



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. IV Honors (Chemistry)**

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

With effect from Academic Year 2026-2027

Title: B. Sc. Honors (Chemistry)

1. Preamble:

This syllabus is framed to give advanced knowledge of Chemistry to students at fourth year of four years of **B. Sc. Honors** degree course. The goal of the syllabus is to make the study of chemistry, interesting and encouraging to the students for higher studies including research. The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

2. GENERAL OBJECTIVES OF THE COURSE:

1. To educate and prepare post graduate students from rural and urban area who will get employment on large scale in academic institutes, R & D and Quality control laboratories of Indian chemical/pharmaceutical industries as well as multinational and forensic Laboratories.
2. To provide students with broad theoretical and applied background in all specialization of Chemistry with emphasis on qualitative and quantitative technique.
3. To provide broad common framework of syllabus to expose our young graduates to the recent and applied knowledge of interdisciplinary branches of chemistry involving applied organic, inorganic, physical, analytical, industrial, pharmaceutical, polymer, nano science & technology.
4. To conduct lesser written tests and to encourage on non-written tests.
5. To focus on encouraging students to conduct various academic activities like midterm tests, online tests, open book tests, tutorial, surprise test, oral, seminar, assignments and seminar presentation.

Learning Outcomes:

1. A graduate with a Bachelor degree with Honors in Chemistry has in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.
2. The graduate has expert knowledge of a well-defined area of research with in chemistry. The graduate has specific skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques. Skilled in examining specific phenomena theoretically and/or experimentally, the graduate is able to contribute to the generation of new scientific insights or to the innovation of new applications of chemical research.

3. Duration: One Year

4. Pattern: Semester Examination

5. Medium of Instruction: English

6. Eligibility of Students: B. Sc. III (Chemistry)

7. Eligibility of Teacher: As per the rules and regulations of UGC and Govt. of Maharashtra

Level	Sem	Courses				Course III	Total
		DSC Course I		DSE* Course II			
		T	P	T	P		
6.0	VII	DSC I (4)	DSC P (2)	DSE I (2)	DSE P (2)	RM I (2) RM (P) I (2)	22
		DSC II (4)		DSE II (2)			
		DSC III (4)					

Level	Sem	Courses				Course III	Total
		DSC Course I		DSE* Course II			
		T	P	T	P		
6.0	VIII	DSC I (4)	DSC P (2)	DSE I (2)	DSE P (2)	OJT (4)	22
		DSC II (4)		DSE II (2)			
		DSC III (4)					

* DSE - One paper out of two for each semester.

COURSE TITLE

1) Seventh Semester

Sr. No.	Subject	Course Code	Title of Paper	No. of lectures/ practicals per Week	Credits
1.	DSC I	BCT 471	Physical Chemistry I	4	4
2.	DSC II	BCT 472	Inorganic Chemistry I	4	4
3.	DSC III	BCT 473	Organic Chemistry I	4	4
4.	DSE I	BCT 474	Analytical Chemistry I	2	2
5.	DSE II	BCT 475	Applied Chemistry I		
6.	RM I	BCT RM I 476	Research Methodology	2	2
7.	DSC P	BCP 477	Practical (Based on BCT 471, 472, 473)	1	2
8.	DSE P	BCP 478	Practical (Based on BCT 474, 475)	1	2
9.	RM P	BCPRM I 479	Practical RM	1	2

2) Eighth Semester

Sr. No.	Subject	Course Code	Title of Paper	No. of lectures/ practicals per Week	Credits
1.	DSC I	BCT 481	Physical Chemistry II	4	4
2.	DSC II	BCT 482	Inorganic Chemistry II	4	4
3.	DSC III	BCT 483	Organic Chemistry II	4	4
4.	DSE I	BCT 484	Analytical Chemistry II	2	2
5.	DSE II	BCT 485	Applied Chemistry II		
6.	DSC P	BCP 486	Practical (Based on BCT 481, 482, 483)	2	2
7.	DSE P	BCP 487	Practical (Based on BCT 484, 485)	1	2
8.	OJT	BCPOJT 488	-	2	4

EVALUATION STRUCTURE: **B. Sc. Honors**

Semester VII (6.0)

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BCT 471	20	20	20	60	100	04
	T	BCT 472	20	20	20	60	100	04
	T	BCT 473	20	20	20	60	100	04
	P	BCP 477	20			30	50	02
DSE (1 Theory Paper Out of 2)	T	BCT 474	10	10	10	30	50	02
	T	BCT 475	10	10	10	30	50	02
	P	BCP 478	20			30	50	02
RM 1	T	BCTRM 1 476	10	10	10	30	50	02
RM 1	P	BCPRM 1 479	20			30	50	02
Total							550	22

Semester VIII

Course	Course Category	Course Code	Continuous Comprehensive Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BCT 481	20	20	20	60	100	04
	T	BCT 482	20	20	20	60	100	04
	T	BCT 483	20	20	20	60	100	04
	P	BCP 486	20			30	50	02
DSE (1 Theory Paper Out of 2)	T	BCT 484	10	10	10	30	50	02
	T	BCT 485	10	10	10	30	50	02
	P	BCP 487	20			30	50	02
OJT	P	BCPOJT 488	40			60	100	04
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

9. OTHER FEATURES:

A) LIBRARY:

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

B) EQUIPMENT:

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

b) Laboratory Equipment:

- | | |
|-----------------------------|--------------------|
| 1. Magnetic stirrer | 2. Hot Air Oven |
| 3. Digital weighing balance | 4. Furnace |
| 5. pH meter | 6. Fume hood |
| 7. Spectrophotometer | 8. Conductometer |
| 9. Parallel synthesizer | 10. Microwave oven |
| 11. Potentiometer | 12. Colorimeter |

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. IV (Honors)	Semester - VII
	Type: DSC I	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCT 471: Physical Chemistry I	
Course Objectives: Students should be able to... 1) understand the basic concept and various laws of thermodynamics. 2) study the photochemistry and fluorescence. 3) learn the chemistry of macromolecules. 4) gain the knowledge of basic concepts of Molecular Spectroscopy.		
Course Outcomes: After completion of course, students will be able to... 1) explain the thermodynamics terms and applications. 2) explain prompt phenomenon of fluorescence, delayed fluorescence, and phosphorescence. 3) interpret the electronic structure of molecules, molecular orbitals, electronically excited singlet states, designation based on multiplicity rule. 4) describe the principle of microwave spectroscopy's.		
Module	Title and Contents	Hrs
Module -1:	Thermodynamics 1.1. Introduction: revision of basic concepts: Entropy and third law of thermodynamics 1.2. Methods of determining the absolute entropies of solid, liquid and gases 1.3. Entropies of phase transition 1.4. Maxwell relations and its applications, thermodynamic equation of state 1.5. Ideal and non-ideal solutions 1.6. Thermodynamics of non-electrolyte solutions 1.7. Raoult'slaw 1.8. Duhem-Margules equation and its applications to vapor pressure curves (Binary liquid mixture). 1.9. Gibbs-Duhem equation and its applications to study partial molar quantities 1.10. Chemical potential, variation of chemical potential with temperature & pressure 1.11. Henry's law 1.12. Excess and mixing thermodynamic properties 1.13. Equilibrium constants and general conditions of equilibrium in terms of thermodynamic potentials 1.14. Numerical Problems.	15

