



Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. III Chemistry

Under

Faculty of Science and Technology

(As per NEP 2020)

With Effect from Academic Year 2026-27

Syllabus for Bachelor of Science (B. Sc.) Part –III Chemistry

PREAMBLE:

This updated syllabus is prepared for third year undergraduate students as per NEP 2020 guidelines. The main objective is to develop their interest towards chemistry as basic science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of instrumental techniques with the regular chemistry exercises will help to enhance analytical thinking of the students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at 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 prepare students for academic and industrial sector.

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: **2026-2027**

3. DURATION: **01 year**

4. PATTERN: **Semester Examination**

5. MEDIUM OF INSTRUCTION: **English**

6. ELIGIBILITY OF THE STUDENT: **B. Sc. II**

7. ELIGIBILITY OF THE CORE FACULTY: **As per the rule and regulation of UGC and Government of Maharashtra**

8. STRUCTURE OF COURSE: As per NEP-2020 (2.0)

Level	Sem.	Subject				AEC T	VSC	CEP	OJT	Total
		DSC		DSE*						
		T	P	T	P					
5.5	V	DSC I (2)	DSC P (2)	DSE I (2)	DSE P (2)	AEC III (2)	VSC III (2)	CEP (2)	OJT (4)	22
		DSC II (2)		DSE II (2)						
		DSC III (2)								

Level	Sem.	Subject				AEC T	VSC	SEC	CC	FP	Total
		DSC		DSE*							
		T	P	T	P						
5.5	VI	DSC I (2)	DSC P (2)	DSE I (2)	DSE P (2)	AEC IV (2)	VSC IV (2)	SEC III (2)	CC (2)	FP (2)	22
		DSC II (2)		DSE II (2)							
		DSC III (2)									

Note- For practical number of students = 12 Students

* DSE –One Paper out of two for each semester.

9. COURSE TITLE

1) Fifth Semester

Sr. No.	Subject	Course Code	Title of Paper	No of Lectures/ Practical per Week	Credits
1.	DSC I	BCT 351	Physical Chemistry	2	2
2.	DSC II	BCT 352	Inorganic Chemistry	2	2
3.	DSC III	BCT 353	Organic Chemistry	2	2
4.	DSE I	BCT 354	Analytical Chemistry	2	2
5.	DSE II	BCT 355	Industrial Chemistry		
6.	DSC P	BCP 356	Practical V (Based on BCT 351 and 352)	1	2
7.	DSE P	BCP 357	Practical VI (Based on BCT 353 and E1 354)/ (Based on BCT 353 and E2 355)	1	2
8.	AEC	AEC III		2	2
9.	VSC	BCPVSC III	Computer Skills for Chemist	1	2
10.	CEP	BCPCEP I	--	1	2
11.	OJT	BCPOJT I	--	2	4

2) Sixth Semester

Sr. No.	Subject	Course Code	Title of Paper	No of Lectures/ Practical per Week	Credits
1.	DSC I	BCT 361	Physical Chemistry	2	2
2.	DSC II	BCT 362	Inorganic Chemistry	2	2
3.	DSC III	BCT 363	Organic Chemistry	2	2
4.	DSE I	BCT 364	Analytical Chemistry	2	2
5.	DSE II	BCT 365	Industrial Chemistry		
6.	DSC P	BCP 366	Practical VII (Based on BCT 361 and BCT 362)	1	2
7.	DSE P	BCP 367	Practical VIII (Based on 363 and E1 364)/ (Based on 363 and E2 365)	1	2
8.	AEC	AEC IV		2	2
9.	VSC	BCPVSC IV	Instrumental Analyst	1	2
10.	SEC	BCPSEC III	Effluent Treatment Processes	1	2
11.	FP	BCFP I	--	2	2
12.	CC	BCTCC I	Youth and Shramdan	2	2

10. EVALUATION STRUCTURE: B. Sc. III NEP 2.0

Semester V (5.5)

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BCT 351	10	10	10	30	50	02
	T	BCT 352	10	10	10	30	50	02
	T	BCT 353	10	10	10	30	50	02
	P	BCP 356	20			30	50	02
DSE (1 Theory Paper Out of 2)	T	BCT 354	10	10	10	30	50	02
	T	BCT 355	10	10	10	30	50	
	P	BCP 357	20			30	50	02
AEC	T	AEC III	10	10	10	30	50	02
VSC	P	BCPVSC III	20			30	50	02
CEP	P	BCPCEP I	20			30	50	02
OJT	P	BCPOJT I	40			60	100	04
Total							550	22

Semester VI (5.5)

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BCT 361	10	10	10	30	50	02
	T	BCT 362	10	10	10	30	50	02
	T	BCT 363	10	10	10	30	50	02
	P	BCP 366	20			30	50	02
DSE (1 Theory Paper Out of 2)	T	BCT 364	10	10	10	30	50	02
	T	BCT 365	10	10	10	30	50	
	P	BCP 367	20			30	50	02
AEC	T	AEC IV	10	10	10	30	50	02
VSC	P	BCPVSC IV	20			30	50	02
SEC	P	BCPSEC III	20			30	50	02
CC	T	BCTCC I	10	10	10	30	50	02
FP	P	BCPFP I	20			30	50	02
Total							550	22

DSC: Discipline Specific Course; DSE: Discipline Specific Elective CCE:- Continuous Comprehensive Examination; AEC: Ability Enhancement Course; VSC: Vocational Skill Course; SEC: Skill Enhancement Course; OJT: On Job Training; FP: Field Project; CEP: Community Engagement Program, CC: Co-Curricular Course; T: Theory; P: Practical

11. OTHER FEATURES:

A) LIBRARY:

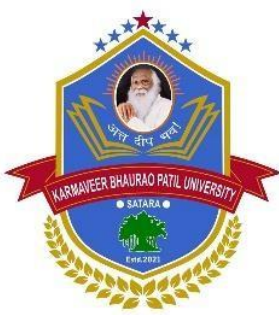
Reference books, Textbooks, Journals, and Periodicals are available in Institute and Departmental Library.
(Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENTS:

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

b) Laboratory Equipments:

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|-------------------------------|------------------------|
| 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 synthesis reactor | 10. Microwave oven |
| 11. Potentiometer | 12. Colorimeter |
| 13. Ultrasonicator | 14. Centrifuge machine |
| 15. Suction pump | 16. Refractometer |
| 17. Thermostat | 18. Ice Flaker |
| 19. Turbidimeter | |

	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. III	Semester– V	
	Type: DSC-I	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT 351: Physical Chemistry			
Course Objectives: Students should be able to...			
1. understand the basic concepts in elementary quantum mechanics. 2. know fundamentals of various spectroscopic techniques. 3. study the photochemical activation and deactivations of molecules. 4. learn electromotive force in reversible and irreversible cell and various types of cells.			
Course Outcomes: After completion of the course, students will be able to...			
1. apply operator concept to particle in one dimensional box. 2. derive energy equations for rotational, vibrational spectra of molecules. 3. draw and explain photochemical pathways using Jablonski diagram. 4. apply emf concept to various batteries used in day-to-day life.			
Module	Title and Contents		Hrs
Module-1:	Elementary Quantum Mechanics 1.1 Introduction and recapitulation 1.2 Dual nature of matter and energy: de Broglie Hypothesis. 1.3 The Heisenberg’s Uncertainty Principle. 1.4 Concept of Operator, Energy Operators (Hamiltonian Operator). 1.5 Derivation of Schrodinger Wave Equation. 1.6 Physical Interpretation of the Ψ and Ψ^2 . 1.7 Particle in a One-dimensional Box. Concept of Quantum numbers. 1.8 Numerical problems.		8
Module-2:	Spectroscopy 2.1 Introduction, Electromagnetic Radiation. 2.2 Interaction of radiation with matter, Electromagnetic Spectrum, Energy level diagram. 2.3 Rotational spectra of diatomic molecules: Rigid rotor model; moment of inertia; energy levels of rigid rotor, selection rules; Intensity of spectral lines, determination of bond length; isotope effect, Microwave oven. 2.4 Vibrational spectra of diatomic molecules: Simple Harmonic Oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, Overtones. 2.5 Raman spectra: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. 2.6 Comparative study of IR and Raman spectra, rule of mutual exclusion- CO ₂ molecule. 2.7 Numerical problems.		7
Module-3:	Photochemistry 3.1 Introduction, Difference between thermal and photochemical processes. 3.2 Laws of photochemistry: i) Grotthuss-Draper law, ii) Lambert law, iii) Lambert – Beer’s law (with derivation), iv) Stark - Einstein law.		8

	3.3 Quantum yield, Reasons for high and low quantum yield. Factors affecting Quantum yield. 3.4 Photosensitized reactions – Dissociation of H₂, Photosynthesis. 3.5 Examples of Photochemical reactions-Photo dimerization of anthracene, decomposition of HI and HBr. 3.6 Photo-physical and photochemical processes. 3.7 Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence. 3.8 Chemiluminescence, Electroluminescence and Bioluminescence 3.9 Numerical problems.	
Module-4:	Electromotive Force 4.1 Introduction, Recapitulation of Nernst equation, Reversible and Irreversible cells. 4.2 Electrochemical Cells: i) Chemical cells without transference. Concentration cells with and without transference. 4.3 Liquid – Liquid junction potential: Origin, elimination and determination. 4.4 Applications of emf measurements to determine Solubility and solubility product of sparingly soluble salts (based on concentration cell). 4.5 Introduction, Principle and example of i] Dye sensitized cell ii] Nuclear Fuel cell iii] Lithium-ion battery. 4.6 Numerical problems.	7

Reference Books: -

1. Bahl, B. S., and Tuli, G. D. Essential of Physical Chemistry. New Delhi: S. Chand, 1982
2. Banwell, C. N., and McCash, E. M. Fundamentals of Molecular Spectroscopy. 4th ed. New Delhi: Tata McGraw-Hill, 2006.
3. Chandra, A. K. Introductory Quantum Chemistry. New Delhi: Tata McGraw-Hill, 1994.
4. Puri, B. R., Sharma, L. R. and Pathania, M. S. Principles of Physical Chemistry. Jalandhar: Vishal Publishing Company, 2020.
5. Soni, P. L., Dharmarha, O. P. and Dash, U. N. Text Book of Physical Chemistry. New Delhi: Sultan Chand and Sons, 2011.

