Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Four Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Undergraduate Programme of Science and Technology

B.Sc. (Honors/Research) in Chemistry

Board of Studies

in

Chemistry

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2023

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. II Year** to be effective from the **Academic Year 2024-25.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 24/03/2024

Place: Latur

NEP CELL

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors/Research) in Chemistry** Programme to be effective from the **Academic Year 2023-24.**

Date: 14/07/2023

Place: Latur

Prof. Dhananjay Palke

Chairperson
Board of Studies in Chemistry
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Chemistry
Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Prof. Dhananjay Palke** Head, Department of Chemistry, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur	Chairperson	HoD
2	**Prof. Vijay Bhosale** Department of Chemistry, Yeshwant Mahavidyalaya, Nanded. Mo.No.9403067252	Member	V.C. Nominee
3	**Prof. S. P. HangiragekarDepartment of** Chemistry, Shivaji University, Kolhapur Mo.No.9890363931	Member	Academic Council Nominee
4	**Dr. Bapu B. Shingate** Department of Chemistry, Dr. B. A. M. U. Aurangabad Mo.No.9850298591	Member	Academic Council Nominee
5	**Prof. S. B. Patwari** Chemistry, Laal Bhadur Shastri, Mahavidyalaya, Dharmabad Mo.No.9067583746	Member	Expert from outside for Special Course
6	**Dr. Pinak M. Chincholkar** Springer Nature Technology & Publishing Solutions. Tower 8 and 9 Magarpatta City, Hadapsar. Pune. Mo.No.9823966381	Member	Expert from Industry
7	**Dr. R. V. Hangarge** Department of Chemistry, Tai Golwalkar Mahavidyalaya, Ramtek. Mo. No. 9075641697	Member	P.G. Alumni
8	**Dr. K. I. Momin** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
9	**Dr. K. C. Tayade** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
10	**Mr. M. S. Sudewad**	Member	Faculty Member

Sr. No.	Name	Designation	In position
	Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512		
11	**Dr. K. D. Sawant** Department of Botany , Rajarshi Shahu Mahavidyalaya, (Autonomous) Latur 413512	Member	Member from same Faculty

From the Desk of the Chairperson…

The Department of Chemistry was established in the academic year 1971-72. Need of Chemist, is at the forefront of the noteworthy growth in industries, the college took initiative in starting the B.Sc. Chemistry Program from 1971-72 at Undergraduate (B.Sc.) level. Now, this course is successfully flourishing the need of industries by availing Chemist with sound subject knowledge. Also, Post graduate Program in Chemistry started from Academic Year 2014-2015. From Academic Year 2023-24 we are implementing National Education Policy-2020 (NEP-2020) & Started B.Sc. (Honors/Research) Chemistry Programme to be effective from the same academic year. Department has well equipped laboratories with number of sophisticated instruments. In 2006-07, UGC recognized this department as a "Star Department" in the college and awarded CPE status.

The B.Sc. Chemistry Programme is designed to give sound knowledge and understanding of Chemistry to undergraduate students of the B.Sc. Degree course. The goal of the Programme is to make the study of Chemistry as stimulating, interesting, and relevant as possible. The curriculum is prepared with the aim of making the students capable of studying Chemistry in academic and industrial courses. Also, to expose the students to Chemistry and build up their interest in various fields of chemistry. The new and updated Curriculum is based on National Education Policy-2020 (NEP-2020) Guidelines which includes multiple entries & multiple Exit & interdisciplinary approach with vigor and depth. The curriculum is designed on the basis of Feedbacks & suggestion given by Various Stakeholders and by considering the syllabi of Competitive examination like, IIT-JAM, NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities.

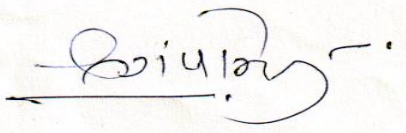
Our Vision to evolve as a world class dynamic center of higher education disseminating knowledge rigorously at affordable cost and to emerge as a premier centre that promotes technological competence and democratic values.

*"Pursuit of Excellence" in higher education to make our students globally competent.

* Enable students to develop as responsible citizens with human values.

* Provide value and need based education.

* Develop scientific attitude among students.



Prof. Dhananjay Palke
Chairperson
Board of Studies in Chemistry
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Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Index

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in B.Sc. II Year Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT,FP,CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
II 5.0	III	DSC V: 04 Cr. DSC VI: 04 Cr.	NA	DSM I 04 Cr.	GE-III: 02 Cr.	SEC-III: 02 Cr.	AEC-I ENG: 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ (SES-I)/ FP: 02 Cr.	22	44 Cr. UG Certificate
	IV	DSC VII: 04 Cr. DSC VIII: 04 Cr.	NA	DSM II 04 Cr.	GE-IV: 02 Cr.	SEC-IV: 02 Cr.	AEC-IIENG: 02 Cr. VEC-II: 02 Cr.	CC-III: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr.	22	
	Cum. Cr.	16	-	-	08	04+04=08	04+02+02=08	04	44	

Exit Option: Award of UG Certificate in Major with 44 Credits and Additional 04 Credits Core NSQF Course/Internship or continue with Major and Minor

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	OE	: Open Elective
5.	VSEC	: Vocational Skill and Skill Enhancement Course
6.	VSC	: Vocational Skill Courses
7.	SEC	: Skill Enhancement Course
8.	AEC	: Ability Enhancement Course
9.	MIL	: Modern Indian Languages
10.	IKS	: Indian Knowledge System
11.	VEC	: Value Education Courses
12.	OJT	: On Job Training
13.	FP	: Field Projects
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Courses
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

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Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Programme Outcomes (POs) for B.Sc. Programme	
PO 1	**Academic Competence** Knowledge of various concepts of Organic, Inorganic and Physical Chemistry.
PO 2	**Scientific Outlook** An ability to perform and demonstrate experiments in Chemistry to study Stoichiometry, Kinetics, Thermodynamics of Chemical reactions, Synthesis of Organic and Inorganic Compounds, Analysis of Organic and Inorganic Compounds Qualitatively and Quantitatively.
PO 3	**Personal and Professional Competence** Core competency, Systematic and coherent understanding of the fundamental concepts in Chemistry and allied subjects.
PO 4	**Entrepreneurial Competence** Opportunity to act as team player by contributing in laboratory, field based situation and industry.
PO 5	**Research Competence** Advanced research skills, competency for basic tools needed to carry out independent chemical research and acquire proficiency in their specialized area of chemistry.