Module -2:	A Photochemistry 2.A.1. Absorption of light and nature of electronic spectra 2.A.2. Electronic transition 2.A.3. Frank Condon principle 2.A.4. Selection rules 2.A.5. Photo-dissociation 2.A.6. Pre-dissociation 2.A.7. Photo-physical phenomena 2.A.8. Electronic structure of molecules 2.A.9. Molecular orbital 2.A.10. Electronically excited singlet states 2.A.11. Designation based on multiplicity rule 2.A.12. Life time of electronically excited state 2.A.13. Construction of Jablonski diagram 2.A.14. Electronic transitions and intensity of absorption bands 2.A.15. Photo-physical pathways of excited molecular system (radiative and nonradiative) 2.A.16. Photochemistry of environment: Greenhouse Effect. B Fluorescence Spectroscopy 2.B.1. Introduction 2.B.2. Delayed fluorescence and phosphorescence 2.B.3. Fluorescence quenching: concentration quenching 2.B.4. Quenching by excimer and exciplex emission, 2.B.5. Fluorescence resonance energy transfer between photo-excited donor and acceptor systems. 2.B.6. Stern-Volmer relation, Bimolecular collisional quenching 2.B.7. Critical energy transfer distances 2.B.8. Energy transfer efficiency Examples and analytical significance	15
Module -3:	Macromolecules 3.1. Macromolecules: Mechanism of polymerization 3.2. Molecular weight of a polymer (Number and mass average) 3.3. Viscosity average molecular weights 3.4. Degree of polymerization and molecular weight 3.5. Methods of determining molecular weights (Osmometry, viscometer, light scattering, diffusion and ultracentrifugation) 3.6. Chemistry of polymerization: Ceiling temperature, Free radical polymerization (Initiation, propagation and termination) 3.7. Kinetics of free radical polymerization, step growth polymerization (Poly condensation) 3.8. Molecular weight distribution, 3.9. Kinetics of step polymerization and cationic and anionic polymerization 3.10. Electronically conducting polymers 3.11. Thermodynamics of polymer solutions: Flory-Huggins Theory. 3.12. Glass transition temperature and molecular weight, factors	15

	influencing Glass transition temperature, determination of glass transition temperature 3.13. Numerical problems	
Module -4:	Molecular Spectroscopy 4.1 Recapitulation: Width and intensity of spectral transitions 4.2 Fourier transform 4.3 Signal-to-noise ratio 4.4 Microwave spectroscopy 4.5 Rotation spectra of diatomic molecules-rigid and non-rigid molecules 4.6 Stark effect. 4.7 Infra-red spectroscopy: Harmonic and anharmonic oscillator 4.8 Electronic spectroscopy of molecules: Born – Oppenheimer approximation 4.9 Electronic spectra of diatomic molecules and it's applications.	15
Reference Books: - [1] Atkins P. W. Physical Chemistry. 8 th edition. Oxford University press. 2006. [2] Glasstone S. and Nostrand D. Van. Thermodynamics for Chemists. New Delhi: Affiliated East-West press. 1965. [3] Srivastava R. C., Saha S. K. and Jain A. K. Thermodynamics, A Core Course. 2 nd edition. Prentice-Hall of India. 2004. [4] Banewell C. N. and Cash E. Mc. Fundamentals of molecular spectroscopy. 4 th edition. Elaine M. Mc Cash department of chemistry university of York. 1994. [5] Deshpande D. D. Physical Chemistry of macromolecules. Vishal Publications. 2000.		
Evaluation Pattern: 60:40		
Total Marks: 100		
Continuous Comprehensive Evaluation : (40 Marks) • Internal Work–CCE-I Home Assignment (20 Marks) • Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks) • Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 Marks) • (Internal Evaluation best of the two CCE marks will be considered)		End Semester Examination: 60 Marks • Question -1: Short Answer (12 Marks) • Question -2: Long Answer (12 Marks) • Question -3: Long Answer (12 Marks) • Question -4: Long Answer (12 Marks) • Question -5: Short Note (12 Marks) • Question -6: Short Note (12 Marks) • Question -7: Short Note (12 Marks) Question 1 compulsory and any four from Q. 2 to 7

	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. IV (Honors)	Semester - VII
	Type: DSC II	Marks: 100
	Credits: 4	From: A. Y. 2026-27
Name of the Course: BCT 472: Inorganic Chemistry I		
Course Objectives: Students should be able to... 1) understand chemistry of transition elements. 2) study different organometallic compounds and their chemistry. 3) learn the nuclear chemistry and its importance. 4) acquire the knowledge of nanoscience and nanomaterials		
Course Outcomes: After completion of course, students will be able to... 1) apply the theories for coordination compounds and their applications. 2) demonstrate the bonding in organometallic compounds. 3) explain the nuclear transformations and its uses. 4) demonstrate the nanoscience, nanotechnology and nanomaterials.		
Module	Title and Contents	Hrs
Module -1:	Chemistry of Transition Elements 1.1. General discussion on the properties of the transition elements 1.2. Coordination chemistry of transition metal ions 1.3. Stereochemistry of coordination compounds 1.4. Crystal field theory, splitting of orbital's in low field environment with examples. 1.5. Crystal field stabilization energy (CFSE), Factors affecting the crystal field parameters, Examples 1.6. Spectrochemical series 1.7. Jahn-Teller effect 1.8. Interpretation of electronic spectra including d-d and charge transfer spectra.	15
Module -2:	Organometallic Chemistry 2.1. Synthesis and bonding in pi-metal organometallic complex 2.2. Structure and reactivity of organometallic compounds 2.3. Classification of organometallic compounds based on hapticity and polarity 2.4. Nomenclature and general characters 2.5. 18 electron rule-applications and exceptions 2.6. Reactions of organometallic compounds: Oxidative addition, reductive elimination, Insertion and elimination 2.7. Organometallics in homogeneous catalysis 2.8. Hydrogenation, hydroformylation, isomerization and polymerization	15

Module -3:	A. Nuclear Chemistry 3.A.1. Radioactive decay and equilibrium 3.A.2. Nuclear reactions, Q value, cross sections 3.A.3. Types of reactions 3.A.4. Chemical effects of nuclear transformations 3.A.5. Fission and fusion 3.A.6. Fission products and fission yields 3.A.7. Radioactive techniques B. Transition Metal Carbonyls and Related Compounds 3.B.1. Introduction, Preparation, structure, physical and chemical properties of metal carbonyls 3.B.2. Anionic and cationic carbonyl complexes 3.B.3. Lewis base derivatives of carbonyls 3.B.4. Carbonyl hydrides and Carbonyl halides	15
Module -4:	Nanoscience and Nanomaterials 4.1. Introduction to nanoscience and nanotechnology 4.2. Historical background 4.3. Classification of nanomaterials: 1D, 2D, 3D (with their examples) 4.4. Applications of nanotechnology & Nanomaterials 4.5. Implications of nanotechnology 4.6. Future fantasy and nanotechnology 4.7. Experimental methods for preparation of nanomaterials: Chemical and Physical techniques 4.8. Size dependent properties of nanoparticles 4.9. Characterization techniques for nanomaterials: Principle and working of XRD, SEM and TEM	15
Reference Books: - [1] Lee J. D. Concise Inorganic Chemistry. 5 th edition. John Wiley & Sons. 2009. [2] Shriver D. F. and Atkins P. W. Inorganic Chemistry. 3 rd edition. Oxford. 1999. [3] Puri B. R., Sharma L. R. and Kalia K. C. Principals of Inorganic Chemistry, India, Vishal Publishing company. 2007. [4] Arnikaar H. J. Essentials of Nuclear Chemistry, Wiley Eastern. 1988. [5] Pradeep T. Nano The Essentials: Understanding Nanoscience and Nanotechnology, Mc Graw Hill Education. 2010.		
Evaluation Pattern: 60:40		
Total Marks: 100		
Continuous Comprehensive Evaluation : (40 marks) - Internal Work–CCE-I Home Assignment (20 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 Marks) (Internal Evaluation best of the two CCE marks will be considered)		End Semester Examination: 60 Marks - Question -1: Short Answer (12 Marks) - Question -2: Long Answer (12 Marks) - Question -3: Long Answer (12 Marks) - Question -4: Long Answer (12 Marks) - Question -5: Short Note (12 Marks) - Question -6: Short Note (12 Marks) - Question -7: Short Note (12 Marks) Question 1 compulsory and any four from Q. 2 to 7