Evaluation Pattern: 60:40

Total Marks:50

Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II-Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (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-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. III	Semester– V
	Type: DSC-II	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCT-352: Inorganic Chemistry		
Course Objectives: Students should be able to... 1. learn metal ligand bonding in transition metal complexes. 2. understand properties of metal, semiconductors, superconductors and their applications. 3. study the fundamentals of organometallic chemistry. 4. learn types of catalysis and their industrial applications.		
Course Outcomes: After completion of the course, students will be able to... 1. explain isomerism and bonding in complexes. 2. describe semiconductors and superconductors. 3. discuss organometallic compounds of Li, Be, Al. 4. identify types of catalysis and discuss their applications.		
Module	Title and Contents	Hrs
Module-1:	Metal Ligand Bonding in Transition Metal Complexes 1.1 Isomerism in complexes with C.N. 4 and 6: Geometrical Isomerism, Optical Isomerism, Structural Isomerism-Ionization Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination Position Isomerism. 1.2 Molecular Orbital Theory (MOT): Introduction. Concept of Operator, Energy Operators (Hamiltonian Operator). 1.3 MOT of octahedral complexes with sigma bonding such as $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$, $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$. 1.4 Merits and demerits of MOT.	8
Module-2:	Metals, Semiconductors and Superconductors 2.1 Introduction. Properties of metallic solids. 2.2 Theories of bonding in metal. i) Free electron theory. ii) Molecular orbital theory (Band theory). 2.3 Classification of solids as conductor, insulators and semiconductors on the basis of band theory. 2.4 Semiconductors: Types of semiconductors - intrinsic and extrinsic semiconductors. Applications of semiconductors. 2.5 Superconductors: Ceramic Superconductors-Preparation and structures of mixed oxide $\text{YBa}_2\text{Cu}_3\text{O}_7$. Applications of superconductors.	8
Module-3:	Organometallic Chemistry 3.1 Introduction: Definition 3.2 Nomenclature of organometallic compounds. 3.3 Synthesis and structural study of alkyl and aryl compounds of Li, Be and Al. 3.4 Mononuclear carbonyl and nature of bonding in simple metal carbonyls.	6
Module-4:	Catalysis 4.1 Introduction to Catalysis, basic principles, activity and selectivity in catalysis, 4.2 Types of catalysis, homogeneous vs. heterogeneous catalysis	8

	4.3 importance of catalysis in the synthesis of high value chemicals. 4.4 Homogeneous catalysis: catalytic cycles for following reactions: a) Hydrogenation of olefins using Wilkinson complex, b) Hydroformylation of olefins using Cobalt and Rhodium complexes c) Carbonylation reaction: methanol to acetic acid process i.e. Monsanto processes and d) C-C coupling reactions: Heck reaction. 4.5 Heterogeneous catalysis: History of the development of industrial heterogeneous catalysis, 4.6 Classification of heterogeneous catalysts, supported metal catalyst, Role of support, Promoters and Poisons. 4.7 Catalytic processes viz., a) Hydrogenation of olefins using Raney Nickel catalyst, b) Zeolites in catalysis: Catalytic cracking, c) Biodiesel synthesis using Heteropoly acids (HPAs) d) Automotive Exhaust catalysts: The catalytic converters.	
Reference Books: - 1. Cotton, F. A., Wilkinson, G. Murillo, C. A. and Bochmann, M. Advanced Inorganic Chemistry. New York: Wiley, 1999. 2. Lee, J. D. Concise Inorganic Chemistry. 5th ed. New Delhi: Wiley India Pvt. Ltd., 2008. 3. Manku, G. S. Theoretical Principles of Inorganic Chemistry. New Delhi: McGraw Hill Education, 1982. 4. Mehrotra, R. C., and Singh, A. Organometallic Chemistry. New Delhi: Wiley Eastern Ltd., 1991. 5. Shriver, D. F., Atkins, P. W. and Langford, C. H. Inorganic Chemistry. New York: W. H. Freeman, 1994.		
Evaluation Pattern: 60:40		
Total Marks:50		
Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (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-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.	

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. III	Semester– V
	Type: DSC-III	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCT-353: Organic Chemistry		
Course Objectives: Students should be able to... 1. understand about reagents and mechanism of name reactions in organic synthesis. 2. learn structure determination of natural products. 3. study the stereochemistry of acyclic and cyclic compounds. 4. know the steps in synthesis of pharmaceutical compounds and reactions of heterocyclic compounds.		
Course Outcomes: After completion of the course, students will be able to... 1. illustrate the preparation of reagents, mechanism of name reactions and their applications in the project work. 2. sketch the conformational analysis of cyclohexane. 3. report general methods of structure determination of terpenoids, alkaloids. 4. express the qualities of ideal drugs, synthesis of pharmaceuticals and heterocyclic compounds.		
Module	Title and Contents	Hrs
Module-1:	Reagents and Name Reactions in Organic Synthesis 1.1A Preparation and Applications of following reagents: 1. Osmium tetroxide (OsO_4) 2. Selenium dioxide (SeO_2) 3. Lithium aluminium hydride (LiAlH_4) 4. Sodium Borohydride (NaBH_4) 5. Raney Nickel 6. Diazomethane 7. N-Bromosuccinamide (NBS) 1.2 B Name Reactions with Mechanism: 1. Diels - Alder reaction 2. Oppenauer Oxidation 3. Meerwein – Ponderff - Verley reduction 4. Hofmann rearrangement 5. Favorskii rearrangement 6. Benzilic acid rearrangement 7. Dieckmann's reaction or condensation.	8
Module-2:	Natural Products 2.1 A] Terpenoids: 1. Introduction, Occurrence, Isolation, General Characteristic, Classification. 2. General Methods for structure determinations of Terpenoids. 3. Analytical evidences and synthesis of Citral. 2.2 B] Alkaloids: 1. Introduction, Occurrence, Isolation, Classification, Properties. 2. General Methods for structure determination of alkaloids. 3. Analytical evidences and synthesis of Ephedrine.	7

Module-3:	Stereochemistry 3.1 Introduction, Conformational Isomerism. 3.2 Cycloalkanes relative stability: Baeyer's strain theory, Theory of strainless rings. 3.3 Conformation and stability of Cycloalkanes: cyclohexane, monosubstituted cyclohexane (Methyl cyclohexane), Effect of size of substituents, locking of conformation. 3.4 Conformation and stability of disubstituted cyclohexane: methyl cyclohexanes (1,2, 1,3, 1,4 disubstituted).	7
Module-4:	Pharmaceuticals and Heterocyclic Chemistry 4.1 A) Pharmaceuticals: 1. Introduction, Classification of Drugs, Qualities of ideal drug. 2. Synthesis and Uses: Ethambutol, Phenobarbitone, Isoniazide, Benzocaine, Chloramphenicol, Paludrine. 4.2 A) Heterocyclic Chemistry: Introduction, Classification 1. Pyrrole: Methods of synthesis from acetylene, from furan, from succinimide. Physical Properties, Reactivity of pyrrole, electrophilic substitution with mechanism, Chemical reactions: Nitration, sulphonation, Halogenation, friedel craft reaction, coupling reaction, oxidation, reduction. 2. Pyridine: Methods of synthesis.: i] From acetylene and hydrogen cyanide ii] From piperidine. Physical properties, Basic character of pyridine. iii] Electrophilic substitution with mechanism, Chemical reactions: Nitration, sulphonation & bromination. Nucleophilic substitution reactions: General mechanism, reactions with sodamide, sodium hydroxide and n-Butyl lithium. 3. Indole: Synthesis – Fischer Indole Synthesis. Physical properties. Chemical reactions: Electrophilic substitution reactions: General mechanism, Nitration, bromination, Friedel Craft's acylation. 4. Quinoline: Synthesis- Skraup's synthesis, Physical properties. Reactions of quinoline: Electrophilic substitution reactions: General mechanism, Nitration sulphonation.	8
Reference Books: - 1. Bahl, A., and Bahl, B. S. A Text Book of Organic Chemistry. New Delhi: S. Chand Publication, 2016. 2. Bansal, R. K. Heterocyclic Chemistry: Synthesis, Reactions and Mechanism – Stereochemistry, Conformation and Mechanism. New Delhi: New Age International, 2005. 3. Burger. Medical Chemistry. 8 th ed. Hoboken, NJ: Wiley, 2021. 4. Eliel. Stereochemistry of Carbon Chemistry. New Delhi: McGraw Hill Education, 2001. 5. Finar, I. L. Organic Chemistry. 6 th ed. New Delhi: Pearson Education India, 2002. 6. Jain, M. K. Principles of Organic Chemistry. New Delhi: S. Nagin, 1978. 7. Tewari, K. S., Mehrotra, S. N. and Vishnoi, N. K. A Text Book of Organic Chemistry. 4 th ed. New		
Evaluation Pattern: 60:40		
Total Marks:50		

Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (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-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.
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	Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. III	Semester– V	
	Type: DSE-I	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT-354: Analytical Chemistry			
Course Objectives: Students should be able to...			
1. know the basic idea of artificial intelligence. 2. learn nanomaterials and their applications 3. understand fundamentals of flame photometry. 4. study the theory of chromatographic techniques and its application in analytical industries and laboratories.			
Course Outcomes: After completion of the course, students will be able to...			
1. gain the basic knowledge of artificial intelligence and role of AI in chemistry. 2. discuss nanomaterials and their applications. 3. explain principle, instrumentation and application of flame photometry to alkali and alkaline earth elements. 4. describe chromatographic separations.			
Module	Title and Contents		Hrs
Module-1:	Artificial Intelligence 1.1 Introduction, fundamentals: classical/symbolic approach to Artificial Intelligence. 1.2 Theories and technologies for building complete A.I. systems, Knowledge representation and reasoning, Uncertain and probabilistic reasoning (Bayesian networks, fuzzy sets). 1.3 AI for chemistry, Molecule property prediction, Molecule design, Retrosynthesis, Reaction outcome prediction, Reaction conditions prediction, Chemical reaction optimization. 1.4 AR/VR introduction fundamentals etc.		7
Module-2:	Nanomaterials 2.1 Introduction: Nanomaterial and Nanotechnology. 2.2 Size dependent properties of Nanomaterials - Optical properties and semiconducting properties. 2.3 Approaches for preparation of nanomaterials a. Top-down Approach b. Bottom-up Approach. 2.4 Synthesis: Physical Methods, Chemical Method, Sol gel Method. 2.5 Characterization of Nanomaterial: Introduction to 1. Scanning Electron Microscopy (SEM) and 2. Transmission Electron Microscopy (TEM). 2.6 Applications of Nanomaterial.		8
Module-3:	Flame Photometry 3.1 Introduction, General principles of flame photometry. 3.2 Instrumentation: Block diagram, Burners (Premix and Lundergarph burners), mirror, slits, filters, detector (Photomultiplier tube). 3.3 Effect of solvent in flame photometry, Experimental procedure of analysis (Standard addition and internal standard). 3.4 Interference and Factors that influence the intensity of emitted radiation in a		7

	flame Photometer. 3.5 Application of flame photometry in real sample analysis. 3.6 Limitations of flame photometry.	
Module-4:	Chromatographic Technique and its Applications 4.1 Introduction, Developments in chromatography, Classification of chromatography. 4.2 Column Chromatography: Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases, Methodology-Column packing, applications of sample, development, detection methods, recovery of components, Applications. 4.3 Ion Exchange Chromatography: Introduction, Principle, Types and properties of ion exchangers, Methodology- Column packing, application of sample, elution, detection/ analysis, Applications. 4.4 Gas Chromatography: Principal, Methodology, Column packing, application of sample, elution, detection/analysis, Applications.	8
Reference Books: - 1. Akerkar, R. Introduction to Artificial Intelligence. Prentice Hall India Learning Private Limited, 2005. 2. Chatwal, G. R., and Anand, S. Instrumental Methods of Chemical Analysis. Mumbai: Himalaya Publishing House, 2011. 3. Kaur, H. Instrumental Methods of Chemical Analysis. Meerut: Pragati Prakashan, 2012. 4. Khopkar, S. M. Basic Concepts of Analytical Chemistry. New Delhi: New Academic Science, 2008. 5. Nilsson, N. J. Artificial Intelligence: A New Synthesis. San Francisco: Morgan Kaufmann, 1998. 6. Russell, S., and Norvig P. Artificial Intelligence: A Modern Approach. 4 th edition, Noida: Pearson, 2020.		
Evaluation Pattern: 60:40		
Total Marks:50		
Continuous Comprehensive Evaluation : (20 Marks) - CCE-I- Home Assignment (10 Marks) - CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) - CCE-III-Objective (MCQ) (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-10 Marks) - Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) - Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.	

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	Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. III	Semester– V	
	Type: DSE-II	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT 355: Industrial Chemistry			
Course Objectives: Students should be able to...			
1. learn polymers based on origin, composition, structure, and properties. 2. study dyes and explain their structures and applications. 3. know the manufacturing, properties, and uses of cement and glass. 4. understand drugs and describe the synthesis and manufacture of common pharmaceuticals.			
Course Outcomes: After completion of the course, students will be able to...			
1. classify the polymers based on origin, composition, structure, and properties. 2. describe applications od dyes and paints. 3. explain cement and glass production and uses. 4. understand the synthesis and applications of pharmaceutical compounds.			
Module	Title and Contents		Hrs
Module-1:	Synthetic Polymers and Applications 1.1 Introduction, Classification: Based on origin; Based on composition – organic, inorganic polymers; Based on method of preparation; Based on general physical properties; Based on structure. Addition. 1.2 Polymerization: Free radical addition and ionic addition polymerization, Ziegler Natta polymerization. 1.3 Method of preparation and applications of some organic polymers: Polyethylene, polystyrene, polyvinyl chloride, Phenol-formaldehyde resin. 1.4 Conducting organic polymers: Synthesis and properties of Polyaniline, polypyrrol, Applications of conducting organic polymers.		7
Module-2:	Dyes and Paints A. Dyes 2.1 Introduction. 2.2 Classification of dyes: Structures and applications, nitro, nitroso, azo, heterocyclic, phthalenes, xanthenes, rhodamines, thiazine, cyanine, anthraquinone, indigoids, thioindigoids, phthalocyanines, wet dyes. B. Paints 2.1 Introduction of paints. 2.2 Ingredients and classification, new technologies; properties of coatings, solvents, plasticizers, dyes and bioactive additives.		8
Module-3:	Cement and Glass industry A. Cement industry: 3.1 Introduction. 3.2 Importance, composition of portland cement, raw materials, proportioning of raw materials. 3.3 Setting and Hardening of cement, reinforced concrete. B. Glass industry 3.1 Introduction. 3.2 Importance, physical and chemical properties of glass, chemical reaction,		7

	annealing of glass. 3.3 Special glasses: colored, safety, hard, borosilicate, optical, photosensitive, conducting, glass laminates.	
Module-4:	Drugs and Pharmaceutical Industries 4.1 Definition of drug, qualities of drugs, classification of drugs (functional and chemotherapeutic drugs). 4.2 Meaning of following terms with one example: - analgesic, antipyretic, diuretics, sulpha drugs, anesthetics, antibiotics, antacid, anti-inflammatory, tranquilizers. 4.3 Synthesis and use of following drugs: -paracetamol, sulphanilamide, benzocaine, synthetic penicillin. 4.4 Manufacture of aspirin with flow sheet.	8
Reference Books: 1. Austin, G. T. Shreeve's Chemical Process Industries. 5 th ed. New York: McGraw-Hill, 2017. 2. Das, R. K. Industrial Chemistry. Asia Publishing House, 1967. 3. Finar, I. L. Organic Chemistry, Vol. I. New Delhi: Pearson Education. 4. Finar, I. L. Organic Chemistry, Vol. II. New Delhi: Pearson Education, 1956. 5. Gowariker, V. R. Polymer Science. New Delhi: New Age International, 1986. 6. Sharma, B. K. Industrial Chemistry. 10th ed. Meerut, India: Goel Publishing House, 1987.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) - CCE-I- Home Assignment (10 Marks) - CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) - CCE-III-Objective (MCQ) (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-10 Marks) - Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) - Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation 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. III	Semester– V
	Type: DSC P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCP 356: Practical V Practical's based on BCT 351, BCT 352		
Course Objectives: Students should be able to... 1. learn various instruments like conductometer, potentiometer. refractometer etc. 2. study volumetric and gravimetric estimations efficiently. 3. understand determination of percentage purity of commercial samples. 4. know the preparative skills for commercially important compounds.		
Course Outcomes: After completion of the course, students will be able to... 1. operate various instruments like conductometer, potentiometer. refractometer etc. 2. conduct volumetric and gravimetric estimations efficiently. 3. calculate the percentage purity of commercial samples. 4. prepare important compounds of commercial use.		
Title and Contents		Hrs
Chemical Kinetics 1. To determine energy of activation of first order reaction hydrolysis of methyl acetate in presence of 0.5 N HCl/0.5 N H₂SO₄. 2. To study the hydrolysis of methyl acetate by using its two concentrations in presence of 0.5 N HCl and hence find velocity constant of the reaction. Conductometry 3. To determine the percentage composition (by weight) of strong acid and weak acid in a given mixture by titrating against strong base conductometrically. 4. To determine the normality of oxalic acid by titrating it with strong alkali conductometrically. Potentiometry 5. To determine the normality of the strong acid by titrating it with strong alkali by potentiometric method. 6. To determine standard electrode potential of Zn/Zn⁺⁺, Cu/Cu⁺⁺. Refractometry 7. To determine specific refractivities of pure liquids A and B and of their mixtures and to determine percentage composition of the unknown mixture. Gravimetric Estimation 8. To estimate amount of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid gravimetrically. 9. To estimate amount of nickel as bis (dimethyl glyoximato) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free Sulphuric acid gravimetrically. Inorganic Preparations 10. To prepare sodium cuprous thiosulphate. 11. To prepare tris (ethylene diamine) nickel (II) thiosulphate. 12. To prepare bis (ethylene diamine) copper (II) thiosulphate. 13. To prepare tetra ammine copper (II) chloride. Titrimetric Estimations: Percentage Purity 14. To determine percentage purity of ferrous ammonium sulphate.		60

