3	Physical Properties of Liquids 3.1 Classification of physical properties. 3.2 Viscosity, coefficient of viscosity, determination of viscosity by Ostwald’s		07

	Viscometer. 3.3 Refractive index, measurement of refractive index by Abbe's refractometer, specific and molecular refraction, molecular refractivity. 3.4 Surface Tension: Surface tension and its determination using Stalagmometer and differential capillary rise method. 3.5 Numerical problems.	
Module-4	Thermochemistry 4.1 Important Principles and definitions of thermochemistry, 4.2 Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution 4.3 calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, 4.4 Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. 4.5 Numerical problems	07

Reference Books:

- 1) Bahl B. S., Tuli G. D., Essentials of Physical Chemistry: S. Chand & Sons. 2010.
- 2) Dash U. N., Darmarha U. N., Soni P. L., Text Book of Physical Chemistry: S. Chand & Sons. 2016.
- 3) Atkins P. W., Paula Julio de, Elements of Physical Chemistry: Oxford University Press, 2012.
- 4) Dogra S. K., Dogra D., Physical Chemistry through Problems, Wiley Eastern Ltd., 1984.
- 5) Puri B. R., Sharma L. R., Pathania M. S., Principles of Physical Chemistry: Vishal Publishing Company, 4th edition., 2013.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation (20Marks): • CCE-I: Compulsory home assignment (10 Marks) • CCE-II: Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10 marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks
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Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Chemistry

Programme: B. Sc. II

Semester- IV

Type: Minor-VIII

Marks: 50

Credits: 2

From: A. Y. 2025-26

Name of the Course: BCT 245: Principles of Inorganic Chemistry

Course Objectives: Students should be able to...

- 1) study the periodic properties of s and p block elements.
- 2) know the characteristic properties of transition & inner-transition elements.
- 3) learn the importance of bio-inorganic chemistry and the role of elements in biological processes.
- 4) acquire practical understanding of the preparation, reactions, and applications of important inorganic compounds.

Course Outcomes: After completion of the course, students will be able to...

- 1) explain the characteristic properties of s and p-block elements.
- 2) discuss the properties of transition elements, lanthanides and actinides.
- 3) describe the role of elements in biological processes.
- 4) perform laboratory experiments related to the synthesis, identification, and characterization of inorganic compounds following safe laboratory practices.

Module	Title and Contents	Hrs
Module-1	Chemistry of s- and p-block Elements 1.1 Introduction 1.2 Physical properties: valency, atomic radii, ionic radii, ionization energy, electron affinity and electro negativity 1.3 Important compounds: oxacids, Boranes, Silicates, Phosphazenes	08
Module-2	Chemistry of Transition Elements 2.1 Introduction: Definition and position in Periodic table 2.2 Electronic configuration and oxidation states of 3d, 4d and 5d series elements 2.3 Applications of transition elements in industrial processes.	07
Module-3	Chemistry of Inner-Transition Elements 3.1 Introduction of lanthanides, Objectives 3.2 General Features-Electronic Configuration, Oxidation states and ionic radii 3.3 Lanthanide contraction, Separation of Lanthanide. 3.4 Introduction of Actinides 3.5 General features-Electronic Configuration, Oxidation States & ionic radii.	08
Module-4	Introduction to Bioinorganic Chemistry: 4.1 Role of metal ions in biological systems. 4.2 Hemoglobin and Myoglobin (Iron in biology). 4.3 Role of Mg in chlorophyll and Zn in enzymes.	07

Reference Books:

- 1) Gopalan R., Ramalingam V., Concise Co-ordination Chemistry: Vikas Publishing House Pvt. Ltd., 2008.
- 2) Kaur H., Instrumental Methods of Chemical Analysis: Pragati Prakashan Meerut, 2016.
- 3) Lee J. D., Concise Inorganic Chemistry: Oxford University Press, 2008.
- 4) Puri B. R., Sharma L. R., Kalia K. C., Principles of Inorganic Chemistry: Vishal Publishing Company, 2020.

Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20Marks) • CCE-I: Compulsory home assignment (10 Marks) • CCE-II Short & long answer question Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each) • CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks Note:-Best two scores of CCE will be considered out of three.	End Semester Examination (30Marks): • Question-1: Solve the following questions (five questions of 2 marks) 10 M • Question-2: Attempt any two questions (three questions of 10 marks) 20 M • Question-3: Attempt any four questions (six questions of 5 marks) 20 M Note: Conversion of 50 marks of ESE to 30 marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- IV
	Type: Minor Practical-IV	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCP-246: Minor Practical Course-IV (Practicals Based on Course BCT 244 & 245)		
Course Objectives: Students should be able to... 1) study physical properties of liquid like viscosity, refractive index and conductance etc. 2) understand the reaction rate equation and reaction rate constant, as well as the relationship between chemical reaction rates and reactant concentrations. 3) gain knowledge of preparation methods of various inorganic compounds specially the coordination complex. 4) learn the qualitative, quantitative estimations and Inorganic semi-micro qualitative analysis.		
Course Outcomes: After completion of the course, students will be able to... 1) find viscosity, Refractive index and conductance etc. of given liquid samples. 2) recognize the order of reaction and calculate the rate constant. 3) estimate the amount of metal by gravimetric method. 4) prepare inorganic coordination complex compounds and identify the unknown radicals present in inorganic binary mixtures.		
Title and Contents (Any 15 of the following)		Hrs
Section I-Physical Chemistry: Instrumental 1. Viscosity: Determination of percentage composition of a given liquid mixture by viscosity method (Density data to be given). 2. Refractometry: Determination of specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer & hence determination of the refraction of -CH₂- group (Methylene group) 3. Conductometry: 3.1 Determination of cell constant of a conductivity cell using standard KCl (N/10 or N/50) solutions 3.2 Determination of degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically. 3.3 Determination of the normality of the given strong acid by titrating it against strong alkali conductometrically. 3.4 Determination of the normality of the given weak acid by titrating it against strong alkali conductometrically. Non-Instrumental 4. Chemical Kinetics 4.1 Study the hydrolysis of methyl acetate in presence of HCl and H₂SO₄ and to determine the relative strength of acids. 4.2 Study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester. 4.3 Study the kinetics of the reaction between K₂S₂O₈ and KI in solution with unequal initial concentration of the reactants 4.4 Study the reaction between potassium bromate and potassium iodide (KBrO₃ & KI) in		60

solution and hence to determine the order of the reaction.

Section II-Inorganic Chemistry:

5. Gravimetric Analysis:

- 5.1 Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid.
- 5.2 Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid.

6. Inorganic Preparations:

- 6.1 Preparation of ferrous ammonium sulphate (Mohr's salt)
- 6.2 Preparation of tetrammonium copper (II) sulphate
- 6.3 Preparation of chloropentammine cobalt (III) chloride

7. Titrimetric Estimations:

- 7.1 Determination of percentage purity of given sample of soda ash
- 7.2 Determination of total hardness of water using 0.01M EDTA solution
- 7.3 Determination of Percentage purity of tetrammine copper (II) Sulphate

8. Inorganic Semi-micro Qualitative Analysis: Analysis of Inorganic binary mixture : (Any five mixtures)

Anions: Cl^- , Br^- , NO_3^- , NO_2^- , SO_4^{2-} , CO_3^{2-}

Cations: Cd^{+2} , Fe^{+2} , Al^{+3} , Cr^{+3} , Zn^{+2} , Mn^{+2} , Co^{+2} , Mg^{+2} , K^+ , NH_4^+ , Ba^{+2} , Cu^{+2}

References Books:

- 1) Arora C., Bhattacharya S., Advanced Physical Chemistry Practical Guide, 2022.
- 2) Chand S., Venkateswaran V., Basic Principles of Practical Chemistry: Sultan Chand and Sons., 2012.
- 3) Pandey O. P., Bajpay D. N., Giri S., Practical Chemistry: For B. Sc. I, II and III year students of all India Universities, 2010.
- 4) Verma N. K., Vermani B. K., Verma N., Comprehensive Practical Chemistry: Laxmi Publication (P) LTD., 2010
- 5) Vogel Arthur, Bassett John., A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumentation Analysis: Longman Sc and Tech., 1980.
- 6) Vogel Arthur., Vogel's Text Book of Quantitative Analysis: Longman, 1989.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation (20 marks)

- Journal: 10 Marks
- Students Performance & attendance: 10 Marks

End Semester Evaluation: (30 Marks)