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	Programme: B. Sc. IV (Honors)	Semester - VII
	Type: DSC III	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCT 473: Organic Chemistry I	
Course Objectives: Students should be able to... 1) know different reactive intermediate and their reactivity 2) understand the mechanism of different types of substitution reactions. 3) acquire the knowledge of addition and elimination reactions. 4) learn the basic concepts of the stereochemistry.		
Course Outcomes: After completion of course, students will be able to... 1) explore conceptual fact of reaction mechanism and basic of reactivity. 2) compare the SN2, SN1 and SNi reactions with respects to mechanism, orientation and stereochemistry of aromatic systems. 3) differentiate between addition reactions and elimination reactions. 4) explain stereochemistry of organic compounds.		
Module	Title and Contents	Hrs
Module -1:	Reaction Mechanism: Structure and Reactivity 1.1. Types of reactions, 1.2. Chemical bonding and basis of reactivity- Chemical bond, 1.3. Delocalization, conjugation, resonance, hyper conjugation, tautomerism, inductive effects. 1.4. Acidity and basicity: various structural effects, hard and soft acid and base concept.; 1.5. Aromaticity: Structural, thermochemical, and magnetic criteria for aromaticity, including NMR characteristics of aromatic systems. 1.6. Benzenoid and non-benzenoid compounds, Huckels rule, antiaromaticity, Application to carbocyclic and heterocyclic systems, annulenes, azulenes, tropylium cations, metallocenes, current concepts of aromaticity.; 1.7. Structure and stability of reactive intermediates, carbenes, nitrenes, carbocations, carbanions and free radicals.	15

Module -2:	A) Aliphatic Nucleophilic substitutions 2.A.1. The SN^2, SN^1 and SN^i reactions with respects to mechanism and stereochemistry. 2.A.2. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. 2.A.3. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. 2.A.4. SN reactions at bridge head carbon, competition between SN^1 and SN^2, 2.A.5. Ambient nucleophiles, Neighboring Group Participation. B) Aromatic Electrophilic Substitutions 2.B.1. Introduction, the arenium ion mechanism. 2.B.2. Orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems, energy profile diagrams 2.B.3. The ortho/para ratio, ipso attack, concept of aromaticity, orientation in their ring systems 2.B.4. Diazo-coupling 2.B.5. Vilsmeier-reaction 2.B.6. Von-Richter rearrangement	15
Module -3:	A) Addition Reactions 3.A.1. Addition to C-C multiple bonds mechanism and stereo chemical aspects of addition reaction. Electrophile, nucleophile and free radicals, 3.A.2. Regio and chemo selectivity, 3.A.3. Orientation and reactivity, 3.A.4. Conjugate addition. B) Elimination Reactions: 3.B.1. The E^1, E^2 and E^1CB mechanisms. 3.B.2. Orientation in Elimination reactions. 3.B.3. Hoffman Versus Saytzeff elimination, 3.B.4. Competition between substitution and elimination reactions, 3.B.5. Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions. 3.B.6. Pyrolytic elimination reactions. 3.B.7. Chugaev reaction, 3.B.8. Pyrolysis of acetates.	15
Module -4:	Stereochemistry 4.1. Introduction: 4.2. Molecules with two or more chiral centers: 4.3. Configurational nomenclature 4.4. Constitutionally unsymmetrical molecules: Erythro-Threo and Syn-Anti systems. Constitutionally symmetrical molecules with odd and even number of chiral centers: 4.5. Enantiomeric and meso forms, 4.6. concept of stereogenic, chirotopic and pseudo asymmetric centers. 4.7. Axial and planar chirality: Principles of axial and planar chirality. 4.8. Prochirality: Homotopic, heterotopic and diastereotopic ligands	15

	and faces. Identification using substitution and symmetry criteria. 4.9. Nomenclature of stereoheterotopic ligands and faces. 4.10 Symbols for stereoheterotopic ligands in molecules with one or more prochiral centres,	
Reference Books: - [1] Sykes Peter. A guide book to mechanism in Organic chemistry. 6 th edition. United States: Orient-Longmens. 1985. [2] Morrison R. T. and Boyd R. N. Organic Chemistry. 7 th edition. Prentice Hall: Ashok Kghosh. 2002. [3] Eliel E. L. Stereochemistry of Carbon Compounds. 1 st edition. McGraw-Hill,: Eliel. 1962. [4] D. Nasipuri. Stereochemistry of Organic compounds. New Delhi: New age International. 1994. [5] March J. Advanced Organic Chemistry. Sixth edition. Hooboken: McGraw-Hill. 2007. [6] J. Clayden, N. Greeves, S. Warren. Organic Chemistry. Sixth edition UK: Oxford University press. 2014.		
Evaluation Pattern: 60:40		
Total Marks: 100		
Continuous Comprehensive Evaluation : (40 Marks) • Internal Work–CCE-I Home Assignment (20 Marks) • Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks) • Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 Marks) (Internal Evaluation best of the two CCE marks will be considered)	End Semester Examination: 60 Marks • Question -1: Short Answer (12 Marks) • Question -2: Long Answer (12 Marks) • Question -3: Long Answer (12 Marks) • Question -4: Long Answer (12 Marks) • Question -5: Short Note (12 Marks) • Question -6: Short Note (12 Marks) • Question -7: Short Note (12 Marks) Question 1 compulsory and any four from Q. 2 to 7	

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	Board of Studies in Chemistry	
	Programme: B. Sc. IV (Honors)	Semester - VII
	Type: DSE I	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCT 474 : Analytical Chemistry I	
Course Objectives: Students should be able to... 1) know the concept of errors and treatment in analytical chemistry. 2) familiar with different types of chromatographic techniques. 3) understand fluorescence and phosphorescence with respect to analytical applications. 4) learn Thermal Analysis, TGA, DTA and DSC.		
Course Outcomes: After completion of course, students will be able to... 1) explain the errors, average derivation and standard derivation. 2) perform chromatographic methods, like Gas, Ion exchanges etc. 3) apply the knowledge of fluorescence methods and its applications. 4) classify and compare thermo gravimetry analysis and differential thermal analysis.		
Module	Title and Contents	Hrs
Module -1:	Errors and Treatment in Analytical Chemistry 1.1. Errors, Determinant, constant and indeterminate 1.2. Accuracy and precision, Distribution of random errors 1.3. Average deviation and standard deviation, variance and confidence limit 1.4. Significance figures and computation rules 1.5. Least square method	8
Module -2:	Chromatographic Methods 2.1. General principle, classification of chromatographic methods 2.2. Nature of partition forces 2.3. Chromatographic behavior of solutes 2.4. Column efficiency and resolution 2.5. Gas Chromatography: instrumentation, detector, optimization of experimental conditions 2.6. Thin layer chromatography: coating of materials, preparative TLC	7
Module -3:	Luminescence Spectrometry 3.1. Introduction of Luminescence Spectrometry 3.2. Comparison of absorption and fluorescence methods 3.3. Theory of Luminescence Spectrometry, fluorimetry 3.4. Instrumentation, applications of fluorimetry 3.5. Applications of Phosphometry	8

Module -4:	Thermal Analysis Introduction to thermal analysis, types of thermal analysis, significance of thermal analysis in Analytical Chemistry, effect of heat on materials, chemical decomposition, phase transformation etc. A) Thermogravimetry Analysis (TGA), 4.A.1. Principle, instrumentation, working, types of TGA, factors influencing TGA, curve to show nature of decomposition reactions, the product and qualities of compounds expelled, TGA in controlled atmosphere, TGA curves, analysis, research and analytical implications of TGA. B) Differential Thermal Analysis (DTA), 4.B.1. Instrumentation, methodology, application and research implications. Thermometric titrations method and applications Problems: Simple problems based on TGA, DTA and DSC.	7
Reference Books: - [1] Chatwal G. R., Anand S. K. Instrumental methods of chemical analysis, Himalaya Publishing House, 2016. [2] H. H. Willard, L. L. Mirrit, J. A. Dean. Instrumental Methods of analysis (CBS): Wads worth Publishing Company, 1988. [3] D. Skoog and D. West. Principal of Instrumental Analysis 6th edition Cengage Learning. 2006. [4] H. K. Kaur. Instrumental methods of chemical analysis. Pragati Prakashan Meerut. 2016. [5] El-Zeiny Ebeid, Mohamed Zakaria Thermal Analysis from Introductory Fundamentals to Advanced Applications. 1st Edition. 2021.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) - Internal Work–CCE-I Home Assignment (10 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (10 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (10 Marks) (Internal Evaluation best of the two CCE marks will be considered)	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.	