15. To determine percentage purity of Nickel (II) complexometrically using murexide indicator.	
Reference Books: - 1. Findlay, Alexander. Practical Physical Chemistry. 9th ed. Revised by Levitt, B. P. London: Longman, 1973. 2. Khosla, B. D., Garg, V. C. and Adarsh Gulati. Senior Practical Physical Chemistry. 18th ed. New Delhi: R. Chand & Co., 2018. 3. Vogel A. I., Vogel's Text Book of Quantitative Inorganic Analysis: Longman, 1989. 4. Palmer, W. G. Experimental Inorganic Chemistry: Cambridge Uni. Press, New York, 1954. 5. Agarwal, O. P. Advanced Practical Organic Chemistry. Meerut: Krishna Prakashan Media (P) Ltd., 2014. 6. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry. 5th ed. New Delhi: Pearson India, 2003.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B.Sc. III	Semester– V
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCP-357 Practical VI Practicals based on BCT 353, 354 (E1)		
Course Objectives: Students should be able to... 1. understand the qualitative and quantitative estimations. 2. know identification techniques to study drugs. 3. learn estimations of industrial compounds. 4. develop critical laboratory skills for analysis of industrial compounds useful for research applications.		
Course Outcomes: After completion of the course, students will be able to... 1. determine unknown concentrations of substance in the given solutions quantitatively. 2. estimate amount of drugs by spectrophotometric method. 3. determine and estimate industrially important compounds. 4. perform the synthesis and applications of pharmaceutical compounds.		
Title and Contents		Hrs
1. Quantitative Analysis: Organic Estimations 1. Estimation of sucrose. 2. To determine the amount of acid and amide present in the given mixture of acid and amide. 3. Determination of Molecular weight of monobasic/dibasic acid by volumetric method. 4. Saponification value of oil. 5. Estimation of NO ₂ group. 2. Organic Preparations: 6. Radical coupling reaction - Preparation of 1, 1, 2 bis-2 naphthol. 7. Diels Alder reaction- Reaction between Furan and Maleic acid and reaction between anthracene and maleic anhydride. 8. Benzil-Benzilic acid rearrangement reaction. 9. Chromatographic separation of a mixture of organic compounds and dyes methyl orange and methylene blue by thin layer chromatography (using benzene) and determination of RF value. 3. Extraction of Natural Products: 10. Caffeine from Tea leaves or isolation of clove oils from cloves. 4. Colorimetry: 11. Determination of copper ions in the given solution by using calibration curve. 5. pH –Metry: 12. To determine the dissociation constant of monobasic acid (Acetic acid). 6. Potentiometry: 13. To prepare buffer solutions and determine their pH experimentally and theoretically using Henderson's equation. 7. Analysis of Commercial Sample: 14. Determination of percentage of magnesium in the given sample of talcum Powder. 15. Determination of amount of aluminium in the given solution of potash alum. (Standard		60

succinic or oxalic acid solution to be prepared to standardize the given sodium hydroxide solution.	
Reference Books: - 1. Agarwal, O. P. Advanced Practical Organic Chemistry. Krishna Prakashan Media (P) Ltd., 2014. 2. Findlay, A. Practical Physical Chemistry. Prentice Hall Press, 1973. 3. Khosla, B. D., Garg, V. C., and Gulati, A. Senior Practical Physical Chemistry. R. Chand and Co., 2018. 4. Sivasankar, B., and Svehla, G. Vogel's Qualitative Chemical Analysis. Pearson Education India, 2012. 5. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry. Pearson India, 2003. 6. Vogel, A. I. Vogel's Text Book of Quantitative Inorganic Analysis. Longman, 1989. 7. Dr. Shinde V.M., Dr. Salvekar J.P., Avasare D. B., Shinde D. R., et. al. Practical Chemistry. Nirali Prakashan, 2004.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination: (30 Marks) Experiment 1 Experiment 2

	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. III	Semester– V
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCP-357 Practical VI Practicals based on BCT 353, 355 (E2)		
Course Objectives: Students should be able to... 1. understand the qualitative and quantitative estimations. 2. know preparative skills of industrially important compounds. 3. learn the separation techniques of mixture of compounds by thin layer chromatography. 4. develop critical laboratory skills for analysis of industrial compounds useful for research applications.		
Course Outcomes: After completion of the course, students will be able to... 1. determine concentration of substances in the given solutions quantitatively and qualitatively. 2. prepare industrially important compounds. 3. separate compounds from their mixtures using thin layer chromatography. 4. analyze industrial compounds useful for research applications.		
Title and Contents		Hrs
1.Quantitative Analysis: Organic Estimations 1. Estimation of sucrose. 2. Determination of amount of acid and amide present in the given mixture of acid and amide. 3. Determination of Molecular weight of monobasic/dibasic acid by volumetric method. 4. Saponification value of oil. 5. Estimation of NO₂ group. 2.Organic Preparations: 6. Radical coupling reaction - Preparation of 1, 1, 2 bis-2 naphthol. 7. Diels Alder reaction- Reaction between Furan and Maleic acid and reaction between anthracene and maleic anhydride. 8. Benzil-Benzilic acid rearrangement reaction. 9. Chromatographic separation of a mixture of organic compounds dyes methyl orange and methylene blue by thin layer chromatography (using benzene) and determination of RF value. 3.Extraction of Natural Products: 10. Caffeine from Tea leaves or isolation of clove oils from cloves. 4. Synthesis of common industrial compounds involving two step reactions 11. Synthesis of 4-bromoaniline. 12. Synthesis of 4-Aminobenzoic acid. 13. Synthesis of 5-Nitrobenzoic acid. 14. Estimation of formaldehyde. 15. Determination of equivalent weight of an ester.		60
Reference Books: - 1. Agarwal, O. P. Advanced Practical Organic Chemistry. Krishna Prakashan Media (P) Ltd., 2014. 2. Sivasankar, B., and Svehla, G. Vogel's Qualitative Chemical Analysis. Pearson Education India, 2012. 3. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry. Pearson India, 2003.		

4. Vogel, A. I. Vogel's Text Book of Quantitative Inorganic Analysis. Longman, 1989.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination: (30 Marks) Experiment 1 Experiment 2

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. III	Semester– V
	Type: VSC-III	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCPVSC III: Computer Skills for Chemist		
Course Objectives: Students should be able to... 1. learn scientific documents preparation and presentations using Microsoft office tools. 2. study to present experimental data using spreadsheets and graphs. 3. communicate effectively through digital platforms and collaborative tools. 4. acquire knowledge of softwares like Chems sketch or Chemdraw for drawing structures.		
Course Outcomes: After completion of the course, students will be able to... 1. create well-structured scientific reports and presentations using MS office tools. 2. analyze and interpret experimental data using spreadsheet functions and visualizations. 3. demonstrate effective digital communication and collaboration skills using email and cloud platforms. 4. draw structures of compounds and mechanisms of organic reactions using Chems sketch or Chemdraw software.		
Title and Contents (Any 15 of the following)		Hrs
1. To write a lab report with proper formatting, headings, and citations. 2. To insert tables, figures, and graphs into a report using Microsoft office. 3. To analyze experimental data in a spreadsheet. 4. To use basic formulae (e.g., SUM, AVERAGE) to perform simple calculations in Excel. 5. To create basic charts (e.g., bar graphs, line graphs) to visualize data using Excel. 6. To compose and send professional emails, attaching files, and formatting text. 7. To introduce Google Drive/OneDrive for file sharing and collaboration. 8. To prepare the power point presentation based on projects. 9. To annotate PDFs for notes, highlighting important sections, or adding comments. 10. To draw the structure of chemical compounds by using Chem Sketch or Chem draw software. (any 2) 11. To draw mechanisms of organic reactions using Chems sketch. 12. To draw the graphs using Origin Software. 13. To site the publications using Google Scholar in different format. 14. To site the publications using Zotero and Mendeley software. 15. Internet search for Chemical Safety Data Sheets (SDS). 16. To search Research Articles Online Search chemistry papers using Google Scholar and PubChem.		60
Reference Books: - 1. ACS. The ACS Style Guide: Effective Communication of Scientific Information. 3rd ed. Edited by Anne M. Coghill and Lorrin R. Garson. Washington, DC: American Chemical Society, 2006. 2. ACD/Labs. ACD/ChemSketch, Version 2024. Toronto, ON: Advanced Chemistry Development, Inc., 2024. https://www.acdlabs.com/resources/freeware/chemsketch/ 3. Alley, Michael. The Craft of Scientific Writing. 4th ed. New York: Springer, 2013. 4. Horstmann, Cay S. Mastering PowerPoint Made Easy: Projects and Presentations for Students. Hoboken, NJ: Wiley, 2021. 5. Microsoft Corporation. Excel for Microsoft 365. Redmond, WA: Microsoft Corporation, 2023. https://support.microsoft.com/en-us/excel.		

6. Perrin, Robert. Pocket Guide to APA Style. 7th ed. Boston: Cengage Learning, 2020.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation : (20 Marks)

Student Performance (5 marks)

Attendance (5 Marks)

Journal records (10 Marks)

End Semester Examination: (30 Marks)

Experiment 1

Experiment 2

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. III	Semester- V
	Type: OJT	Marks: 100
	Credits: 4	From: A. Y. 2026-27
Name of the Course: On Job Training (BCPOJT I)		
Course Objectives: Students should be able to... 1. recognize and explain workplace structure, professional ethics, safety practices, and standard operating procedures relevant to the assigned organization. 2. apply theoretical knowledge and technical skills in real work situations under supervision, following established protocols and guidelines. 3. analyze work processes, identify problems, and interpret practical challenges encountered during on-job training. 4. evaluate workplace practices and performance, and develop solutions, reports, or improvements based on experiential learning.		
Course Outcomes: By the end of the course, students will be able to... 1. demonstrate knowledge of workplace operations, safety norms, and professional conduct, and apply disciplinespecific skills effectively. 2. perform assigned tasks independently or collaboratively, using appropriate tools, techniques, and standard procedures. 3. analyze practical problems, interpret data or observations, and suggest feasible solutions in a professional setting. 4. evaluate their performance, prepare structured reports, and communicate findings effectively, demonstrating readiness for professional employment.		
Title and Contents		Hrs
OJT will provide opportunities for internships with local/regional industries, business organizations, health and allied areas, local government, etc., so that students may actively engage with the employability opportunities. Students will undergo 4 credit work- based learning/OJT/internship.		120
Evaluation Pattern: 60:40		
Total Marks: 100		
Continuous Comprehensive Evaluation : (40 Marks) Attendance/Daily Logbook- (20 Marks) Supervisor Evaluation from Industry- (20 Marks)		End Semester Examination: (60 Marks) Report-(20 Marks) Viva-(20 Marks) Presentation-(20 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. III

Semester– V

Type: CEP

Marks: 50

Credits: 2

From: A. Y.2026-27

Name of the Course: Community Engagement Programme (BCPCEP I)

Course Objectives: Students should be able to...