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Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Programme Specific Outcomes (PSOs) for B.Sc. Chemistry (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Have firm foundations in the fundamentals and application of current chemical and scientific theories.
PSO 2	integrate their knowledge from each of these areas with critical thinking skills in order to become problem solvers
PSO 3	Be proficient in the chemistry laboratory, especially with respect to the abilities to follow and understand general laboratory practice guidelines, including safety. Perform qualitative & Quantitative chemical analyses. Perform chemical synthesis &Understand and use modern chemical instrumentation.
PSO 4	Find gainful employment in industry or government, be accepted at graduate or professional schools (law, medicine, etc.), or find employment in school systems as instructors or administrators.
PSO 5	Demonstrate a systematic or coherent understanding of the fundamental concepts, principles and processes underlying the academic field of chemistry, its different subfields (analytical, inorganic, organic and physical), and its linkages with related disciplinary areas/subjects;
PSO 6	Demonstrate a procedural knowledge that creates different types of professionals in the field of chemistry and related fields such as pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.;
PSO 7	Demonstrate a skills related to specialisation areas within chemistry as well as within subfields of chemistry (analytical, inorganic, organic and physical), and other related fields of study, including broader interdisciplinary subfields (life, environmental and material sciences).
PSO 8	Apply appropriate methodologies in order to conduct chemical syntheses, analyses or other chemical investigations; and apply relevant knowledge and skills to seek solutions to problems that emerge from the subfields of chemistry as well as from broader interdisciplinary subfields relating to chemistry;
PSO 9	Use chemical techniques relevant to academia and industry, generic skills and global competencies, including knowledge and skills that enable students to undertake further studies in the field of chemistry or a related field, and work in the chemical and nonchemical industry sectors.
PSO 10	Undertake hands on lab work and practical activities which develop problem solving abilities required for successful career in pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

B.Sc. II Year

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
II 5.0	III	201CHE3101 (DSC-V)	Physical Chemistry-II	03	45
		201CHE3103 (DSC-V)	Lab.Course V	01	30
		201CHE3102 (DSC-VI)	Inorganic Chemistry III	03	45
		201CHE3104 (DSC-VI)	Lab. Course VI	01	30
		OE-III	From Basket	02	30
		201CHE3301 (DSM-I)	Fundamentals of Chemistry-I	03	45
		201CHE3302 (DSM-I)	Minor Lab. Course I	01	30
		(SEC-III)	From Basket	02	30
		(AEC-I)	From Basket	02	30
		CC	CC - II	02	30
		AIPC/OJT-II	Field Project	02	60
	Total Credits			**22**	
	IV	201CHE4101 (DSC-VII)	Organic Chemistry II	03	45
		201CHE4103 (DSC-VII)	Lab. Course VI	01	30
		201CHE4102 (DSC-VIII)	Physical Chemistry-III	03	45
		201CHE4104 (DSC-VIII)	Lab.Course V	01	30
		OE-IV	From Basket	02	30
		201CHE4301	Fundamentals of	03	45

		(DSM-I)	Chemistry-II		
		201CHE1302 (DSM-I)	Minor Lab. Course II	01	30
		(SEC-IV)	From Basket	02	30
		(AEC-II)	From Basket	02	30
		CC	CC - III	02	30
		AIPC/OJT-III	CEP-I	02	30
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Curriculum

Major and VSC Courses

Semester - III

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry
Semester- III

Course Type: DSC-V
Course Title: Physical Chemistry-II
Course Code: 201CHE3101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. Introduce the students to Chemical Kinetics concepts, rate of reactions and
LO 2. Different orders of reactions
LO 3. To learn about photochemistry, difference between thermal and photochemical reaction and the laws of photochemistry
LO 4. Familiarize the students with concepts of Phase rules and distribution law.
LO 5. To know the principle of volumetric analysis and types of titrations.
LO 6. Learn about different properties of P block element.

Course Outcomes:

After successful completion of the course the students:

CO 1. Know the concepts of Chemical kinetics, rate of reactions and different orders of reactions
CO 2. Can understand about photochemistry, difference between thermal and photochemical reaction and the laws of photochemistry.
CO 3. Became familiarize with concepts of Phase rules and distribution law.
CO 4. Can know the principle of volumetric analysis and types of titrations.
CO 5. Can understand about different properties of P block element. Bonding and shapes of diamond Graphite and C_{60} (Fullerene).

Unit No.	Title of Unit & Contents	Hrs.
I	**Photochemistry & Electronic Spectra**	**10**
	A) Photochemistry 1. Introduction: Thermal and Photochemical reaction, Difference between them, electromagnetic spectrum. 2. Lambert-Beer law – Discussion of , Optical density (O.D.) transmittance (Numerical Expected) 3. Laws of Photochemistry: Grothus – Drapper law and Stark-Einstein law. 4. Quantum yield (Brief view) and numerical. 5. Photocatalysis. 6. Jablonski diagram with various processes occurring in the excited state, Qualitative description of fluorescence, Phosphorescence, ISC and IC. 7. Chemiluminiscence and Photosensitized reactions	

Unit No.	Title of Unit & Contents	Hrs.
	B) Electronic Spectra : 1. Concept of potential energy curve. 2. Frank – Condon principle 3. Types of electronic transitions, applications.	
	Unit Outcomes: UO 1. Students will be able to discuss the photochemical Reaction UO 2. Students can Analyze the Electronic Spectra of Compounds	
II	**Surface Chemistry & Catalysis**	**10 Hours**
	A) Adsorption: 1. Mechanism of adsorption, factors affecting adsorption, difference between adsorption and absorption. 2. Types of adsorption–physical adsorption and chemical adsorption. 3. Adsorption of gases by solids. 4. Adsorption isotherm: Freundlich adsorption isotherm and Langmuir adsorption Isotherm. **B) Catalyst:** 1. Types of catalyst – positive and negative catalyst with examples. 2. Catalysis-Types of catalysis, homogeneous and heterogeneous catalysis with examples. 3. Characteristics of catalytic reactions. 4. Promoters – Definition, example of promotion action. 5. Catalytic poisoning – Definition, example, explanation of catalytic poisoning. 6. Active centre on catalyst surface. 7. Effect of particle size and efficiency of nanoparticles as catalyst. 8. Acid-Base catalysis. 9. Enzyme catalysis: Mechanism of enzyme catalysis, characteristics of enzyme catalysis, examples.	
	Unit Outcomes: UO 1. Student will be able to explain Types of adsorption & Adsorption isotherm UO 2. Student will be able to write about catalysis, their types & Mechanism	
III	**Chemical Kinetics**	**13**
	1. Introduction: Rate of reaction, Definition and units of rate constant, Factors affecting rate of a reaction, order and molecularity of a reaction. 2. Zero order reaction: Rate expression and characteristics 3. First order reaction: Rate expression and characteristics 4. Pseudo unimolecular or pseudo first order reaction 5. Second order reaction : Rate expression and characteristics (with equal and unequal concentration of reactants) 6. Third order reaction : Rate expression and characteristics 7. Methods of determination of order of a reaction : i) Hit and trial	