- Experiment 1: 20 Marks
- Experiment 2: 10 Marks

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- IV
	Type: VSC	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCPVSC – II : Fertilizer Quality Analyst		
Course Objectives: Students should be able to... 1) know in fertilizer analysis techniques for precise NPK content determination. 2) acquire titration skills to assess nitrogen levels in diverse fertilizer types. 3) develop practical skills in the determination of essential plant nutrients such as nitrogen, phosphorus, potassium, and micronutrients in fertilizer samples. 4) explain the classification, composition, and properties of organic, inorganic, and bio-fertilizers.		
Course Outcomes: After completion of the course, students will be able to... 1) perform fertilizer analysis, especially moisture, nitrogen determination. 2) conduct titration for nitrogen quantification in diverse Fertilizers. 3) apply quality control and quality assurance (QA/QC) practices in fertilizer testing laboratories and industries. 4) interpret analytical results, prepare technical reports, and recommend appropriate measures to ensure fertilizer quality and regulatory compliance.		
Title and Contents (Any 15 of the following)		Hrs
1 Determination of total nitrogen in organic manure by Kjeldahl's method. 2 Estimation of total nitrogen in plant sample. 3 Estimation of Zn in zinc sulphate. 4 Determination of moisture from sludge fertilizer. 5 Determination of moisture from organic fertilizer. 6 Determination of nitrogen content in given ammonium chloride fertilizer by titration method. 7 Determination of nitrogen content in given nitro-phosphate fertilizer by titration method. 8 Determination of nitrogen content in given NPK fertilizer by titration method. 9 Determination of nitrogen content in given vermin-compost fertilizer by titration method 10 Study sampling of organic manure, solid and liquid fertilizers 11 Study physical properties of organic manure and fertilizer. 12 Estimation of calcium and magnesium in fertilizers by EDTA method 13 Determination of sulphur in fertilizers by EDTA gravimetric method 14 To determine the particle diameter of Triple super phosphate by dry type sieve. 15 Determination of the particle diameter of NPK with a dry type sieving analysis. 16 To determine the particle diameter of Ammonium chloride by dry type sieve.		60
References Books: 1) Smith P. H., Johnson R. E., Practical Guide to Fertilizers: Properties, Processes, and Applications. Wiley-Blackwell, 2003 2) Tandon H. L. S., Methods of Analysis of Soils, Plants, Waters, Fertilizers & Organic Manures. Fertilizer Development and Consultation Organization, 1996. 3) Brady N. C. and Weil R. R., The Nature and Properties of Soils, 15th Ed., Pearson Education, 2016. 4) Jackson M. L., Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.		
Evaluation Pattern: 60:40		
Total Marks: 50		

Continuous Comprehensive Evaluation (20 marks) • Journal:10Marks • Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) • Experiment 1: 20 Marks • Experiment 2: 10 Marks
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- IV
	Type: SEC	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCPSEC–II : Soil Quality Analyst		
Course Objectives: Students should be able to... 1) acquire the collection and handling the various soil samples. 2) learn the preparation of soil samples for analysis. 3) study the different quality parameters of soil analysis 4) understand the fundamental concepts of soil science, soil composition, and factors affecting soil quality.		
Course Outcomes: After completion of the course, students will be able to... 1) handle the various samples of soil for analysis. 2) measure the quality parameters of soil such as pH, conductance, fertility, productivity, heavy metal contamination etc. 3) perform the experiments using qualitative and quantitative methods of analysis. 4) evaluate soil fertility, nutrient status, and contamination levels in accordance with established soil quality standards.		
Title and Contents (Any 15 of the following)		Hrs
1. Soil Profile study 2. Visit to Soil Testing Laboratory & Report writing. 3. Visit to Farmers Fields for Collection of Soil Samples, identification of nutrient deficiency Symptoms in Crop. 4. Preparation of Various Chemical reagents required for soil testing. 5. Processing of Soil Sampling for analysis. 6. Determination of pH of soil sample using pH meter. 7. Determination of Electrical Conductivity of Soil Sample using Electrical Conductivity meter. 8. Determination of Organic Carbon by wet Oxidation method. 9. Determination of available Nitrogen from Soil Samples. 10. Determination of available phosphorus from soil samples. 11. Determination of available Potassium from soil samples. 12. Determination of Calcium Carbonate from soil samples. 13. Determination of micronutrients from soil samples. 14. Determination of Gypsum requirement of Soil. 15. Preparation of soil test report, Interpretation of result and fertilizer recommendation. 16. Field Visit and project.		60
References Books: 1) Gupta I. C., Yaduvanshi N.P.S., Gupta S.K., Standard Method of Analysis of Soil, Plant and Water: Scientific Publishers, 1 st Ed, 2020. 2) Wagh G. S., Soil Testing Manual: Nirali Prakashan, 2017. 3) Black C. A. (Ed.), Methods of Soil Analysis, Part I & Part II, American Society of Agronomy, Madison, Wisconsin, 1965. 4) Tandon H. L. S., Methods of Analysis of Soils, Plants, Waters, Fertilizers & Organic Manures, Fertilizer Development and Consultation Organization (FDCO), New Delhi, 1996.		

Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 marks) • Journal:10Marks • Students Performance & attendance: 10 Marks	End Semester Evaluation: (30 Marks) • Experiment 1: 20 Marks • Experiment 2: 10 Marks

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. II	Semester- IV
	Type: VEC	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BCTVEC-II: Environmental Awareness for Chemistry		
Course Objectives: Students should be able to... 1) understand the current environmental issues. 2) know the environmental laws and ethics to protect environment. 3) realize the sustainable goals. 4) learn the role of chemistry in sustainable development.		
Course Outcomes: After completion of the course, students will be able to... 1) describe the various environmental issues. 2) discuss and implement the environmental laws and ethics. 3) implement sustainable goals in every practice related to environment. 4) conduct the experiments using energy efficient equipment and green methods.		
Module	Title and Contents	Hrs
Module-1	Environmental Issues 1.1 Pollution (Air, Water and Land), 1.2 Fresh water overuse 1.3 Natural disasters 1.4 Fuel and Energy storage due to overuse 1.5 Increase in wasteland, Biodiversity loss, Global warming and climate change	08
Module-2	Environmental Laws and Ethics 2.1 Environmental Protection Act, 2.2 Wildlife Protection Act, 2.3 Forest Conservation Act, 2.4 Prevention and Control of Pollution Act protection from unsustainable to sustainable development, 2.5 Responsibilities of an Environmentally aware citizen	08
Module-3	Sustainable Development Goals 3.1 Definition, Concept and strategies of sustainable development, 3.2 United Nation Conference on Environment and Development with special reference to agenda 21, CSR and sustainability, 3.3 Clean development mechanism, 3.4 Commission on sustainable development, 3.5 The world summit on sustainable development, threats to sustainable development, principles of sustainable development	07
Module-4	Role of Chemistry in Meeting the Sustainable Development Goals 4.1 Green Chemistry Principles 4.2 Study of different chemical reactions by using green chemistry principles. 4.3 Green Methods in practicals-Use of Micro kits in reactions, two burette system etc. 4.4 Green Equipments for Energy saving-Applications of Sonicator, Fuming Hood, Ultrasonic Probe, ETP, Microwave	07

References Books:

- 1) Anastas P. T., Warner J. C., Green Chemistry: Theory and Practice: OUP UK, 2005.
- 2) De A. K., Environmental Chemistry: New Age Publisher International Pvt Ltd, 1st Ed., 2016
- 3) Dey S. P., Sepay N., A Textbook of Green Chemistry: Techno World, 2022.
- 4) Nobel, B.J., Kormandy, E.J., Environmental Science, 1981.
- 5) Turk A., Turk, J., Wittes J. T., Wittes, R.E., Environmental Science: Atlantic Books, 1988.
- 6) Wanniski J., The Way the World Works: Gateway Editions, 1998.
- 7) Watt, K.E.F., Principles of Environmental Science: McGraw-Hill Book Company, 1973.

Evaluation Pattern: 60:40**Total Marks: 50****Continuous Comprehensive Evaluation (20Marks):**

- CCE-I: Compulsory home assignment (10 Marks)
- CCE-II: Short & long answer question
(Test/seminar/open book test/ quiz/case study/book review/field work/industrial visit (10 Marks each)
- CCE-III: Compulsory MCQ test (Each question for 1Mark) 10 Marks

Note:-Best two scores of CCE will be considered out of three.

End Semester Examination (30Marks):

- Question-1: Solve the following questions (five questions of 2 marks) 10 M
- Question-2: Attempt any two questions (three questions of 10 marks) 20 M
- Question-3: Attempt any four questions (six questions of 5 marks) 20 M

Note: Conversion of 50 marks of ESE to 30 marks