1. increase public understanding of basic chemical concepts and their applications in daily life.
2. educate communities about pollution prevention, waste management, water conservation, and sustainable practices through chemical principles.
3. disseminate knowledge regarding safe use of household chemicals, sanitation, clean drinking water, and personal hygiene.
4. foster collaboration between educational institutions and local communities for mutual learning and development.

Course Outcomes: By the end of the course, students will be able to...

1. develop scientific literacy among community members through sharing chemical knowledge.
2. aware people regarding environmental and health issues.
3. adoptsafe, sustainable and eco-friendly practices.
4. strengthen collaboration between educational institutions and society.

Title and Contents

Hrs

Field project on community engagement programme supported by a teacher/Faculty member and presentation.

60

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation : (20 Marks)

Attendance/Participation- (10 Marks)
Field Diary/Logbook- (10 Marks)

End Semester Examination: (30 Marks)

Scientific Activity/ Demonstration-(10 Marks)
Final Report-(10 Marks)
Viva Voce/Presentation-(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. III	Semester- VI	
	Type: DSC-I	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT 361: Physical Chemistry			
Course Objectives: Students should be able to...			
1. learn basic concept of surface chemistry and its applications in catalysis. 2. recall the concepts of thermodynamics and apply it to physical and chemical systems. 3. understand the laws of crystallography. 4. learn simultaneous reactions and their types.			
Course Outcomes: After completion of the course, students will be able to...			
1. recognize applications of surface chemistry in catalysis. 2. relate free energy, chemical potential in thermodynamic equations. 3. explain the laws of crystallography. 4. derive rate constant equations of simultaneous reaction.			
Module	Title and Contents		Hrs
Module-1:	Surface Chemistry 1.1 Introduction - Terminologies in surface chemistry - Difference between adsorption and absorption. 1.2 Mechanism of adsorption, Factors affecting adsorption. 1.3 Types of adsorption: Physical and Chemical Adsorption. 1.4 Types of adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm with derivation. 1.5 BET equation and determination of surface area of adsorbent by BET equation. 1.6 Applications of adsorption. 1.7 Application of Adsorption in catalysis: Mechanism of Catalytic Reaction, Characteristics of Catalyst. 1.8 Types of Catalysis-Homogeneous Catalysis - Heterogeneous Catalysis.		8
Module-2:	Thermodynamics 2.1 Introduction, Free energy: Gibbs function (G) and Helmholtz function (A) 2.2 Criteria for thermodynamic equilibrium and spontaneity. 2.3 Relation between ΔG and ΔH : Gibbs Helmholtz equation. 2.4 Thermodynamic derivation of law of mass action, Van't-Hoff isotherm and isochore. 2.5 Fugacity and activity concepts. 2.6 Partial molar quantities, Partial molar volume. 2.7 Concept of chemical potential, Gibbs-Duhem equation. 2.8 Numerical problems.		7
Module-3:	Solid State Chemistry 3.1 Introduction Space lattice, lattice sites, Lattice planes, Unit cell. 3.2 Laws of crystallography: i] Law of constancy of interfacial angles ii] Law of rational indices iii] Law of crystal symmetry. 3.3 Weiss indices and Miller indices. 3.4 Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing of lattice planes.		8

	3.5 Diffraction of X - rays, Derivation of Bragg's equation.Determination of crystal structure by Bragg's method. 3.6 Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation. 3.7 Debye Scherrer method. 3.8 Numerical Problems.	
Module-4:	Chemical Kinetics 4.1 Introduction and recapitulation. 4.2 Simultaneous reactions such as i. Opposing reaction:(Derivation of rate equation for first order opposed by first order expected) ii. Side reaction iii. Consecutive reactions iv. Chain reaction 4.3 Influence of ionic strength on rates of reactions. 4.4 Flow method and Flash photolysis method for fast reaction. 4.5 Steady state approximation.	7
Reference Books: - 1. Atkins, P. W., and Julio De Paula. The Elements of Physical Chemistry. 7th ed. Oxford: Oxford University Press, 2005. 2. Levine, Ira N. Physical Chemistry. 5th ed. New Delhi: Tata McGraw Hill Publishing Co. Ltd., 2002. 3. Puri, B. R., Sharma, L. R. and Pathania,M. S. Principles of Physical Chemistry. New Delhi: Vishal Publishing Company, 2008. 4. Rao, Y. V. C. An Introduction to Thermodynamics. Hyderabad: Universities Press, 2003.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (10 Marks) Note:-Best two scoresof CCE will be considered out of three.	End Semester Examination: (30 Marks) • Question 1- Solve the following questions (Five questions of 2 Marks-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.	

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	Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Chemistry		
	Programme: B. Sc. III	Semester– VI	
	Type: DSC-II	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT 362: Inorganic Chemistry			
Course Objectives: Students should be able to...			
1. learn the mechanism of the reactions involved in inorganic complexes of transition metals. 2. gain knowledge about generation of nuclear power with the help of nuclear reactions and applications of radio isotope. 3. know the techniques involved in ore dressing and extraction of cast iron from its ore. 4. study different theories of acids and bases and learn non aqueous solvents.			
Course Outcomes: After completion of the course, students will be able to...			
1. explain inorganic reaction mechanism and thermodynamics and kinetic stability of inert and labile complexes. 2. describe theory behind nuclear reactions and applications of radioactive isotopes in everyday life. 3. elucidate extraction process of metal and ore preparation. 4. differentiate between Lewis’s acids and bases.			
Module	Title and Contents		Hrs
Module-1:	Coordination Chemistry A] Inorganic Reaction Mechanism 1.1 Introduction. 1.2 Classification of Mechanism: Association, dissociation, interchange and the rate determining steps, SN ¹ and SN ² reaction for inert and labile complexes, Mechanism of substitution in cobalt (III) octahedral complexes. 1.3 Trans effect and its theories. 1.4 Applications of trans effect in synthesis of Pt (II) complexes. B] Thermodynamic and Kinetic Aspects of Metal Complexes. 1.5 Introduction. 1.6 Thermodynamic stability. 1.7 Kinetic Stability. 1.8 Relation between thermodynamic and kinetic stability.Stepwise stability constant and factor affecting the stability of complexes. Determination of Stability constant by Job variation, Mole ratio and Slope ratio method.		8
Module-2:	Nuclear Chemistry 2.1 Nuclear reactions and energetic of nuclear reactions. 2.2 Types of nuclear reactions i] Artificial transmutation. ii] Artificial radioactivity. iii] Nuclear fission and its application in Heavy water nuclear reactor. iv] Nuclear fusion. 2.3 Applications of radio-isotopes as tracers: i] Chemical Investigation-Esterification. ii] Structural determination- Phosphorus pentachloride. iii] Analytical Chemistry- Isotopic dilution method for determination of volume of blood. iv] Age Determination-Dating by C-14.		7

Module-3:	Iron and Steel 3.1 Occurrence and ores of iron. 3.2 Definition of the Terms - Ore, Mineral, Slag, Flux, Gangue, Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching. 3.3 Extraction of iron by Blast furnace. 3.4 Steel: Definition and types. 3.5 Conversion of cast iron in to steel by i] Bessemer process. ii] L.D. process. 3.6 Heat treatment on steel.	8
Module-4:	Acid Bases and Non-Aqueous Solvents 4.1 Introduction to Theories of Acids and bases. 4.2 Arrhenius concept. 4.3 Bronsted - Lowry concept. 4.4 Lewis Concept 4.5 Lux - Flood Concept (definition and examples). 4.6 Hard and Soft Acids and Bases. (HSAB Concept) i] Classification of acids and bases as hard, soft and borderline. ii] Pearson's HSAB concept. iii] Acid -Base strength and hardness - softness. iv] Application and limitations of HSAB principle. Chemistry of Non aqueous Solvents 4.7 Introduction. 4.8 Definition and characteristics of solvents. 4.9 Classification of solvents. 4.10 Physical properties and Acid base reactions in Liquid Ammonia (NH ₃) and liquid Sulphur Dioxide (SO ₂).	7

Reference Books: -

1. Arnikaar, H. J. Essentials of Nuclear Chemistry. 4th ed. New Delhi: New Age International Pvt. Ltd., 2011.
2. Kettle, S. F. A. Coordination Compounds. Berlin: Springer, 1995.
3. Lee, J. D. Concise Inorganic Chemistry. 5th ed. New Delhi: Wiley India Pvt. Ltd., 2008.
4. Mehrotra, R. C., and Sing, A. Organometallic Chemistry. New Delhi: Wiley Eastern Ltd., 1982.
5. Puri, B. R., Sharma, L. R. and Kalia, K. C. Principles of Inorganic Chemistry. 33rd ed. Jalandhar: Vishal Publishing Co., 2020.
6. Shriver, D. F., Atkins, P. W. and Langford, C. H. Inorganic Chemistry. New York: W. H. Freeman, 1994.