Unit No.	Title of Unit & Contents	Hrs.
	method ii) Half life method iii) Isolation method 8. Numerical on half life method and order of reaction. 9. Collision theory of reaction rates 10. Arrhenius equation, numerical 11. Activated complex theory (ACT) of bimolecular reaction Iyring equation 12. The Lindeman theory of unimolecular gaseous reaction 13. Complex reactions (Brief view) 14. Kinetics of : i) Opposing (Reversible) reactions ii) Consecutive reactions	
	Unit Outcomes: UO 1. Students can discuss about theories of reaction rate UO 2. Student can explain effects of various factor on rate of reaction & derive Arrhenius Equation	
IV	**Phase Equilibrium & Distribution Law**	**12**
	A) Phase Equilibrium : 1. Phase rule; statement and explanation of the terms: phase, component and degree of freedom. 2. One component system : H2O, Sulphur and CO2 system 3. Two component system: Pb-Ag system, KI-H2O system. 4. Partially miscible liquids: critical solution temperature upper critical solution temperature, lower critical temperature phenol-water, triethylamine-water, Nicotin – water systems. **B) Distribution Law :** 1. Nernst distribution law : statement, explanation and limitations 2. Applications of distribution law – solvent extraction, partition chromatography.	
	Unit Outcomes: UO 1. Students can Draw the phase diagrams of one component , two component System. UO 2. Student will be able to discuss the applications of Distribution law	

Learning Resources:

1. University General Chemistry By C.N.R. Rao
2. Principles of Physical Chemistry By Maron and Prutton
3. Physical Chemistry by G.M. Barrow
4. Essentials of Physical Chemistry by Bhal and Tuli
5. Elements of Physical Chemistry by Glasston and Lewis
6. Physical Chemistry by Robert A. Alberty
7. Principles of Physical Chemistry by Puri, Sharma, Pathania

8. Elements of Physical Chemistry by P.W. Atkins
9. Advanced Physical Chemistry by Harish Gurdeep
10. Physical Chemistry by W.J. Moor
11. Physical Chemistry by A.J. Mee
12. Chemical Kinetics by K.J. Laidler
13. Text book of Physical Chemistry by Soni, Dharmarha
14. Advanced physical chemistry by D.N. Bajpai
15. Text book of Physical Chemistry by S. Glasston
16. Text book of Physical Chemistry by A.S. Negi

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry
Semester- III

Course Type: DSC-V
Course Title: Lab. Course-V
Course Code: 201CHE3103
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To practice instrumental analysis involving Colorimeter.
LO 2. To Estimate & Determine Empirical Formula of Complexes using Colorimeter
LO 3. Study of Kinetics Using Polarimeter
LO 4. To Study Langmuir Adsorption Isotherm

Course outcome:

After successful completion of the course the students:

CO 1. Verify Lamberts Beers law using Colorimeter
CO 2. Determine Empirical Formula of Complexes using Colorimeter
CO 3. Determine Order of Reaction & Activation energy of Reaction
CO 4. Study Langmuir Adsorption Isotherm & Predict The effect of Pressure on Adsorption.

Practical	Title of Practical	Hrs.
I	**Instrumental**	**15**
	1. To Determine the of Stoichiometry of a complex by using colorimeter. 2. To verify Lambert-Beer law for $KMnO_4$ and determine the concentration of the given. 3. To determine indicator constant of indicator by using colorimeter. 4. To determine the specific rotation of a given optically active compound. 5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture colorimetricaly. 6. To determine the specific refractivity's of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C. 7. Determine the concentration of Cu^{2+} ion in given solution, titrating it against std. EDTA solution by colorimetric measurements. 8. Determine the empirical formula of a complex between Fe^{3+} and 5-Sulphosalicylic acid by Job's method colorimetrically.	
II	**Non-Instrumental**	**15**
	1. To study the distribution of benzoic acid between benzene and water 2. To study the effect of solute (NaCl) on the CST of phenol-water	

Practical	Title of Practical	Hrs.
	system and hence determine the amount of solute in the given sample of phenol-water composition 3. To study the effect of addition of electrolyte (KCl/NaCl) on solubility of weak organic acid at room temperature. 4. To determine the solubility of benzoic acid in water at different temperature (at least three temperature by difference of 10^0C) and have its heat of solution. 5. To study the Partition coefficient of iodine between water and carbon tetrachloride. 6. To construct the phase diagram of three component system(Acetic acid-chloroform-water) 7. Determine the energy of activation of reaction between KI and $K_2S_2O_8$. 8. To determine the equilibrium constant for the reaction: $KI + I_2 \longrightarrow KI_3$. 9. To study the rate of acid catalysed iodination of acetone. 10. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Unequal concentrations). 11. Freundlich and Langmuir isotherms for adsorption of acetic acid on active charcoal.	

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry
Semester- III

Course Type: DSC-VI
Course Title: Inorganic Chemistry-III
Course Code: 201CHE3102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. Familiarize students with basic concept of coordination chemistry
LO 2. Familiarize with theories of coordination compounds
LO 3. Learn the concept of hybridization, their types, rules, applications and Postulates of VSEPR theory and its applications
LO 4. Understand the concept of MOT, LCAO method and will be able to draw the energy level diagram of diatomic molecules.

Course Outcomes:

After completion of course the student will be able to-

CO 1. Explain the basic concept of Coordination number, Ligand ,Complex ion ,Coordinate bond etc..
CO 2. Describe the various theories of coordination compounds.
CO 3. Understand the concept of MOT, limitations of VBT, LCAO method & orbital energy level diagram of homo nuclear and hetero nuclear diatomic molecules..
CO 4. Explain the Postulates of VSEPR theory and various types of hybridization

Unit No.	Title of Unit & Contents	Hrs.
I	**Coordination Chemistry-I**	**10**
	1)Meaning of the terms i) Coordination number ii) Ligand iii) Complex ion iv)Coordinate bond v) Coordination sphere vi) Chelation-defination, types of chelating agents, application of chelation with reference to DMG & EDTA 2. Difference between double salt and complex compound 3. Types of ligands with examples 4. Nomenclature of coordination compounds (mention latest IUPAC Rules). 5 Isomerism in coordination compounds –Structural, Geometrical (C.N. 4 & 6) &Optical 6. Effective Atomic Number. 7. Application of complex compounds in everyday	
	Unit Outcomes: UO 1. Define Coordination number, Ligand , types of chelating agents UO 2. Identify the types of ligand and Nomenclature of coordination compounds	