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	Programme: B. Sc. IV (Honors)	Semester - VII
	Type: DSE II	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCT 475 : Applied Chemistry I	
Course Objectives: Students should be able to... 1) study about preparation of Thin Film Materials. 2) acquire the knowledge of Light-Emitting Polymers. 3) learn the techniques of Biophysical Chemistry. 4) understand Spread sheets and Calculations Used in Analytical Chemistry.		
Course Outcomes: After completion of course, students will be able to... 1) explain definition, methods and application of Thin film Materials. 2) derive the synthesis of Light Emitting Polymers. 3) apply concept of Biophysical techniques and applications. 4) draw of Spreadsheets, Units of Measurement and Calculations used in Analytical Chemistry.		
Module	Title and Contents	Hrs
Module -1:	Thin Film Materials 1.1. Introduction, Definition of thin films, 1.2. Preparation of Thin Film Materials, 1.3. Methods: Spray Pyrolysis, Physical Vapor Deposition (PVD), Sputtering, DC Glow discharge and Low-pressure sputtering 1.4. Chemical Vapor Deposition (CVD) and Chemical Bath Deposition (CBD)	8
Module -2:	Organic Light Emitting Material-I 2.1. Introduction, Poly (p-Phenylene Vinylenes), 2.2. Synthetic Routes to Poly (p-Phenylene Vinylenes), 2.3. Substituted Poly (p-Phenylene Vinylene) Homopolymers, 2.4. Alkoxy-Substituted Poly (p-Phenylene Vinylenes)	7
Module -3:	Biophysical Chemistry 3.1. Introduction to biophysical chemistry: amino acids, peptides, proteins, enzymes, nucleic acids. 3.2. Introduction to primary, secondary, tertiary and quaternary structures, acid-base properties. 3.3. Intermolecular forces: H-bonding, Vander Waals forces, Lenard -Jones potential, 3.4. Columbic interactions, 1-4 interactions, hydrophobic hydration and interaction.	8

Module -4:	Spreadsheets and Calculations Used in Analytical Chemistry 4.1 Keeping Records and Making Calculations, 4.2 More Complex Examples, 4.3 Some Important Units of Measurement, 4.4 Unified Atomic Mass Units and the Mole, 4.5 The Factor - Label Approach to Example solutions and Their Concentrations, 4.6 Chemical Stoichiometry.	7
Reference Books: - [1] Holland L. Vacuum Deposition of Thin Films, Wiley. 1956. [2] Li Z., Meng H. Organic light emitting materials and devices. CRC Publisher, United Kingdom. 2014. [3] Nelson D. L., Cox M. M., Freeman W. H. Lehninger Principle of Biochemistry, 6th edition. W. H. Freeman and Company. 2013. [4] Allen J. P. Biophysical Chemistry, Wiley-Blackwell. 2008.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) - Internal Work–CCE-I Home Assignment (10 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (10 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (10 Marks) (Internal Evaluation best of the two CCE marks will be considered)	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.	

	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. IV (Honors)	Semester - VII
	Type: Research Methodology	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCTRM I 476: Research Methodology (RM)	
Course Objectives: Students should be able to... 1) understand the idea about need of Research Design. 2) acquire the knowledge for implementation of Sample Survey.		
Course Outcomes: After completion of course, students will be able to... 1) classify the research data. 2) explain different types of research.		
Module	Title and Contents	Hrs
Module -1:	Research Design 1.1. Meaning of Research Design 1.2. Need of Research Design 1.3. Features of Good Design 1.4. Important Concept Relating to Research Design 1.5. Different Research Design 1.6. Basic principles of Experimental Designs	8
Module -2:	Design of Sample Surveys 2.1. Introduction, Sample Design 2.2. Sampling and Non-Sampling Errors 2.3. Sample Survey and Census Survey 2.4. Types of Sampling Designs 2.5. Non-probability Sampling and Probability Sampling	7
Module -3:	Data Preparation and process 3.1. Data preparation process 3.2. Questionnaire checking 3.3. Editing, Coding and classification of data 3.4. Tabulations and Graphical representation of data 3.5. Data cleaning and adjusting	8

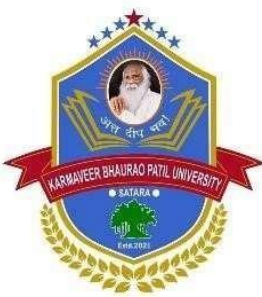
Module -4:	Research report and ethics 4.1. Research report and its structure 4.2. Components of journal article 4.3. Components of thesis and dissertation 4.4. Referencing style and bibliography 4.5. Plagiarism and copyright infringement 4.6. Consequences of plagiarism	7
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Reference Books: -

- [1] Kothari C. R., Research Methodology: Research and techniques. New Delhi: New Age International Publishers. 1980.
- [2] Hibbert D. B., Gooding J. J. Data analysis for chemistry. Oxford University Press. 2006.
- [3] Topping J. Errors of observation and their treatment. Fourth Ed., Chapman Hall, London. 1984.
- [4] Harris D. C., Quantitative chemical analysis. 6th Ed., Freeman. 2007.
- [5] Denscombes M., The Good Research Guide: For small-scale social research projects. Maiden-Read: Open University Press. 2010.
- [6] Dornyei Z., Research Methods in Applied Linguistics. Oxford: Oxford University Press. 2007.

Evaluation Pattern: 60:40
Total Marks: 50

Continuous Comprehensive Evaluation : (20 Marks) - Internal Work–CCE-I Home Assignment (10 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (10 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (10 Marks) (Internal Evaluation best of the two CCE marks will be considered)	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.
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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. IV (Honors)	Semester – VII
	Type: Practical	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCP 477: (Practical based on 471, 472, 473)	
Course Objectives: Students should be able to... 1) learn about ore and its complete analysis. 2) understand about the preparation of coordination complexes. 3) acquire the knowledge about single stage preparation of organic products. 4) study the estimation of organic compounds.		
Course Outcomes: After completion of course, students will be able to... 1) Conduct different ore analysis having different metal compositions. 2) Differentiate the coordination complexes. 3) Perform the estimations and preparations of organic compounds. 4) Apply the knowledge of different practicals from Inorganic and Organic Chemistry to projects.		
Title and Contents		Hrs
Attempt any fifteen experiments of the following 1) Determination of Silica and Iron from Hematite ore (6 Hr). 2) Determination of Sn & Pb from Solder metal alloy (6 Hr). 3) Preparation of Potassium hexathiocyanatochromate (III) tetrahydrate. 4) Preparation of pentamminechlorocobalt (III) chloride. 5) Preparation of hexathiourea lead (II) nitrate. 6) Preparation of Copper ferrite. 7) Percentage purity of Lead form Hexathiourea lead (II) nitrate. 8) Preparation of ZnO nanoparticles. 9) One stage preparation of 5, 5 - Diphenyl hydantoin. 10) One stage preparation of 7-Hydroxy 4-methyl coumarin. 11) Biginelli reaction: Microwave assisted synthesis of Dihydropyrimidone. 12) Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and p-Bromoaniline. 13) Preparation of 2,3-diphenylquinoxaline from benzil and OPD. 14) Preparation of benzimidazole derivative. 15) Preparation of m-nitroacetophenone from acetophenone. 16) Preparation of Schiff's base from acetophenone. 17) Extraction and separation of organic compound from plant extract. 18) Estimation of formaldehyde.		60

Reference Books: -

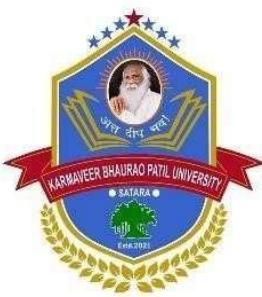
- [1] Vogel A. I. A text book of Quantitative Inorganic Analysis including elementary instrumental analysis, Longman Sc & Tech. 1980.
- [2] Palmer W. G. Experimental Inorganic Chemistry. Cambridge University Press. 1948.
- [3] Mann and Saunders Practical organic chemistry. United states of America: Longman Inc. 1960.
- [4] Viswanathan B. and Raghavan P. S. A. I. Vogel Chemistry. London. McGraw-Hill. 1983.
- [5] Athawale A. D. and Parul Mathur, Vogelical C Chemistry. New Age International Private limited. 2001.