Evaluation Pattern: 60:40

Total Marks:50

Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (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-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation 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. III	Semester– VI	
	Type: DSC-III	Marks: 50	
Credits: 2	From: A. Y. 2026-27		
Name of the Course: BCT 363: Organic Chemistry			
Course Objectives: Students should be able to...			
1. understand the basic principles of spectroscopy. 2. know the different regions of the spectrum and the type of molecular transitions. 3. study basic concept of NMR spectroscopy and understand chemical shift. 4. learn instrumentation of mass spectrometry and solve combined problems based on UV, IR, NMR and mass spectroscopy.			
Course Outcomes: After completion of the course, students will be able to...			
1. explain basic principle of spectroscopy and regions of electromagnetic radiation. 2. calculate the λ_{max} by woodward and fisher rules for dienes and enones systems. 3. calculate chemical shift values of protons of compounds based on spectral data of NMR spectroscopy. 4. predict different types of ions produced and predict the structure of organic compound with the help of provided spectral data.			
Module	Title and Contents		Hrs
Module-1:	UV Spectroscopy 1.1 Introduction of spectroscopy. 1.2 Nature of electromagnetic radiation, Different regions of electromagnetic radiations. 1.3 Types of spectroscopy and advantages of spectroscopic methods. Energy types and energy levels of atoms and molecules. 1.4 Beer - Lamberts law, absorption of UV radiation by organic molecules leading to different excitation. 1.5 Terms used in UV Spectroscopy - Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Hyperchromic and Hypochromic effect. 1.6 Modes of electromagnetic transitions, Effect of conjugation on position of UV band. 1.7 Calculation of λ_{max} by Woodward and Fisher rules for dienes and enones systems. 1.8 Applications of UV Spectroscopy.		8
Module-2:	IR Spectroscopy 2.1 Introduction, Principle of IR Spectroscopy, IR Instrumentation, schematic diagram. 2.2 Fundamental modes of vibrations types and calculation – Condition for absorption of IR radiations. 2.3 Regions of IR Spectrum, functional group region, finger print region. 2.4 Hooke's Law for Calculation of vibrational frequency, Factors affecting on IR Absorption frequency. 2.5 Characteristic of IR absorption of following functional groups a] Alkanes, alkenes, alkynes b] Alcohol and phenols c] Ethers d] Carbonyl compounds e] Amines f] Nitro compounds g] Aromatic Compounds.		7

Module-3:	NMR Spectroscopy 3.1 Introduction, Principles of PMR Spectroscopy. 3.2 NMR - Instrumentation, Schematic diagram. 3.3 Magnetic and nonmagnetic nuclei, Chemical shift definition, measurement, calculation, Factors affecting Chemical shift. 3.4 Shielding & deshielding, Peak Integration. 3.5 Merits of TMS as PMR reference compounds. 3.6 Coupling Constant, Types of Coupling Constant, Spin-spin splitting ($n + 1$) rule, applications.	8
Module-4:	Mass Spectroscopy and combined problems based on spectroscopy 4.1 Introduction, Principle of mass spectroscopy. 4.2 Mass spectrometer - schematic diagram. 4.3 Types of ions produced in mass spectrum. 4.4 MacLafferty rearrangement, Applications. 4.5 Combined Problems based on UV, IR, NMR, Mass Spectral Data.	7

Reference Books: -

1. Field, L. D., and Sternhell, S. Organic Structures from Spectra. Hoboken, NJ: John Wiley & Sons Pvt. Ltd., 2012.
2. Jacobsen, N. E. NMR Data Interpretation Explained: Understanding 1D and 2D NMR Spectra of Organic Compounds and Natural Products. Hoboken, NJ: John Wiley & Sons Pvt. Ltd., 2016.
3. Kalsi, P. S. Spectroscopy of Organic Compounds. New Delhi: New Age International Private Limited, 2002.
4. Parikh, V. M. Spectroscopy. Mumbai: Wesley Publishing Company, 1974.
5. Pavia, Donald. Introduction to Spectroscopy. 4th ed. New Delhi: Thomson Press (India) Ltd., 2012.
6. Silverstein, Robert M., and Francis X. Webster. Spectrometric Identification of Organic Compounds. 6th ed. Hoboken, NJ: John Wiley & Sons Pvt. Ltd., 1996.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (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-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation 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. III	Semester– VI	
	Type: DSE-I	Marks: 50	
Credits: 2	From: A. Y.2026-27		
Name of the Course: BCT 364: Analytical Chemistry			
Course Objectives: Students should be able to...			
1. understand the principles, instrumentation, and applications of GC. 2. learn the fundamentals and applications of TGA and DTA. 3. study various extraction processes. 4. know the working principles and applications of AAS in elemental analysis.			
Course Outcomes: After completion of the course, students will be able to...			
1. explain the principles, instrumentation, and applications of gas chromatography (GC). 2. interpret thermo gravimetric and differential thermal analysis data for material characterization. 3. apply the separation techniques to determine various elements. 4. utilize atomic absorption spectroscopy (AAS) for elemental analysis in various chemical applications.			
Module	Title and Contents		Hrs
Module-1:	Gas Chromatography 1.1 Introduction. 1.2 Apparatus: A supply of carrier gas from a high-pressure cylinder, Sample injection system and derivatization, the column (Packed columns, Open tubular columns). 1.3 The detector (properties, hot wire detector or TCD, FID, ECD). 1.4 Quantitative analysis by GC (Area normalization method and internal standard addition method), Elemental analysis, numerical.		8
Module-2:	Thermal Methods of Analysis (TGA & DTA) 2.1 Classification of thermal methods. 2.2 Thermogravimetric Analysis, Derivative Thermogravimetric Analysis. 2.3 Differential Thermal Analysis DTA. 2.4 Interpretation of graphs.		7
Module-3:	Separation Techniques: 3.1 Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction 3.2 Batch extraction, continuous extraction and counter current extraction. Synergism. 3.3 Application-Determination of Iron (III).		8
Module-4:	Atomic Absorption Spectroscopy 4.1 Principles of AAS, Difference between AAS and flame Photometry, Atomic Absorption Process, Sample preparation & calculation, characteristic concentration and detection limits. 4.2 Instrumentation of single beam for atomic absorption spectrometer (Source, chopper, nebulizer, monochromator, detector, amplifier), Interference: Spectral and chemical. 4.3 Applications of AAS.		7

Reference Books: -

1. Atkins, P. W., and Julio De Paula. The Elements of Physical Chemistry. 7th ed. Oxford: Oxford University Press, 2005.
2. Fowles, Ian A. Gas Chromatography. 2nd ed. Analytical Chemistry through Open Learning Series. Chichester: Wiley.
3. Levine, Ira N. Physical Chemistry. 5th ed. New Delhi: Tata McGraw Hill Publishing Co. Ltd., 2002.
4. Lindsay, Sandie. High Performance Liquid Chromatography. 2nd ed. Analytical Chemistry through Open Learning Series. Chichester: Wiley.
5. Silverstein, Robert M., and Francis X. Webster. Spectrometric Identification of Organic Compounds. 6th ed. Hoboken, NJ: John Wiley & Sons Pvt. Ltd., 1996.

Evaluation Pattern: 60:40**Total Marks:50**

Continuous Comprehensive Evaluation : (20 Marks)	End Semester Examination: (30 Marks)
• CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (10 Marks) Note:-Best two scores of CCE will be considered out of three.	• Question 1- Solve the following questions (Five questions of 2 Marks-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation 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. III		Semester– VI
	Type: DSE-II		Marks: 50
	Credits: 2		From: A. Y. 2026-27
Name of the Course: BCT 365: Industrial Chemistry			
Course Objectives: Students should be able to...			
1. understand the industrial production of ammonia, sulphuric acid, and nitric acid using Haber, Contact, and Ostwald processes. 2. study the manufacturing of sugar and alcohol, including fermentation and distillation. 3. explore the composition, classification, and production of soaps and detergents. 4. learn industrial production of N, P, K fertilizers.			
Course Outcomes: After completion of the course, students will be able to...			
1. explain the industrial production of ammonia, sulfuric acid, and nitric acid. 2. describe sugar and alcohol manufacturing processes. 3. differentiate between soaps and detergents and their production. 4. grasp the manufacture and importance of fertilizers.			
Module	Title and Contents		Hrs
Module-1:	Manufacture of Ammonia, Sulphuric acid, Nitric acid 1.1 Introduction. 1.2 Manufacture of Ammonia (NH ₃). i] Physico-chemical principles. ii] Manufacture by Haber’s process. 1.3 Manufacture of Sulphuric acid (H ₂ SO ₄) i] Physico-chemical principles. ii] Manufacture byContact process. 1.4 Manufacture of Nitric acid (HNO ₃) i] Physico-chemical principles. ii] Manufacture by Ostwald’s (Ammonia oxidation process).		7
Module-2:	Sugar Industry and Fermentation Industries 2.1 Importance of sugar industry, manufacture of raw and refined sugar with flow sheet, estimation of sugar (physical and chemical methods). 2.2 Definition of fermentation, importance of various fermentation industries, basic requirements for fermentation, steps in fermentation process. 2.3 Manufacture of alcohol from molasses, distillation, Coffey still, preparation of absolute alcohol, various useful fractions and their uses, proof spirit, denatured spirit.		8
Module-3:	Soaps and Detergents 3.1 Definition of terms like soaps, surfactants, detergents, classification of surfactants. 3.2 Manufacture of soap by continuous process with flow sheet. 3.3 Special soaps. 3.4 Raw materials for detergents with flow sheet. 3.5 Cleaning action of soaps and detergents, household detergents.		7
Module-4:	Fertilizer Industry 4.1 Introduction, importance of fertilizers.		8