Unit No.	Title of Unit & Contents	Hrs.
II	**Coordination Chemistry-II**	**15**
	1. Werner's coordination theory 2. Sidgwick theory of effective atomic number rule 3. Valence Bond theory –Main assumptions of VBT 4. Interpretation of geometry and magnetic properties of coordination compounds such as $[Fe(CN)_6]^{4-}$, $[PtCl_6]^{2}$-, $[Fe(H_2O)_6]^{2+}$, $[Co(NH_3)_6]Cl_3$. Ex. Sp^3d^2, d^2sp^3 5. Tetrahedral Complex such as $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$, $[Ni(CO)_4]$ 6. Crystal field theory – Postulates, splitting of d-orbitals in octahedral and tetrahedral fields 7. Crystal Field Stabilization Energy (CFSE) 8. calculation of CFSE, for octahedral (weak and strong field) and tetrahedral complexes with d^1 to d^{10} metal ion configurations 9. Interpretation of colour and magnetic properties Comparison of Valence Bond Theory and Crystal Field Theory.	
	Unit Outcomes: UO 1. Describe the various theories of coordination compounds UO 2. Calculate the CFSE for octahedral and tetrahedral complex	
III	**Molecular Orbital Theory**	**10**
	1 Limitations of Valence Bond theory (VBT), Need of Molecular orbital theory (MOT). 2. Molecular orbital concept of bonding, Linear combination of atomic orbitals (LCAO). 3. Energy level diagram for homonuclear diatomic molecules and their ions: H_2, H_2^+, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2, O_2^+, O_2-, O_2^2, F_2 4. Bond order, Energy level diagram of hetero nuclear diatomic molecules of NO, CO, HF	
	Unit Outcomes: UO 1. Identify paramagnetic and diamagnetic Homonuclear diatomic molecules . UO 2. Calculate the bond order for diatomic molecules.	
IV	**Concept of Hybridisation and VSEPR Theory**	**10 Hours**
	1. Definition of hybridisation of atomic orbitals 2.Steps in the process of hybridization of atomic orbitals. 3.Types of hybridization characteristics of each type of hybridization 4. Explanation of shapes of following ions and molecules on the basis of hybridization : i) BF_3 ii) $SiCl_4$ iii) PCl_5 iv) SF_6 v) $SnCl_2$ vi) CO_2 vii) NO_2^- 5.Postulates of VSEPR theory : explanation and limitations. 6. Regular and irregular geometries. 7. Shape of CH_4, NH_3 & H_2O molecule,Shape of sulphate ion SO_4^{2-}, chlorate	

Unit No.	Title of Unit & Contents	Hrs.
	ion ClO_3^- and perchlorate ion ClO_4^-.	
	Unit Outcomes: UO 1. Define hybridization and its various types. UO 2. Identify the shape of various molecules on the basis of VSEPR theory.	

Learning Resources:

1. Puri, Sharma, Kalia Text Book Of Inorganic Chemistry, Milestone Publications-
2. W.L. Jolly , Modern Inorganic Chemistry (Mc Graw Hill Book company
3. J.E. Huheey, E.A. Keiter, R.L. Keiter Inorganic Chemistry - By Pearson
4. Gurudeep Raj, Chatwal Anand Advanced Inorganic Chemistry Goel Pub., 1974
5. Wilkinson and Cotton, Inorganic Chemistry, Wiley; Third edition
6. J. D. Lee: Fifth Edition, Concise Inorganic Chemistry, Wiley, 2008.
7. Inorganic chemistry, Gary L. Miessler and Donald A. Tarr, Third edition, 2014.
8. Bodie Douglas and DarlMcdaniel: Concepts and Models of Inorganic Chemistry ,Third Edition, Wiley, 1983.
9. Duward Shriver, P. W. Atkins: Inorganic Chemistry, Fifth Edition, Oxford University Press 2002

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry
Semester- III

Course Type: DSC-VI
Course Title: Lab Course-VI
Course Code: 201CHE3104
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. Learn about analysis of water sample**.**
LO 2. Estimations of ions gravimetrically.

Course Outcomes:

CO 1. Can estimates the ions gravimetrically.
CO 2. To know all information about ligands and form a co-ordinate complex.

1	Estimate the amount iron by external and internal indicator method using standard K2Cr2O7 solution
2	Analyse the water sample for temporary hardness, permanent hardness and total hardness by EDTA method
3	Prepare the standard solution of oxalic acid and estimate the amount of $KMnO_4$ in the given solution
4	Estimate the amount of iron in the given solution gravimetrically
5	Estimate the amount of Barium as barium chromate gravimetrically
6	Estimate the amount of Barium as barium Sulphate gravimetrically
7	Estimate the amount of Nickel as Ni-DMG complex gravimetrically
8	Preparation of hexaammine nickel(II) chloride, $[Ni(NH_3)_6]Cl_2$.
9	Preparation of Manganese (III) acetylacetonate, $[Mn(acac)_3]$
10	Preparation of Potassium dioxalatocuprate(II), $[Cu(C_2O_4)_2]_2$
11	Preparation of Potassium trioxalatoferrate(III), $K_3[Fe(C_2O_4)_3]$.
12	Preparation of hexaammine cobalt(III) chloride, $[Co(NH_3)_6]Cl_3$

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry

Course Type: DSM-I
Course Title: Fundamentals of Chemistry-I
Course Code: 201CHE3301
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts like, Electronic configuration, Pauli's exclusion principle, Hund's rule, Aufbau principle, etc.
LO 2. To study the periodic properties of elements and their trends in periodic table such as Ionization energy, Electron affinity, Electronegativity etc.
LO 3. To confront students with general properties and periodic Properties of s, p & d block elements
LO 4. To Study Bohr's atomic model, concept of shells, sub shells and orbitals, dual nature of electron
LO 5. To study the Nomenclature of organic compounds and types of reactions.

Course Outcomes:

After completion of course the student will be able to-

CO 1. Familiarize the students with concept of Electronic configuration, Pauli's exclusion principle, Hund's rule, Aufbau principle, etc.
CO 2. Write the periodic properties of elements and their trends in periodic table such as Ionization energy, Electron affinity, Electronegativity etc.
CO 3. Explain general properties and periodic Properties of s and p block elements
CO 4. Describe Bohr's atomic model, concept of shells, sub shells and orbitals, dual nature of electron
CO 5. Identify IUPAC name of organic compound and type of reaction.