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

Student Performance, attendance, journal records and viva voce

End Semester Evaluation: (30 Marks)

Question 1

	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. IV (Honors)	Semester – VII
	Type: Practical	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCP 478: (Practical based on 474, 475)	
Course Objectives: Students should be able to... 1) learn about relative strength and dissociation constants of acids. 2) understand about solubility of salts. 3) acquire the knowledge about drug samples. 4) study the estimation of compounds by using different instruments.		
Course Outcomes: After completion of course, students will be able to... 1) conduct different analysis of acids. 2) perform different estimations of compounds. 3) handle variety of instrumentations. 4) apply the knowledge of different practicals from Physical and Analytical Chemistry to projects.		
Title and Contents (Any 15 from following)		Hrs
1) To determination relative strength of chloroacetic acid and acetic acid by conductivity measurement. 2) Determination of the acid and base dissociation constant of an amino acid and hence isoelectric point of the acid. 3) Kinetics of reaction between bromate and iodide. 4) To determine the molar extinction coefficient and unknown concentration of given sample colorimetrically. 5) To determine radius of molecule by viscosity measurement. 6) To determine the solubility product and solubility of sparingly soluble salts of silver (AgCl, AgBr, AgI) 7) To construct phase diagram of three component containing ethanol, benzene, water. 8) To determine pKa value of given weak monobasic acid by emf measurement. 9) To investigate the adsorption of acetic acid from aqueous solution by activated charcoal. 10) To determine the normality and strength of each acid in the given mixture of strong acid and weak acid conductometrically. 11) Determination of calcium from given drug sample. 12) Determination of total hardness of water sample 13) To estimate the amount of isoniazide from the pharmaceutical tablet. 14) To determine the acid value of given oil.		60

15) To estimate the quantity of Ibuprofane from given Pharmaceutical tablet. 16) To determine the solubility of calcium oxalate in presence of different concentrations of KCl 17) To determine the solubility of Calcium oxalate in presence of different concentration of HCl. 18) To verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample Spectrophotometrically. 19) To estimate the amount of D-glucose in a given solution colorimetrically. 18) To determine the iron potentiometrically by titrating with potassium dichromate.	
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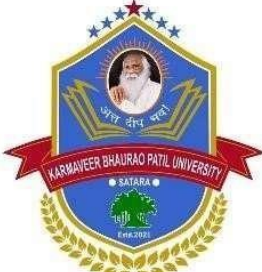
Reference Books: -

- [1] Kitchner J. A. Findlay's Practical Chemistry. Vth edition. Longmans, Green and Co, 1954.
- [2] Viswanathan B. and Raghavan P. S. A. I. Vogel Chemistry. London. McGraw-Hill. 1983.
- [3] Athawale A. D. and Parul Mathur, Vogelical C Chemistry. New Age International Private limited. 2001.
- [4] Rajbhoj S. W. and Chondhekar T. K. IIIrd edition Anjali Publication. 2013.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation (20 marks) Student Performance, attendance, journal records and viva voce	End Semester Evaluation: (30 Marks) Question 1
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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. IV (Honors)	Semester – VII
	Type: RM Practical	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCP RM I 479: Research Methodology (RM)	
Course Objectives: Students should be able to... 1) develop Research Skills 2) gain Hands-on Experience in Data Handling 3) understand Research Tools and Ethics 4) apply Scientific Reasoning for Report Writing and Presentation		
Course Outcomes: After completion of course, students will be able to... 1) design a complete research proposal with a clear problem statement, objectives, and methodology. 2) demonstrate proficiency in data collection, statistical analysis, and result interpretation. 3) create and format professional research reports using LaTeX and other digital tools. 4) adhere to research ethics, avoid plagiarism, and maintain scientific integrity in their work.		
Title and Contents (Any 15 of the following)		Hrs
1) Development of a good research design for a hypothetical study 2) Simulation of different research designs using case studies 3) Creation of a literature survey for different variables 4) Designing an experimental research plan with control variables 5) Survey planning: Census vs. Sample Survey on a small population 6) Different types of sampling techniques 7) Preparation and distribution of a questionnaire 8) Conduct structured and unstructured interviews 9) Data coding and tabulation 10) Classifying raw data using MS Excel 11) Drawing different types of graphs from the data 12) Graphical representation of collected data 13) Plagiarism detection and correction using software 14) Formatting references using software 15) Writing abstract and introduction for a journal article 16) Identifying and organizing components of a dissertation 17) Structuring a mini research report on collected data 18) Preparation of a research poster for different purpose 19) Preparation of a research proposal for funding 20) Identifying research problems from different fields		60

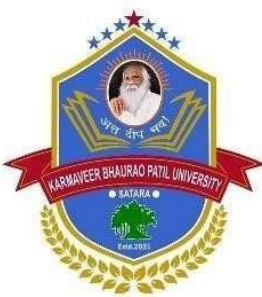
Reference Books: -

- [1] Kothari C. R., Research Methodology: Research and techniques. New Delhi: New Age International Publishers. 1980.
- [2] N. Gurumani, Scientific thesis writing and Paper presentation, (MJP Publishers, Chennai, 2010)
- [3] Hibbert D. B., Gooding J. J. Data analysis for chemistry. Oxford University Press. 2006.
- [4] Topping J. Errors of observation and their treatment. Fourth Ed., Chapman Hall, London. 1984.
- [5] Denscombes M., The Good Research Guide: For small-scale social research projects. Maiden-Read: Open University Press. 2010.
- [6] Dornyei Z., Research Methods in Applied Linguistics. Oxford: Oxford University Press. 2007.

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

Student Performance, attendance, journal records and viva voce

End Semester Evaluation: (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. IV (Honors)	Semester – VIII
	Type: DSC I	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCT 481: Physical Chemistry II	
Course Objectives: Students should be able to... 1) understand the basic concepts of quantum chemistry. 2) recall the concepts of statistical thermodynamics. 3) learn the theoretical principle of Huckel theory of inter-ionic attraction. 4) acquire the knowledge of homogeneous and heterogeneous catalysis.		
Course Outcomes: After completion of course, students will be able to... 1) explore applications of commutator, linear operators, uncertainty principle. 2) explain Boltzmann-Plank equation, Sackur-tetrode equation, ensembles, ensemble average and time average of property. 3) apply Debye-Huckel theory of inter-ionic attraction to explain ionic atmosphere, time of relaxation. 4) discuss the experimental methods of following kinetics of a reaction.		
Module	Title and Contents	Hrs
Module -1:	Quantum Chemistry 1.1. Introduction: Wave particle duality of matter 1.2. De Broglie’s hypothesis, Uncertainty principle, Schrodinger equation 1.3. conditions for acceptable wave functions and its interpretation 1.4. Operators: algebra of operators, linear operator, commutator, angular momentum operator, ladder operator and operator related theory 1.5. Normalization and orthogonality 1.6. Eigen functions and Eigen values, postulate of quantum mechanics 1.7. Solutions of wave equation for a free particle and particle in a box problem 1.8. Transition dipole moment integral and selection rule 1.9. Symmetric and antisymmetric wave functions 1.10. Pauli Exclusion Principle 1.11. Spectroscopic term symbols.	15

Module -2:	Statistical Thermodynamics 2.1. Stirling Approximation 2.2. Weights and configurations 2.3. The most probable configuration 2.4. Ensembles, ensemble average and time average of property. 2.5. Maxwell-Boltzmann (MB)distribution law 2.6. Partition function and its significance. 2.7. Rotational, translational, vibrational and electronic partition functions 2.8. Relationship between partition function and thermodynamic properties 2.9. Thermodynamic probability and entropy: Boltzmann –Planck equation 2.10. Application to mono atomic gases-Sackur-Tetrode equation and applications to 2.11. di atomic molecules 2.12. Limitations of Maxwell-Boltzmann statistics 2.13. Numerical Problems	15
Module -3:	Electrochemistry 3.1. Debye - Huckel theory of inter-ionic attraction 3.2. Ionic atmosphere, time of relaxation 3.3. Relaxation and electro-phoretic effects, 3.4. Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions 3.5. Abnormal ionic conductance of hydroxyl and hydrogen ions 3.6. Activity coefficients: forms of activity coefficients and their interrelationship 3.7. Debye-Huckel limiting law and activity coefficients of dilute electrolytic solutions and its applications to concentrated solutions 3.8. Debye-Huckel-Bronsted equations 3.9. Quantitative and qualitative verification of Debye-Huckel limiting law 3.10. Bjerrum theory of ion-ion association 3.11. Types of electrode 3.12. Determination of activity coefficients of an electrolyte using concentration cells 3.13. Degree of dissociation of mono basic weak acid (approximate and accurate), instability constant of silver ammonia complex 3.14. Acid and alkaline storage batteries.	15