	4.2 N, P, K ratio, micronutrients, organic manure, Vermi-compost. 4.3 Nitrogenous fertilizers: a. Manufacture of urea, b. Phosphatic fertilizers: Manufacture of triple super phosphate c. Mixed fertilizers: Manufacture of mixed fertilizer.	
Reference Books: 1. Austin, G. T. Shreeve's Chemical Process Industries. 5th ed. New York: McGraw-Hill, 2017. 2. Das, R. K. Industrial Chemistry. Asia Publishing House, 1967. 3. Finar, I. L. Organic Chemistry, Vol. I. New Delhi: Pearson Education. 4. Finar, I. L. Organic Chemistry, Vol. II. New Delhi: Pearson Education, 1956. 5. Sharma, B. K. Industrial Chemistry. 10th ed. Meerut, India: Goel Publishing House, 1987. 6. Austin, George T. Shreve's Chemical Process Industries. 5th ed. New York: McGraw-Hill, 1984.		
Evaluation Pattern: 60:40		
Total Marks:50		
Continuous Comprehensive Evaluation : (20 Marks) • CCE-I- Home Assignment (10 Marks) • CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks) • CCE-III-Objective (MCQ) (10 Marks) Note:-Best two scoresof CCE will be considered out of three.	End Semester Examination: (30 Marks) • Question 1- Solve the following questions (Five questions of 2 Marks-10 Marks) • Question 2- Attempt any two questions (Three questions of 10 Marks-20 Marks) • Question 3- Attempt any four questions (Six questions of 5 Marks-20 marks) Note:- Conversion of 50 marks of ESE evaluation 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. III	Semester– VI
	Type: DSC P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCP-366:Practical VII Practicals based on BCT 361, BCT 362		
Course Objectives: Students should be able to... 1. study the rates of chemical reactions kinetically. 2. understand volumetric and gravimetric estimations efficiently. 3. learn determination of percentage purity of commercial samples. 4. recall knowledge of various instruments.		
Course Outcomes: After completion of the course, students will be able to... 1. determine the rate of chemical reaction.. 2. conduct qualitative and quantitative estimations. 3. calculate percentage purity of commercial samples. 4. operate various instruments.		
Title and Contents		Hrs
Chemical Kinetics 1. To determine energy of activation of the reaction between potassium persulphate and potassium iodide (Equal/Unequal concentration). 2. To study the effect of addition of electrolyte (KCl) on the reaction between K ₂ S ₂ O ₈ and KI (Equal concentration). Adsorption 3. To investigate the adsorption of Oxalic acid by activated charcoal and test the validity of Freundlich & Langmuir isotherms. Conductometry 4. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloroacetic acid (cell constant to be given). 5. To determine rate constant of hydrolysis of ethyl acetate by NaOH conductometrically. Thermodynamics 6. To determine partial molar volume of ethanol water mixture at a given composition Solid State Chemistry: 7. To prepare theoretical models based on Solid State Chemistry. Gravimetric Estimations 8. To estimate amount of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid gravimetrically. 9. To estimate amount of barium as barium chromate from the given solution containing barium chloride, ferric chloride and free hydrochloride acid gravimetrically. [For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm ³ and asked to dilute to 100 cm ³ (or the stock solution should be given in the range of 20 to 30 cm ³ and asked to dilute to 250 cm ³). Use 50 cm ³ of this diluted solution for estimation.] Inorganic Preparations (Any 2) 10. To prepare hexamine nickel (II) chloride. 11. To prepare tris (thiourea) cuprous sulphate. 12. To prepare potassium diaquabisoxalatocuprate (II).		60

Titrimetric Estimations: Percentage Purity 14. To determine percentage purity of potassium trioxalatoaluminate (III). 15. To determine percentage purity of potassium trioxalato ferrate (III).	
Reference Books: - 1. Findlay, Alexander. Practical Physical Chemistry. 9 th ed. Revised by Levitt, B. P. London: Longman, 1973. 2. Khosla, B. D., Garg, V. C. and Adarsh Gulati. Senior Practical Physical Chemistry. 18 th ed. New Delhi: R. Chand & Co., 2018. 3. Vogel A. I., Vogel's Text Book of Quantitative Inorganic Analysis: Longman, 1989. 4. Palmer, W. G. Experimental Inorganic Chemistry: Cambridge Uni. Press, New York, 1954.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2

	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. III	Semester– VI
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCP-367: Practical VIII Practicals based on BCT 363, 364 (E1)		
Course Objectives: Students should be able to... 1. understand separation and identification of organic compounds. 2. get the idea of chromatographic separation technique using ion exchange resins. 3. learn various instruments required for analyzing commercial and real samples. 4. understand volumetric and gravimetric estimations efficiently.		
Course Outcomes: After completion of the course, students will be able to... 1. estimate organic functional groups qualitatively and quantitatively. 2. separate inorganic cations and anions by chromatographic method. 3. handle various instruments for analyzing real life and commercial samples. 4. conduct qualitative and quantitative estimations.		
Title and Contents		Hrs
1. to 5. Qualitative Analysis Separation of Binary Mixture and Identification of Components (5 mixtures) Solid – Solid Solid – Liquid Liquid – Liquid 1) Solid – Solid Mixtures: One mixture from each the following types should be given: i) Acid + Phenol ii) Acid + Base iii) Acid + Neutral iv) Phenol + Base v) Phenol + Neutral vi) Base + Neutral 2) Solid – Liquid Mixtures: Mixture of type Neutral + Neutral or Acid + Neutral should be given. 3) Liquid – Liquid Mixtures: Mixture of type Neutral + Neutral or Base + Neutral should be given. Following compounds should be used for preparation of mixtures Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid. Phenols: α -naphthol, β -naphthol, resorcinol, Bases: o-nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N- dimethylaniline, diphenylamine, Neutrals: Anthracene, acetanilide, m-dinitrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, bromobenzene, urea and thiourea. NB: 1. For Solid - Liquid and Liquid - Liquid mixtures avoid detection of type of mixture. Instead, the weightage is given to detection of nature and separation of mixture. 2. Separation and qualitative analysis of the binary Mixtures should be carried out on microscale using microscale kits. 6. Estimate amount of salicylic acid from the aspirin tablet. 7. Estimation of amount of iron from the given tablet. 8. Estimate the amount of aniline present in the given solution. 9. Estimate the amount of phenol present in the given solution. 10. Estimate the amount of ethyl methyl ketone present in the givensolution. 11. Estimation of alkali from the antacid tablet. 12. Estimation of Paracetamol content in analgesic tablet. 13. Detection of nitrogen, halogen and sulphur form the packed food sample. 14. Determine percentage of ash in the given milk sample. 15. Determination of concentration of acetic acid in fatty acid from the given soap sample.		60

Reference Books: -

1. Agarwal, O. P. Advanced Practical Organic Chemistry. Krishna Prakashan Media (P) Ltd., 2014.
2. Sivasankar, B., and G. Svehla. Vogel's Qualitative Chemical Analysis. Pearson Education India, 2012.
3. Vogel, A. I. Vogel's Text Book of Quantitative Inorganic Analysis. Longman, 1989.
4. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry. Pearson India, 2003.

Evaluation Pattern: 60:40**Total Marks: 50**

Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2
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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. III	Semester– VI
	Type: DSE P	Marks: 50
Credits: 2	From: A. Y. 2026-27	
Name of the Course: BCP-367: Practical VIII Practicals based on BCT 363, 365 (E2)		
Course Objectives: Students should be able to...		
1. acquire the knowledge of various instruments for analyzing real life and commercial samples. 2. learn the estimations qualitatively and quantitatively. 3. understand the use of ion exchange resins in determination of elements. 4. know volumetric and gravimetric estimations efficiently.		
Course Outcomes: After completion of the course, students will be able to...		
1. operate the various instruments for analyzing real life and commercial samples. 2. estimate the amount of substance from the given solution. 3. perform practical using cation and anion exchange resins. 4. conduct qualitative and quantitative estimations.		
Title and Contents		Hrs
Qualitative Analysis Separation of Binary Mixture and identification of Components (5 mixtures) Solid – Solid Solid – Liquid Liquid – Liquid 1) Solid – Solid Mixtures: One mixture from each the following types should be given: i) Acid + Phenol ii) Acid + Base iii) Acid + Neutral iv) Phenol + Base v) Phenol + Neutral vi) Base + Neutral 2) Solid – Liquid Mixtures: Mixture of type Neutral + Neutral or Acid + Neutral should be given. 3) Liquid – Liquid Mixtures: Mixture of type Neutral + Neutral or Base + Neutral should be given. Following compounds should be used for preparation of mixtures Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid. Phenols: α -naphthol, β -naphthol, resorcinol, Bases: o-nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N- dimethylaniline, diphenylamine, Neutrals: Anthracene, acetanilide, m-dinitrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, bromobenzene, urea and thiourea. NB: 1. For Solid - Liquid and Liquid - Liquid mixtures avoid detection of type of mixture. Instead, the weightage is given to detection of nature and separation of mixture. 2. Separation and qualitative analysis of the binary Mixtures should be carried out on microscale using microscale kits.		60
Organic Industrial Section: 6. Estimation of unsaturation–to estimate the percentage purity of given olefin compound by brominating method. 7. Preparation of picric acid from phenol. 8. Estimation of alkali content in Antacid using HCl. Physical Industrial Section: 9. pH metry: To determine the dissociation constant of dibasic acid (Malonic acid). 10. Colorimetry: To estimate of Fe^{+++} ions by thiocyanate method.		