Unit No.	Title of Unit & Contents	Hrs.
I	**Elements and the periodic Table**	**10**
	1.1 Electronic configuration: Pauli's exclusion principle, Hund's rule, Aufbau principle and their role in writing the electronic configuration 1.2 Periodicity: Periodic law, arrangement of elements in the periodic table period, group, diagonal relationship in the periodic table 1.3 General properties of atoms: Size of atoms and ions, atomic radii, ionic radii, covalent radii, trends in Periodic table 1.4 Ionisation energy: Definition, factors effecting, Inert–pair effect, trends of ionization energy in Periodic table, application to explain the	

Unit No.	Title of Unit & Contents	Hrs.
	chemical behavior of an atom. 1.5 Electron affinity: Definition, factors affecting, trends of electron affinity in Periodic table, application to explain the chemical behavior of an atom 1.6 Electronegativity: Definition, factors affecting, trends of electronegativity in Periodic table, application to explain chemical bonding	
	Unit Outcomes: UO 1: Write the electronic configuration of various elements. UO 2: Know the concept of ionization energy ,electron affinity and electronegativity	
II	**S and P Block Elements**	**10**
	2.1 a) Position of the elements in the periodic table b) Electronic configuration of elements c) Hydrides of Alkali & Alkaline earth metals d) Reducing Properties of S-Block elements 2.2 Anomalous behavior of first member of each group in P-Block elements i) Atomic and Ionic Size ii) Ionization energy iii) Electronegativity iv) Oxidation state	
	Unit Outcomes: UO 1: Clarify all the terms related to Anomalous behavior of first member of each group in p block element UO 2: Liable to understand the meaning of hydrides of alkali and alkaline earth metal reducing properties of S block elements	
III	**Atomic Structure**	**10**
	3.1 Introduction , concept of Atom, Theories of Atomic structure , Discoveries & Properties of Subatomic Particles 3.2 Bohr's atomic model – Postulates, derivation for radius and energy of Bohr's orbit. Atomic spectra, applications of Bohr's theory to spectra of hydrogen, limitations of Bohr's theory. Numerical on radius and energy of Bohr's orbit 3.3 Planck's quantum theory of radiation 3.4 Compton Effect, Photoelectric effect, explanation on the basis of quantum theory	

Unit No.	Title of Unit & Contents	Hrs.
	3.5 Heisenberg's uncertainty principle, (Statement, explanation) 3.6 Concept of Orbit and orbital's, Quantum Numbers – Types, explanation and uses	
	Unit Outcomes: UO 1 : Familiarize with Bohr's atomic model UO 2 : Explain quantum theory for atomic structure	
IV	**Nomenclature of Organic Compounds & Basic Concepts in Organic Reaction Mechanism**	**15**
	4.1 Development of organic chemistry, unique properties of organic compound 4.2 Functional groups and types of organic compounds, Basic rules of IUPAC nomenclature, Nomenclature of mono- and bi-functional compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines 4.3 Nomenclature of aromatic compounds: mono-, di- and polysubstituted benzene (with not more than two functional groups), Monosubstituted fused polycyclic arenes – naphthalene, anthracene and phenanthrene. Nomenclature of bicyclic compounds 4.4 Substrate and Reagents, Electrophiles & Nucleophiles 4.5 Homolytic and heterolytic process of bond fission. a)Inductive effect & its Types b)Mesomeric Effect c)Hyperconjugation d)Steric effect 4.6 Formation and Stability of reactive intermediates: Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes & Arynes 4.7 Types of organic reactions: Substitution, Addition, Elimination and Rearrangement. (With one example).	
	Unit Outcomes: UO1 **:** Liable to draw structural formulae of organic molecules UO2: Describe reaction intermediates & draw mechanism.	

Learning Resources:

Organic Chemistry:

1. Organic chemistry by – S.M. Mukherji, S.P. Singh, R.P. Kepoor (Vol. I & II)
2. Organic chemistry by – Jagdamba Singh, L.D.S. Yadav (Vol. I & II)
3. A text book of organic chemistry by P.L. Soni.
4. A text book or organic chemistry by – K.S. Tewari, S.N. Mehrotra, N.K. Vishnoi.

5. A text book of organic chemistry by – Arun Bahl & B.S. Bahl.

6. Principal of organic chemistry by – M.K. Jain.

7. Organic chemistry by – Clayden, Greeves, Warren and Wothers.

8. Organic chemistry by – Morrison and Boyd.

9. Organic chemistry by – Carey.

10. Advanced Organic chemistry by – Jerry March.

11. Organic reactions and their mechanism by – P.S. Kalsi.

12. Organic reactions and their mechanism by – P.S. Kalsi.

13. A guide book to mechanism in organic chemistry by – Peter Sykes.

14. Practical organic chemistry by – A.I. Vogel.

15. Advanced practical organic chemistry by – O.P. Agarwal.

16. Advanced practical organic chemistry by – N.K.Vishnoi.

Inorganic chemistry

1. Text book of inorganic chemistry – Puri Sharma Kalia.

2. Modern Inorganic chemistry – W.L. Jolly (Mc Graw Hill Book company.)

3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,

4. Advanced Inorganic chemistry – Gurudeep Raj, Chatwal Anand.

5. Advanced Inorganic chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan.

Physical chemistry

1. Mathematical Preparation for physical chemistry – By F. Daniel, MC. Graw Hill publication.

2. University General Chemistry – By C.N.R. Raw MC Millan publication.

3. Principles of physical chemistry – By marron and proton 4th edition. Oxford and IBH publication.

4. Physical chemistry – By G.M. Barrow.

5. Essentials of physical chemistry – By B.S. Bahl & G.D. Tul.

6. A Textbook of physical chemistry – By K.L. Kapoor (Vol. 1)

7. Principles of physical chemistry – By Puri, Sharma, Pathania

8. Advanced physical chemistry – By Gurdeep Raj

9. Elements of physical chemistry – By S. Glasstone & D. Lewis

10. Elements of physical chemistry – By P.W. Atkins.

11. Elements of physical chemistry – By Matthew Philips.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Course Type: DSM-I
Course Title: Minor Lab Course I
Course Code: 201CHE3302
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. Learn about analysis of water sample**.**
LO 2. Estimations of ions gravimetrically.

Course Outcomes:

CO 1. Can estimate the ions gravimetrically.
CO 2. To know all information about ligands and form a co-ordinate complex.

A) Physical Chemistry

1	Determination of Heat of solution of KNO_3/ NH_4Cl
2	Determination of heat of reaction of displacement of copper by zinc.
3	Determine the equivalent weight of magnesium by using Eudiometer
4	Preparation of buffer solutions of different pH values i) Sodium acetate-acetic acid ii) Ammonium chloride-ammonium hydroxide.

B) Inorganic Chemistry

1.	1) Prepare standard Na_2CO_3 solution. Standardize the given HCl solution and estimate the amount of NaOH in the given solution.
2.	2) Estimate the amount of Fe^{++} and Fe^{+++} separately in the given mixture using standard $K_2Cr_2O_7$ solution.
3.	3) Find out the strength of supplied NaCl solution using standard NaCl and $AgNO_3$ as link solution (Mohr's method).
4.	4) Standardize the given EDTA solution by using standard Zn^{++} solution and estimate the amount of Ca^{++} from given solution.