Module -4:	Chemical Kinetics 4.1. Experimental methods of following kinetics of a reaction, chemical and physical (measurement of pressure, volume, EMF, conductance, diffusion current and absorbance) methods and examples 4.2. Steady state approximation and study of reaction between NO ₂ and F ₂ 4.3. Decomposition of ozone, and nitrogen pentoxide. 4.4. Ionic reaction: Primary and secondary salt effect, 4.5. Homogeneous catalysis: acid and base catalyzed reactions, 4.6. Michaelis–Menten enzyme catalysis 4.7. Heterogeneous catalysis: Adsorption of gas on a surface and its kinetics	15
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	4.8. Catalyzed hydrogen- deuterium exchange reaction.	
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Reference Books: -

- [1] Chandra A. K. Introductory Quantum Chemistry, Tata McGraw-Hill publishing company ltd. 1988.
- [2] Atkins P. W. Physical Chemistry. 6th edition. Oxford University press. 1998.
- [3] Prasad R. K. Quantum Chemistry. New Age International pvt. Ltd. Publishers New Delhi. 1997.
- [4] Wells C. H. J. Introduction to Molecular Photochemistry. Chapmanand Hall. 1972.
- [5] Glasstone S. Text book of Physical Chemistry. Frink chemical laboratory, Princeton university. 1940.

Evaluation Pattern: 60:40

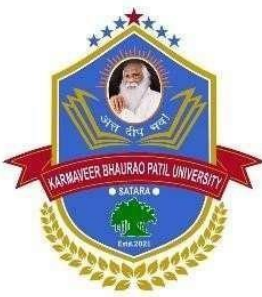
Total Marks: 100

Continuous Comprehensive Evaluation : (40 Marks)

- Internal Work–CCE-I Home Assignment (20 Marks)
- Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks)
- Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 Marks)
- **(Internal Evaluation best of the two CCE marks will be considered)**

End Semester Examination: 60 Marks

- Question -1: Short Answer (12 Marks)
 - Question -2: Long Answer (12 Marks)
 - Question -3: Long Answer (12 Marks)
 - Question -4: Long Answer (12 Marks)
 - Question -5: Short Note (12 Marks)
 - Question -6: Short Note (12 Marks)
 - Question -7: Short Note (12 Marks)
- Question 1 compulsory and any four from Q. 2 to 7

	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. IV (Honors)	Semester – VIII
	Type: DSC II	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCT 482: Inorganic Chemistry II	
Course Objectives: Students should be able to... 1) acquire the knowledge of chemistry of non-transition elements. 2) understand stereochemistry and bonding in main group compounds. 3) learn the chemistry of f-block elements. 4) study the Group Theory and Molecular Symmetry.		
Course Outcomes: After completion of course, students will be able to... 1) understand chemistry of non-transition elements for their coordination compounds. 2) explore conceptual fact of atom and molecule. 3) demonstrate the spectral and magnetic properties. 4) explain the symmetry operations.		
Module	Title and Contents	Hrs
Module -1:	Chemistry of Non-transition Elements and their compounds 1.1. General discussion on the properties of the non-transition elements 1.2. Polymorphism in carbon, phosphorous and Sulphur 1.3. Synthesis, properties and structure of boranes 1.4. Synthesis, properties and structure of Carboranes, Silicates 1.5. Sulphur–nitrogen compounds 1.6. Structure and bonding in oxyacid of Nitrogen, Sulphur, and halogens 1.7. Interhalogens and Psudohalides	15
Module -2:	A) Stereochemistry and bonding in Main group compounds 2.A.1. Hybridization and structure of molecules 2.A.2. VSEPR Theory 2.A.3. $p\pi$ - $p\pi$ and $p\pi$ - $d\pi$ bonds 2.A.4. Bent rule 2.A.5. Walsh Diagram 2.A.6. Back bonding 2.A.7. Some simple reactions of covalently bonded molecules (atomic inversion, Berry Pseudorotation, Nucleophilic displacement, free radical reaction) B) Bioinorganic Chemistry 2.B.1. Mineral origin of life 2.B.2. Transition metal ions in biology 2.B.3. Structure and properties of metalloproteins 2.B.4. Porphyrines, Cytochromes 2.B.5. Ferrodoxins and iron Sulphur proteins	15

	2.B.6. Ion transport across membranes 2.B.7 Nitrogen fixation nitrogenase	
Module -3:	Chemistry of f-block elements (Lanthanides and Actinides) 3.1. Occurrence, properties of the f-block elements 3.2. Colour, oxidation state, Spectral and magnetic properties of lanthanides and actinides 3.3. Lanthanide contraction 3.4. Use of lanthanide compounds as shift reagents 3.5. Compounds of lanthanides 3.6. Photoluminescence properties of lanthanide compounds 3.7. Modern methods of separation of lanthanides and actinides, 3.8 Applications of lanthanide and actinide compounds in Industries	15
Module -4:	Group Theory and Molecular Symmetry 4.1. Symmetry operations 4.2. Symmetry elements 4.3. Point group and its classification (C _n -type, D _n -type, Special-type) 4.4. Schoenflies symbol for point groups 4.5. Determination of point group for AB ₂ (Bent), AB ₃ (Trigonal pyramid), AB ₃ (Trigonal Planar), AB ₄ (Square planar), AB ₅ (Trigonal bipyramidal), AB ₆ (Octahedral), CO ₂ , HCl, CO. 4.6. Symmetry and dipole moment of molecule 4.7. Symmetry and optical active Group and its Properties 4.8. Group multiplication table 4.9. Reducible and Irreducible representations 4.10. Great orthogonally theorem (without proof) and its importance 4.11. Construction of character table for C _{2v} & C _{3v} point groups	15
Reference Books: - [1] Wells F. 1984. Structural Inorganic Chemistry, 5 th edition. Oxford University Press. [2] Chand Manas 2019. Atomic Structure and Chemical bonding. Dreamtech Press. [3] Datta R. L. and Syamal. 2007. Elements of magneto chemistry. Second edition. Eastwest press pvt ltd. [4] Cotton A., Wilkinson R. G. 2021. Advanced Inorganic chemistry. Wiley. [5] Drago R. 2012. Physical method in Inorganic Chemistry, Affiliatedeast-West Press Pvt. Ltd.		
Evaluation Pattern: 60:40		
Total Marks: 100		
Continuous Comprehensive Evaluation : (40 Marks) - Internal Work–CCE-I Home Assignment (20 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 M) (Internal Evaluation best of the two CCE marks will be considered)		End Semester Examination: 60 Marks - Question -1: Short Answer (12 Marks) - Question -2: Long Answer (12 Marks) - Question -3: Long Answer (12 Marks) - Question -4: Long Answer (12 Marks) - Question -5: Short Note (12 Marks) - Question -6: Short Note (12 Marks) - Question -7: Short Note (12 Marks) Question 1 compulsory and any four from Q. 2 to 7