11. Potentiometry: Titration of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution and to calculate redox potential of Fe^{++} , Fe^{+++} system. Inorganic Industrial Section: Ion Exchange Method 12. Determination of amount of sodium present in the given solution of common salt using cation exchange resin (By Acid Base titration). 13. Determination of amount of magnesium in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA. 14. Determination of amount of zinc in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA. 15. Estimation of zinc as zinc pyrophosphate from the given solution containing zinc sulphate, ferrous ammonium sulphate and free sulphuric acid.	
Reference Books: - 1. Agarwal, O. P. Advanced Practical Organic Chemistry. Krishna Prakashan Media (P) Ltd., 2014. 2. Findlay, A. Practical Physical Chemistry. Prentice Hall Press, 1973. 3. Khosla, B. D., V. C. Garg, and A. Gulati. Senior Practical Physical Chemistry. R. Chand and Co., 2018. 4. Sivasankar, B., and G. Svehla. Vogel's Qualitative Chemical Analysis. Pearson Education India, 2012. 5. Vogel, A. I. Vogel's Text Book of Quantitative Inorganic Analysis. Longman, 1989. 6. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry. Pearson India, 2003.	
Evaluation Pattern: 60:40	
Total Marks: 50	
Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2

	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. III	Semester– VI
	Type: VSC	Marks: 50
Credits: 2	From: A. Y. 2026-27	
Name of the Course: BCPVSC-IV: Effluent Treatment Processes		
Course Objectives: Students should be able to...		
1. understand the principles and techniques for collection and preservation of effluent samples for accurate analysis. 2. develop knowledge of key physicochemical parameters (pH, TDS, TSS, BOD, COD, DO, chloride, and hardness) used to assess effluent quality. 3. explore various treatment methods such as coagulation, flocculation, precipitation, adsorption, and microbial degradation. 4. investigate the microbial degradation of organic pollutants.		
Course Outcomes: After completion of the course, students will be able to...		
1. demonstrate proper techniques for sampling, preservation, and handling of effluent samples. 2. analyze and interpret key waste water quality parameters, including pH, TDS, TSS, BOD, COD, DO, chloride, and hardness. 3. apply different treatment techniques such as coagulation-flocculation, precipitation, and adsorption for the removal of pollutants. 4. analyze microbial degradation of organic pollutants and oil/grease content in effluents.		
Title and Contents (Any 15 of the following)		Hrs
1. Collection and Preservation of Effluent Samples. 2. Determination of pH and conductance of Effluent samples 3. Determination of Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). 4. Determination of Biological Oxygen Demand (BOD). 5. Determination of Chemical Oxygen Demand (COD). 6. Estimation of Dissolved Oxygen (DO). 7. Determination of Chloride Content in Effluent. 8. Determination of Hardness of Effluent samples. 9. Determination of Alkalinity of Effluent samples. 10. Determination of Acidity of Effluent samples. 11. Coagulation and Flocculation Study of Effluent. 12. Removal of Heavy Metals by Precipitation Method. 13. Adsorption Study Using Activated Carbon for Effluent Treatment. 14. Study of Microbial Degradation of Organic Pollutants. 15. Determination of Oil and Grease Content in Effluent. 16. Study of a Small-Scale Effluent Treatment Plant (ETP) Model. 17. Analysis of Treated Effluent Quality After Treatment.		60
Reference Books: -		
1. Spellman, Frank R. Handbook of Water and Wastewater Treatment Plant Operations. Boca Raton: Lewis Publishers, CRC Press, 2003. 2. Sharma, B. K., and H. Kaur. Environmental Chemistry. Meerut: Goel Publishing House.		

3. Spiro, Thomas G., and William M. Stigliani. Chemistry of the Environment. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2002.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2
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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. III	Semester– VI
	Type: SEC	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BCPSEC-III: Instrumental Analyst		
Course Objectives: Students should be able to... 1. study the analytical skills required for industrial applications. 2. learn the various instruments required for chemical analysis. 3. understand qualitative and quantitative estimations. 4. recall the knowledge of structural interpretation of compounds using IR spectroscopy.		
Course Outcomes: After completion of the course, students will be able to... 1. evaluate the analytical data and calibrate the curves. 2. handle and operate various instruments like colorimeter, conductometer, spectrophotometer, flame photometer, AAS, IR instrument etc. 3. conduct qualitative and quantitative estimations. 4. interpret the structures of organic compounds using IR spectral data.		
Title and Contents (Any 15 of the following)		Hrs
1. Refractometry-To determine the molar refractivities of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction equivalents of C, H and Cl atoms. 2. Refractometry-To determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution. 3. Potentiometry-To estimation vitamin -C in the given solution by titrating with ceric ammonium sulphate. 4. Potentiometry-To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate. 5. Conductometry- To determine the normality of citric acid in lemon by titrating it against standard 0.2 N NaOH solution by conductometric method. 6. Conductometry-To determine Λ^∞ of strong electrolyte (NaCl or KCl) and to verify Onsagar equation. 7. Conductometry-To estimate the amount of lead present in given solution of lead nitrate by conductometric titration with sodium sulphate. 8. Colorimetry-To determine the concentration and complexion of Ni^{2+} ion with EDTA. 9. Colorimetry-To estimate iron from a given solution by colorimetry. 10. Colorimetry-To estimate Fe^{+3} ions using salicylic acid by colorimetric titration (static method). 11. pH Metry-To determine hydrolysis constant of aniline hydrochloride. 12. pH Metry-To determine dissociation constant of tribasic (phosphoric acid). 13. pH Metry-To determine the dissociation constant of oxalic acid by pH metric titration with strong base. 14. Turbidometer-To determine amount of sulphate in water sample turbidimetrically. 15. To estimate amount of acetic acid in vinegar by using Quinhydrone electrode. 16. To determine amount of phosphate using UV-Vis method. 17. FTIR spectral interpretation of organic compounds (Any 5 samples). 18. Analysis of water sample (pH, conductivity, turbidity).		60

Reference Books: -

- 1.Sharma, B. K., and H. Kaur. Environmental Chemistry. Meerut: Goel Publishing House.
- 2.Instrumental Methods of Chemical Analysis by B.K. Sharma.
3. Vogel's Textbook of Quantitative Chemical Analysis.

Evaluation Pattern:60:40**Total Marks:50**

Continuous Comprehensive Evaluation : (20 Marks) Student Performance (5 marks) Attendance (5 Marks) Journal records (10 Marks)	End Semester Examination (30 Marks) Experiment 1 Experiment 2
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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. III	Semester– VI
	Type: FP	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: Field Project (BCPFP I)		
Course Objectives: Students should be able to... 1. develop skills in sample collection and analysis of water, soil, air, food, or other materials using appropriate chemical techniques. 2. strengthen research aptitude and scientific temperament through field-based learning experiences. 3. enhance communication, teamwork, and leadership skills through collaborative project work. 4. develop report-writing and presentation skills for communicating scientific findings effectively.		
Course Outcomes: By the end of the course, students will be able to... 1. conduct field surveys and collect representative samples. 2. perform basic chemical analyses and interpret results. 3. relate chemistry concepts to real-life problems and recommend practical solutions for environmental and community issues. 4. prepare scientific reports and presentations.		
Title and Contents		Hrs
Field project proposal writing and presentation		60
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) Attendance/Participation- (10 Marks) Field Diary/Logbook- (10 Marks)		End Semester Examination: (30 Marks) Scientific Activity/ Demonstration-(10 Marks) Final Report-(10 Marks) Viva Voce/Presentation-(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. III

Semester– VI

Type: CC

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BCTCC 1 Youth and Shramdan

Course Objectives: Students should be able to...

1. know the basic concepts of NSS.
2. inculcate the awareness and preparation of basic of social important goals.
3. improve personality.
4. understand the importance of chemicals and its managements through shramdan.

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

1. participate in social activities like shramdan.
2. categorize youth according to their abilities.
3. support in personality development for colleges.
4. make the chemical inventory and its managements through shramdan.

Module	Title and Contents	Hrs
Module-1:	Introduction to Basic Concepts of NSS: 1.1 History, philosophy, aims and objectives of NSS, 1.2 Emblem, flag, motto, song, badge etc., 1.3 Organizational structure, roles and responsibilities of various NSS functionaries.	6
Module-2:	Understanding Youth: 2.1 Definition, profile of youth and categories of youth. 2.2 Issues, challenges and opportunities for youths. 2.3 Indian Tradition of volunteerism, Needs and importance of volunteerism. 2.4 Motivation and constraints of volunteerism, shramdan as part of volunteerism. 2.5 Swatch Bharat. Awareness in blood donation/ tree plantation/special camps etc.	8
Module-3:	Chemical Inventory Management: 3.1 Understand meaning of chemicals. 3.2 Segregation of chemicals according to their states. 3.3 Arrangement of chemicals according to acid and base nature. 3.4 Arrangement of chemicals according to their reactivity. 3.5 Listing of chemicals.	8
Module-4:	Laboratory Safety Management: 4.1 Introduction of safety. 4.2 Symbols used for safety. 4.3 Awareness about fire safety. 4.4 Safety precautions required in the laboratory.	8

References:

1. Robinson, J.P., Dando, M., & Pearson, G.S. (2007). "Ethical Issues in Research Involving Chemical and Biological Warfare Agents." Science and Engineering Ethics, 13 (4), 569-580.
2. Rappert, B., & Jefferson, C. (2006). "The Development of the Dual Use Concept in the Life Sciences and Its Influence on International Policy." Science and Public Policy, 33(6), 475-486.

3. Hoffmann, R. (1997). "Ethical Dilemmas in Chemical Sciences: A Few Personal Reflections." Science and Engineering Ethics, 3(2), 199-208.
4. Corgne, S., et al. (2018). "Responsible Research and Innovation in Industry and Laboratories: A Case Study for Nanomaterials." Journal of Nanoparticle Research, 20 (11), 294

Evaluation Pattern: 60:40

Total Marks:50

Continuous Comprehensive Evaluation : (20 Marks)

- CCE-I- Home Assignment (10 Marks)
- CCE-II -Short and Long Answer question/Class tests, assignments/seminars/case studies/ tutorials/ record books/ fieldwork/ project work, quizzes etc. (10 Marks)
- CCE-III-Objective (MCQ) (10 Marks)

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

End Semester Evaluation: (30 Marks)

- Question 1- Solve the following questions (Five questions of 2 Marks)
- Question 2- Attempt any two questions (Three questions of 10 Marks)
- Question 3- Attempt any four questions (Six questions of 5 Marks)

Note:- Conversion of 50 marks of ESE evaluation to 30 Marks.