C) Organic Chemistry

1	Determination of Nature, functional group and physical constant of organic compounds: **(Any 4)** B-naphthol, benzaldehyde, benzoic acid, p-nitroaniline, acetanilide, nitrobenzene, ethylalcohol and aniline.

Learning Resources:

1. Vogel's Qualitative Analysis.
2. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V. Lawande.
3. Advanced Practical Inorganic Chemistry by O.P. Agarwal.
4. Vogel's Quantitative Analysis.
5. Practical Organic Chemistry by A.I. Vogel.
6. Advanced Practical Organic Chemistry by O.P. Agarwal.
7. Advanced Practical Organic Chemistry by N.K. Vishnoi.
8. Experiments in Physical Chemistry by R.C. Das and B. Behra
9. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
10. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
11. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by BalwantraiSatuja

Semester - IV

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry
Semester- IV

Course Type: DSC-VII
Course Title: Organic Chemistry-II
Course Code: 201CHE4101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand different Name reactions with mechanism.

LO 2. To learn about properties, preparations of Carboxylic acids and their derivatives.

LO 3. To know about Organic Compounds of Nitrogen & Organic Synthesis via enolates

Course Outcomes:

After completion of course the student will be able to-

CO 1. Understand different Aldol condensation, Cannizzaro's reaction etc.with their mechanisms.

CO 2. Learn about properties, preparations of Formic acid , Acetic acid & Chloro acetic acid, esters, acid amides

CO 3. Can know about aromatic nitrogen compounds , diazonium salts& Organic Synthesis Via enolates.

Unit No.	Title of Unit & Contents	Hrs.
I	**Carbonyl Compounds :**	13
	1.1 Preparations of Aldehydes: a) By dehydrogenation of alcohols. b) From acyl chloride. c) From nitriles and esters. **1.2 Preparations of Ketone:** a) From acyl chlorides. b) From Nitrile. **1.3 Name Reactions with Mechanism**: a) Knoevengel condensation reaction. b) Benzoin Condensation Reaction. c) Perkin reaction . d) Gatterman Koch reaction. **1.4 Reduction reactions:**	

Unit No.	Title of Unit & Contents	Hrs.
	a) Clemmensen Reduction Reaction. b) Meerwin-Pondorof Verly reduction reaction. c) Reduction with LiAlH4. **1.5 Oxidation Reactions** a) Baeyer-Villiger Oxidation Reaction. b) Oppenauer oxidation.	
	Unit Outcomes: UO 1: Understand different Name reactions with their mechanism. UO 2: Know the preparation methods of carbonyl compounds .	
II	**Carboxylic Acid and their derivatives:**	**12**
	2.1 Carboxylic Acids (Aliphatic & Aromatic) 2.1.1 Introduction & classification 2.1.2 Methods of formation: i) By oxidation of primary alcohol & secondary alcohol ii) By hydrolysis of nitriles 2.1.3 Physical properties: 2.2 Carboxylic Acid Derivatives **A] Acid chlorides: (Acetyl chloride)** 2.2.1 Introduction 2.2.2 Preparation Methods: a) By the action of thionyl chloride on acetic acid b) By the action of phosphorus pentachloride on acetic acid 2.2.3 Chemical Reactions: a) Hydrolysis b) Action with alcohol **B] Esters: (Ethyl acetate)** 2.2.4 Preparation Methods: a) From ethyl alcohol and acetic acid b) From ethyl alcohol and acetyl chloride. 2.2.5 Chemical Reactions: a) Alkaline hydrolysis. b) Action of amines **C] Amides: (Acetamide)** 2.2.6 Preparation Methods: a) By the action of ammonia on acid chloride.	

Unit No.	Title of Unit & Contents	Hrs.
	b) By the action of ammonia on acetic anhydride. 2.2.7 Chemical Reactions: a) Hydrolysis b) Action of nitrous acid c) Reduction **Aromatic Carboxylic acids:** Introduction and Classification of Aromatic Carboxylic Acids Synthesis and Chemical Reactions of Following Acids **A] Benzoic Acid:** Preparations From: a) Phenyl Cyanide b) Toluene Reactions of Benzoic Acid**:** a) Acyl halide formation b) Reduction C) Nitration **B] Salicylic Acid:** 3.1.7 Preparations From: a) Kolbe's reaction b) Reimer-Tiemann reaction 3.1.8 Reactions of Salicylic Acid: a) Bromination b) Nitration	
	Unit Outcomes: UO 1:Familarize preparations of Formic acid , Acetic acid & Chloro acetic acid etc . UO 2: Familarize with properties,of Formic acid , Acetic acid & Chloro acetic acid etc .	
III	**Organic Compounds of Nitrogen**	**10**
	3.1 Aromatic Nitro Compounds. 3.1.1 Introduction 3.1.2 Preparation of Nitrobenzene from benzene 3.1.3 Physical properties of Nitrobenzene. 3.1.4 Chemical properties: 3.1.5 Electrophilic substitution reactions 3.1.6 Reductions: a) In acidic medium b) In neutral medium c) In alkaline medium d)Electrolytic reduction **3.2 Aromatic amines:**	

Unit No.	Title of Unit & Contents	Hrs.
	3.2.1 Introduction & Classification 3.2.2 Methods of formation of aniline from: a) Chlorobenzene b) Phenol c) Nitrobenzene 3.2.3 Chemical properties: a) Diazotization reaction b) Action of benzoyl chloride c) Carbylamine reaction d) Formation of p-nitroacetanilide 3.2.4 Effect of substituent (-NO_2, -OCH_3, -CH_3) on the basicity of aniline. **3.3 Diazomethane** 3.3.1 Introduction. 3.3.2 Methods of formation: a) From N-nitroso-N-methylurethane b) From nitrous oxide and methyl lithium 3.3.3 Reactions of Diazomethane a) Action of heat b) mineral acid c) phenol d) ethanol and ethanamine **3.4 Urea:** 3.4.1 Synthesis of urea by a) Wohlers method b) From CO_2. 3.4.2 Chemical Reactions: a) Action of heat b) Hydrolysis c) Action of thionyl chloride d) Action of hydrazine	
	Unit Outcomes: UO 1: Explain Physical and Chemical Properties of Aromatic Nitro Compound. UO 2: Discuss the Synthesis, Physical and Chemical Properties of Urea.	
IV	**Stereochemistry**	**10**

Unit No.	Title of Unit & Contents	Hrs.
	4.1 Introduction 4.2 Concept and Types of isomerism a) Structural isomerism b) Stereo isomerism 4.3 Types of structural isomerism [Chain, Position, Functional, Metamerism, Tautomerism] 4.4 Types of Stereoisomerism [Conformational (n-butane) and Configurational] 4.5 Geometrical isomerism: Cis -Trans and E and Z system of nomenclature. 4.6 Optical isomerism**:** a) Concept of asymmetric carbon atom & Chiral centre b) Dextro, Laevo forms & Racemic mixture c) Element of symmetry [plane, Centre, and Axis] d) Concept of Diastereoisomers e) Racemic modification (with one example) f) Resolution concept (with one example) g) Walden inversion (with one example) h) Relative Configuration and Absolute configuration [D,L and R,S notations]	
	Unit Outcomes: UO 1: know the concept of isomerism. UO 2: Predict the R/S ,Cis/trans, E/Z configuration.	