	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. IV (Honors)	Semester – VIII
	Type: DSC III	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCT 483: Organic Chemistry II	
Course Objectives: Students should be able to... 1) get knowledge regarding organic reactions and their mechanisms. 2) understand the important oxidizing and reducing agents. 3) know of concept and synthetic applications of hydroboration, enamines and ylides. 4) learn importance of organometallic compounds.		
Course Outcomes: After completion of course, students will be able to... 1) explain the reaction mechanism for various reactions. 2) describe mechanism of oxidizing and reducing reagents. 3) discuss the applications of reactions and reagents to industrial important molecules. 4) recognize applications of organometallic compounds in organic synthesis.		
Module	Title and Contents	Hrs
Module -1:	Study of Organic reactions Mechanism of condensation reaction involving enolates 1.1. Benzoin condensation 1.2. Stobbe condensation 1.3. Dieckmann condensation 1.4. Robinson annulation reaction 1.5. Chichibabin reaction 1.6. Simon-Smith reaction 1.7. Uhlmann condensation 1.8. Mc-Murry reaction 1.9. Dakin reaction 1.10. Curtius rearrangement 1.11. Lossen rearrangement 1.12. Suzuki coupling reaction.	15

Module -2:	Oxidation and Reduction A) Oxidation 2.A.1. Chromic trioxide (CrO_3), 2.A.2. Pyridinium dichromate (PDC), 2.A.3. Pyridinium chlorochromate PCC, 2.A.4. Potassium permanganate KMnO_4 , 2.A.5. Manganese dioxide MnO_2 , 2.A.6. Swern oxidation catalyst, 2.A.7. Hydrogen peroxide H_2O_2 2.A.8. $\text{Pb}(\text{OAc})_4$, NaIO_4 and HIO_4 , 2.A.9. Pd/C , 2.A.10. m-CPBA, O_3 , Etard oxidation, B) Reduction 2.B.1. General mechanism and selectivity, 2.B.2. Important applications of the following reducing reagents: 2.B.3. Metal hydride reduction: Boron reagents (NaBH_4 , NaCNBH_3 , $\text{Na}(\text{OAc})_3\text{BH}$), 2.B.4. Aluminium reagents (LiAlH_4 , DIBAL-H, RedAl), 2.B.5. Reduction with $\text{H}_2/\text{Pd-C}$, 2.B.6. Wilkinson's catalyst, Wolff Kishner reduction	15
Module -3:	Hydroboration, Enamines and Ylides A) Hydroboration: 3.A.1. Various hydroborating agents their Mechanism 3.A.2. Synthetic Applications of, i) 9-BBN, ii) Thexyl borane, iii) Diisamyl borane B) Enamins: 3.B.1. Formation of enamines. 3.B.2. Reactivity of enamines. C) Ylides: 3.C.1. Phosphorus ylide. 3.C.2. Nitrogen ylide. 3.C.3. Sulphur ylide.	15
Module -4:	Study of Organometallic compounds: 4.1. Organo-lithium, 4.2. Organo-cobalt, 4.3. Organo -Fe, 4.4. Organo -Ce, 4.5. Organo -Ti, 4.6. Organo- Cd. 4.7 Use of lithium dialkyl cuprate, their addition to carbonyl and unsaturated carbonyl compounds.	15

Reference Books: -

- [1] Carruthares W. Some modern methods of Organic synthesis-Cambridge: Cambridge University press. 2004.
- [2] Carey R. R. and Sundburg R. J. Advanced Organic chemistry. 2nd Ed. USA: Springer science. 2007.
- [3] Adams R. Organic reactions. John wiley and sons. 1957.
- [4] Norman R. O. C. Principles of organic synthesis. first edition. Oxford: Methuen, 1968.
- [5] House H. O. Modern synthetic reactions. New York: Benjamin. 1965.
- [6] Fieser and Fieser. Reagents in Organic synthesis. John Wiley. 1967.

Evaluation Pattern: 60:40**Total Marks: 100****Continuous Comprehensive Evaluation : (40 Marks)**

- Internal Work–CCE-I Home Assignment (20 Marks)
- Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (20 Marks)
- Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (20 Marks)

(Internal Evaluation best of the two CCE marks will be considered)**End Semester Examination: 60 Marks**

- Question -1: Short Answer (12 Marks)
 - Question -2: Long Answer (12 Marks)
 - Question -3: Long Answer (12 Marks)
 - Question -4: Long Answer (12 Marks)
 - Question -5: Short Note (12 Marks)
 - Question -6: Short Note (12 Marks)
 - Question -7: Short Note (12 Marks)
- Question 1 compulsory and any four from Q. 2 to 7

	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. IV (Honors)	Semester – VIII
	Type: DSE I	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCT 484 : Analytical Chemistry II	
Course Objectives: Students should be able to... 1) understand interpretation of IR, NMR and mass spectra. 2) familiar with ESR, IR, NMR and Mass techniques. 3) familiar with Mossbauer and ESR Spectroscopy. 4) know atomic absorption and emission spectroscopy.		
Course Outcomes: After completion of course, students will be able to... 1) discuss the principles of various spectroscopic techniques. 2) acquire the knowledge of sampling technique, selection rules. 3) classify the spectral parameters and bonding structures of molecules. 4) differentiate between AAS and FES, and ICP-AES.		
Module	Title and Contents	Hrs
Module -1:	Nuclear Magnetic Resonance (NMR) 1.1. Recapitulations of NMR 1.2. Elementary ideas of NMR Integration 1.3. Larmor frequency 1.4. Absorption of radio frequency 1.5. Instrumentation (FT-NMR). Sample preparation, chemical shift 1.6. Factor affecting chemical effect, spin-spin coupling, coupling constant, Cosy, Nosy, DEPT, ¹⁹ F, ¹ H, ¹³ C, ³¹ P, and ¹⁴ NNMR 1.7. First order coupling, applications to simple structural problems.	8
Module -2:	Infrared Spectroscopy (IR) 2.1. Introduction, instrumentation of Infrared Spectroscopy 2.2. Fundamental modes of vibrations, 2.3. Fundamental group region, 2.4. Sampling technique, selection rules, 2.5. Types of bonds, 2.6. Absorption of common functional groups. 2.7. Factors affecting frequencies, applications.	7

Module-:3	Mass spectroscopy (MS) 3.1. Instrumentation, working of mass spectrometer (double beam). 3.2. Formation of different types of ions 3.3. McLafferty rearrangements 3.4. Nitrogen rule, C-13 rule, fragmentation of alkanes, alkyl aromatics, alcohols and ketones, simple applications, 3.5. Simple structural problems based on IR, UV, NMR and MS.	8
Module -4:	Flame Atomic Absorption Spectrometry 4.1. Introduction and Principle 4.2. Instrumentation, Single and double beam AAS, 4.3. Preparation of samples 4.4. Measurement of atomic absorption 4.5. Calibrating solution and methods of Calibration 4.6. Advantages of atomic absorption 4.7. Disadvantage and limitation of atomic absorption.	7
Reference Books: - [1] Silversteine and Bassar, Spectrometric Identification of Organic Compounds. 8 th edition Wiley, NewYork, 2014 [2] Willard, Merrit, Dean and Settle, Instrumental Methods of analysis, Wadsworth Publishing Co Inc, 1998 [3] V. G. Kalalawe and M. V. Kanetkar Advent Academic Publishing Chemical Science, Education 2022. [4] V. M. Parikh, Absorption spectroscopy of organic molecules, Addison-Wesley Pub. Co,U.S. 1974		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) - Internal Work–CCE-I Home Assignment (10 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (10 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (10 Marks) (Internal Evaluation best of the two CCE marks will be considered).		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.