Learning Resources:

1. Organic Chemistry – S.M.Mukherji, S.P.Singh, R.P.Kapoor (Vol. I & II)
2. Organic Chemistry by – Jagdambasingh, L.D.S.Yadav (Vol. I & II)
3. A text book of Organic Chemistry by – P.L.Soni
4. A text book of Organic Chemistry by – K.S.Tewari, S.N.Mehrotra, N.K.Vishnoi
5. A text book of Organic Chemistry by – ArunBahl&B.S.Bahl
6. Principles of Organic Chemistry by – M.K.Jain
7. Organic Chemistry by – Clayden-Greeves, Warren and Wothers
8. Organic Chemistry by – Morrison and Boyd
9. Organic Chemistry by – Carey
10. Advanced Organic Chemistry by – Jerry March
11. Organic Reactions and their Mechanisms by – P.S.Kalsi
12. A guide book to Mechaism in organic chemistry by – Peter Sykes

13. Organic Chemistry by – I.L.Finar
14. Fundamentals of Organic Chemistry Solomon and T.W.Graham.
15. A text book of Organic Chemistry by G.K.Ahluwalia, Madhuri Goyal

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry
Semester- IV

Course Type: DSC-VII
Course Title: Lab. Course-VII
Course Code: 201CHE4103
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To prepare derivatives of organic compounds and understand about TLC

LO 2. Perform quantitative analysis of organic compound

LO 3. To perform organic qualitative analysis of acids, phenols, base, neutral molecules.

Course outcome:

After successful completion of the course the students:

CO 1. Students can perform organic qualitative analysis of acids, phenols, base, neutral molecules.

CO 2. Prepare derivatives of organic compounds and understand about TLC

CO 3. Perform quantitative analysis of glucose, phenol , formaldehyde etc.

Practical	Title of Practical	Hrs.
I	**Organic Qualitative Analysis**	**15**
	At least Six compounds be selected from the following list (Preliminary test, Nature, Elemental analysis, Functional group detection, Physical constant & preparation of derivatives) Acids - Benzoic acid, Salicylic acid, Cinnamic acid Phenols - α- Naphthol, β- Naphthol Base - o – Nitro aniline, p – Nitro aniline, m – Nitro aniline, aniline Neutral - Naphthalene, Anthracene, Acetanilide, m-dinitrobenzene, Benzaldehyde, Acetophenone	
II	**Organic Quantitative Analysis**	**15**
	i) Estimation of glycine by Sorensens method ii) Estimation of Glucose iii) Estimation of Phenol iv) Estimation of Formaldehyde v) Estimation of Crotonic acid (unsaturation)	

Practical	Title of Practical	Hrs.
	vi) Estimation of Amide	

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry
Semester-IV

Course Type: DSC-VIII
Course Title: Physical Chemistry-III
Course Code: 201CHE4102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. To study various theories of Electrolysis & Conductance of Electrolytes.
LO 2. To understand the concept of electrochemical cells, Nernst equation, application of EMF measurement etc.
LO 3. To discuss the First & Second law of Thermodynamics, State functions like E, H & S .
LO 4. To Learn about Gibbs free energy, Nernst heat theorem, variation of chemical potential.

Course outcome:

After successful completion of the course the students:

CO 1. Explain various theories of Electrolysis Define various types Conductance of Electrolytes
CO 2. Discuss the concept of electrochemical cells, Nernst equation, application of EMF measurement etc.
CO 3. Describe First & Second law of Thermodynamics, State functions like E, H & S.
CO 4. Explain Gibbs free energy, Nernst heat theorem, variation of chemical potential.

Unit No.	Title of Unit & Contents	Hrs.
I	**Electrochemistry-I**	**11**
	1. Introduction : Conduction of electricity, Types of conductors – electronic and electrolytic 2. Basic terms used in electrochemistry – Conductance, Specific conductance, Equivalent conductance, Molar conductance 3. Effect of dilution on various types of conductance 4. Conductivity cell, cell constant and its determination 5. Strong and weak electrolytes – Arrehenius theory, Debye Huckel theory, Debye – Huckel Onsger equation. 6. Brief view of transport numbers 7. Kohlrausch law and its applications 8. Conductometric titrations and its advantages i) Numerical problems on Kohlrausch law	
	Unit Outcomes: UO1. Explain various theories of Electrolysis UO2. Define various types Conductance of Electrolytes	

Unit No.	Title of Unit & Contents	Hrs.
II	**Electrochemistry – II**	**12**
	1. Introduction, concept of electrode potential – Nernst theory, single electrode potential, standard electrode potential. 2. Electrochemical cells – Electrolytic and Galvanic cells, reversible and irreversible cells, conventional representation of electrochemical cells. 3. EMF of a cell, its measurement. 4. Reference electrodes – primary (SHE) and secondary (calomel) 5. Relation of emf with G, H and S. 6. Nernst equation – For single electrode potential and emf of the cell (no derivation). 7. Electrolyte concentration cells – concentration cell with transport and without transport, liquid junction potential. 8. Application of EMF measurement in determination of pH by using Quinhydrone electrode & Glass electrode. 9. Potentiometric titrations.(Acid-Base, Redox & precipitation) 10. Numericals on standard emf of the cell, Nernst equation.	
	Unit Outcomes: UO 1. Define Electrode Potential & Discuss single electrode potential, Standard electrode potential UO 2. Describe Electrochemical cell, concentration cell	
III	**Thermodynamics-I**	**10**
	1. Introduction, terms and definations: Internal energy, enthalpy, Heat, Work, etc., Thermodynamic processes. 2. Heat capacity, heat capacity at constant pressure and volume, relation between C_p & C_v 3. Introduction to first law of thermodynamics 4. Joules law, Joule-Thomson effect: qualitative discussion and experimentation, inversion 5. Temperature, Joule-Thomson Coefficient. (Numerical expected) 6. Need for second law of thermodynamics, Statements. 7. Carnot's cycle, efficiency of Carnot's engine, Carnot's theorem. 8. Concept of entropy i) Introduction, Definition, Mathematical expression, Unit, Characteristics ii) Entropy changes for an ideal gas as a function of V and T, P and T iii) Entropy changes in physical transformation iv) Entropy changes of an ideal gas in various processes v) Physical significance of entropy, Entropy as criteria of Spontaneity. 9. Numerical on: Efficiency of Carnot's cycle, Entropy changes in physical transformations, Entropy changes of an ideal gas in different processes.	
	Unit Outcomes: UO 1. State & Explain Laws of Thermodynamics UO 2. Describe Carnot Cycle & determine efficiency of heat engine	