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	Programme: B. Sc. IV (Honors)	Semester - VIII
	Type: DSE II	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCT 485: Applied Chemistry II	
Course Objectives: Students should be able to... 1) learn about fabrication of Metal matrix composites 2) acquire the knowledge of Organic Light-Emitting Diodes. 3) study the mechanism of action of peptides. 4) understand knowledge of Statistical Data, variance, errors and sampling.		
Course Outcomes: After completion of course, students will be able to... 1) explain fabrication, properties and applications of Metal matrix composites. 2) evaluate the structure, properties and application of Organic Light Emitting Materials. 3) demonstrate a core knowledge base in the theory and practice of modern Biochemistry. 4) understand basic theoretical and applied principles of Statistical Data in Analytical samples.		
Module	Title and Contents	Hrs
Module -1:	Metal matrix composites 1.1. Fabrication, interface, 1.2. Properties and applications, 1.3. Dispersion strengthened, 1.4. Particle reinforced, 1.5. Fiber and laminate reinforced composites, 1.6. Fiber reinforced super alloy composites, 1.7. Superconducting composites Introduction type and fabrication.	7
Module -2:	Organic light emitting material-II 2.1. Organic Small Molecule Materials for Organic Light-Emitting Diodes. 2.2. Introductions, 2.3. Structure, Properties and its applications of Hole Injection Materials 2.4. Fluorocarbon Polymers and Hole Transpot Material 2.5. Triarylaminines,	8
Module -3:	Application of Biophysical Chemistry 3.1. Thermodynamics of biopolymer Solutions: Solutions of biopolymers, 3.2. Effect of ΔG , ΔH and ΔS on dissolution of polymer, 3.3. Entropy and heat of mixing of polymer solutions, 3.4. Osmotic pressure, 3.5. Membrane equilibrium.	7

Module -4:	Statistical Data 4.1. Confidence Intervals, 4.2. Statistical Aids to Hypothesis Testing, 4.3. Analysis of Variance,	8
	4.4. Detection of Gross Errors, 4.5. Analytical Samples and Methods, Sampling, 4.6. Automated Sample Handling.	
Reference Books: - [1] Mathews F. L., Rawlings R. D. Composite Materials-Engineering & Science. Chapman & Hall. 1990. [2] Khanna P. A text book of Materials Science & Metallurgy. Dhanpat Rai pub. 1999. [3] Li Z., Meng H. Organic light emitting materials and devices. CRC Publisher, United Kingdom. 2014. [4] Nelson D. L. and Cox M. M. Lehninger Principle of Biochemistry. 6 th edition. W. H. Freeman and Company. 2013.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Continuous Comprehensive Evaluation : (20 Marks) - Internal Work–CCE-I Home Assignment (10 Marks) - Internal Work- CCE-II Short & Long Answer Question Test/Seminar/Open Book Test/Quiz/Case Study/Book Review/Field Work/Industry Visit (10 Marks) - Internal Work– CCE III Compulsory MCQ Test (each question for 1 marks) (10 Marks) (Internal Evaluation best of the two CCE marks will be considered)		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.

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	Programme: B. Sc. IV (Honors)	Semester – VIII
	Type: DSC P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCP 486 (Practical based on BCT 481, 482, 483)	
Course Objectives: Students should be able to... 1) learn about the ore and alloy for their complete compositions. 2) understand synthesis of ferrites and nanomaterials. 3) acquire the knowledge about separation and identification of the two component organic mixtures. 4) study the distillation technique.		
Course Outcomes: After completion of course, students will be able to... 1) calculate the percentage of different elements in ore and alloys. 2) perform the synthesis of ferrites and nanomaterials. 3) handle two component organic mixtures for their separation and identification. 4) apply the knowledge of different practicals from Inorganic and Organic Chemistry to their project work.		
Title and Contents		Hrs
1) Determination of Silica and Mn from Pyrolusite ore 2) Determination of Fe & Cr from Stainless steel alloy 3) Preparation of ammonium trioxalatochromate (III) 4) Preparation of Pentamminenitrocobalt (III) chloride 5) Preparation of Bis(dimethylglyoximate)nickel (II) 6) Preparation of Nickel ferrite 7) Percentage purity of Pentamminenitrocobalt (III) chloride 8) Preparation of CuO nanoparticles 9) Qualitative analysis: Separation and identification of the two component mixtures using Chemical and physical methods Acid +Phenol. 10) Mixture 2- Acid + Base 11) Mixture 3- Acid + Neutral 12) Mixture 4- Phenol + Base 13) Mixture 5- Phenol + Neutral 14) Mixture 6- Base + Neutral 15) Steam distillation techniques.		60

Reference Books: -

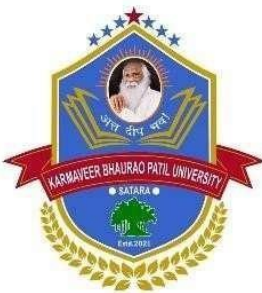
- [1] Vogel A. I. A text book of Quantitative Inorganic Analysis including elementary instrumental analysis, Longman Sc & Tech. 1980.
- [2] Palmer W. G. Experimental Inorganic Chemistry. Cambridge University Press. 1948.
- [3] Vogel. A text book of practical organic chemistry, Thetford: Lowe And Brydone Printers. 1948.
- [4] Mann and Saunders Practical organic chemistry. United states of America: Longman Inc. 1960.
- [5] Viswanathan B. and Raghavan P. S. A. I. Vogel Chemistry. London. McGraw-Hill. 1983.

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

Student Performance, attendance, journal records and viva voce

End Semester Evaluation: (30 Marks)

Question 1

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Chemistry	
	Programme: B. Sc. IV (Honors)	Semester – VIII
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BCP 487 (Practical based on BCT 484, 485)	
Course Objectives: Students should be able to...		
1) acquire the knowledge about rate of reactions and kinetics of reactions. 2) learn about potentiometric and conductometric determinations. 3) understand the solubility of different salts. 4) study the ion exchangers for separation of cations and anions.		
Course Outcomes: After completion of course, students will be able to...		
1) Calculate the rate of reactions and kinetics of reactions. 2) Perform the potentiometric and conductometric estimations. 3) Handle variety of instrumentation techniques. 4) Apply the knowledge of ion exchangers for separation of cations and anions.		
Title and Contents (Any 15 from Following)		Hrs
1) To investigate kinetics of iodination of acetone. 2) To determine formal redox potential of Fe³⁺/Fe²⁺ system. 3) To determine the partial molar volume of ethyl alcohol in a mixture of ethyl alcohol and water. 4) To determine the amount of each halide in the given mixture of KBr & KCl potentiometrically. 5) Titration of a mixture trichloroacetic acid, monochloroacetic acid & acetic acid by NaOH conductometrically. 6) To study inversion of cane sugar polarimetrically. 7) To draw polar plots of atomic orbital like 1s, 2p_z, 3d_z² by using angular part of hydrogen atom wave function. 8) To determine thermodynamic parameter for the copper silver system. 9) Determination of stability constant of silver ammonia complex. 10) Verification of Onsagar Equation for 1:1 type strong electrolyte. 11) To determine the amount of iron in given soap sample by colorimetrically. 12) Determination of alkalinity and salinity of water sample. 13) To Estimate the sulphadimine in the pharmaceutical sample. 14) To verify the Beer-Lamberts Law and determine the concentration of given organic dye solution colorimetrically. 15) To determine the solubility of PbI₂ in presence of different concentration of KNO₃.		60

16) To determine the solubility of PbI_2 in presence of different concentration of KCl 17) Determination of standard deviation from the results obtained by redox titration of iron solution against standard potassium dichromate solution. 18) Application of excel spreadsheet for determination of Mean, median, standard deviation and graph plot. 19) Determination of capacity of cation exchanger 20) Determination of capacity of anion exchanger	
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Reference Books: -

- [1] Vogel A. I. A text book of Quantitative Inorganic Analysis including elementary instrumental analysis, Longman Sc & Tech. 1980.
- [2] Palmer W. G. Experimental Inorganic Chemistry. Cambridge University Press. 1948.
- [3] Vogel. A text book of practical organic chemistry, Thetford: Lowe And Brydone Printers. 1948.
- [4] Mann and Saunders Practical organic chemistry. United states of America: Longman Inc. 1960.
- [5] Viswanathan B. and Raghavan P. S. A. I. Vogel Chemistry. London. McGraw-Hill. 1983.

Evaluation Pattern: 60:40

Total Marks: 50

Continuous Comprehensive Evaluation (20 marks) Student Performance, attendance, journal records and viva voce	End Semester Evaluation: (30 Marks) Question 1
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	Board of Studies in Chemistry	
	Programme: B. Sc. IV (Honors)	Semester - VIII
	Type: OJT	Marks: 100
	Credits: 4	From: A. Y. 2026-27
	Name of the Course: BCPOJT 488: On Job Training (OJT)	
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 discipline specific 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 the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engaged 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 Mark		End Semester Evaluation: (60 Marks) • Report: 20 Mark • Viva: 20 Mark • Presentation: 20 Mark