Unit No.	Title of Unit & Contents	Hrs.
IV	**Thermodynamics – II :**	**12**
	1. Gibbs free energy (G)–Definition, Characteristics, significance, variation with T and P. 2. Helmholtz free energy (A) – Definition, characteristics, significance, variation with T and V. Relation between G and A. 3. Gibb's – Helmholtz equation (derivation) 4. The Nerns't heat theorem, third law of thermodynamics. 5. Partial molar properties, chemical potential, Gibb's – Duhem equation (Derivation), Variation of chemical potential with T and P. 6. Van't – Hoff's isotherm. 7. Van't – Hoff's reaction isochore, its integrated form. 8. Clausius – Clapeyron equation and its applications. 9. Thermodynamic derivation of law of mass action. 10. Numericals on Van't – Hoff's isotherm, Van't – Hoff's isochore & Clausius Clapeyron equation.	
	Unit Outcomes: UO 1. Define Free Energy & Derive Gibbs-Helmholtz Equation UO 2. Derive Vant-Hoffs Isotherm & Isochore, Solve Numericals on Van't – Hoff's isochore & Clausius Clapeyron equation.	

Learning Resources:

1. University General Chemistry By C.N.R. Rao
2. Principles of Physical Chemistry By Maron and Prutton
3. Physical Chemistry by G.M. Barrow
4. Essentials of Physical Chemistry by Bhal and Tuli
5. Elements of Physical Chemistry by Glasston and Lewis
6. Physical Chemistry by Robert A. Alberty
7. Principles of Physical Chemistry by Puri, Sharma, Pathania
8. Elements of Physical Chemistry by P.W. Atkins
9. Advanced Physical Chemistry by Harish Gurdeep
10. Physical Chemistry by W.J. Moor
11. Physical Chemistry by A.J. Mee
12. Chemical Kinetics by K.J. Laidler
13. Text book of Physical Chemistry by Soni, Dharmarha
14. Advanced physical chemistry by D.N. Bajpai
15. Text book of Physical Chemistry by S. Glasston
16. Text book of Physical Chemistry by A.S. Negi

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Semester- IV

Course Type: DSC-VIII

Course Title: Lab. Course-VIII

Course Code: 201CHE4102

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To practice instrumental analysis involving potentiometer.

LO 2. To determine normality, redox potential potentiometrically.

LO 3. To study Heat evolved during Precipitation reaction

LO 4. To determine Enthalpy of Neutralization, Partial Molar Volume etc.

Course outcomes:

After successful completion of the course the students will:

CO 1. Perform instrumental analysis involving potentiometer.

CO 2. Can determine normality, redox potential potentiometrically.

CO 3. Determine the Heat Precipitation

CO 4. Determine Enthalpy of Neutralization, Partial Molar Volume etc.

Practical	Title of Practical	Hrs.
I	**Instrumental**	**15**
	1. Determine the normality and strength of strong acid ($HCl/H_2SO_4/HNO_3$) conductometrically using standard solution of NaOH 2. Determine the normality and strength of weak acid ($CH_3COOH/HCOOH$) conductometrically using standard solution of NaOH 3. Determine the normality and strength of strong acid and weak acid in the given mixture conductometrically using standard solution of NaOH 4. To determine the solubility of a sparingly soluble salts ($BaSO_4$/ $PbSO_4$/ AgCl) conductometrically atroom temperature. 5. Hydrolysis of NH_4Cl or H_3COONa or aniline hydrochloride by conductomery. 6. Determine the equivalent conductance of a strong electrolyte at several concentrations and hence verify the Onsager's equation. 7. determine the normality and strength of strong acid ($HCl/H_2SO_4/HNO_3$)	

Practical	Title of Practical	Hrs.
	potentiometrically using standard solution of NaOH 8. Determine the normality and strength of weak acid (CH_3COOH/HCOOH) potentiometrically using standard solution of NaOH 9. Determine the normality and strength of strong acid and weak acid in the given mixture potentiometrically using standard solution of NaOH 10. To determine the redox potential of Fe^{3+}/Fe^{2+} system by titrating it with standard $KMnO_4$ potentiometrically. 11. To determine the dissociation constant of weak acid potentiometrically by titrating it against alkali.	
II	**Non-Instrumental**	**15**
	1. To determine the solubility of benzoic acid in water at different temperature (at least three temperature by difference of 10^0C) and have its heat of solution. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of latent heat of fusion of a given solid. 4. Determine the effect of surfactant on surface tension of water 5. Determination of heat of precipitation of $BaSO_4$ 6. Determine the transport number of silver & Nitrate ion in Silver nitrate by hittorffs method 7. Determine the heat of ionization of acetic acid	

Learning Resources:

1. Vogel's Qualitative Analysis
2. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V.
3. Experimental Physical Chemistry by A. Findlay
4. Advanced Practical Physical Chemistry by J.B. Yadav
5. Experiments in Physical Chemistry by R.C. Das and B. Behra
6. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
7. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
8. Experimental in Physical Chemistry by J.C. Ghosh
9. Practical Physical Chemistry by B.D. Khosala and V.C. Garg
10. Experiments in Chemistry by D.V. Jahagirdar
11. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by Balwantrai Satuja
12. College Practical Chemistry by H.N. Patel, S.R. Jakal H.P. Subhedar P.P. Turakhia

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry

Course Type: DSM II
Course Title: Minor Chemistry- II
Course Code: 201CHE4301
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To Study various types of chemical bonding and properties of chemical compounds.
LO 2. To confront students with general properties and periodic Properties of d block elements.
LO 3. To gain the knowledge about different types of matter and their properties.
LO 4. To understand the preparation and properties of saturated unsaturated and aromatic hydrocarbons.

Course Outcomes:

After completion of course the student will be able to-

CO 1. Explain types of Bonds and Theories of Chemical Bonding
CO 2. Describe the periodic Properties of d block elements.
CO 3. Identify different states of matter and define the concept of conductance, magnetism, Vapour pressure, Surface Tension, Viscosity.
CO 4. Give the products of reactions of alkanes, alkenes and mechanisms showing how the products are formed.

Unit No.	Title of Unit & Contents	Hrs.
I	**Chemical Bonding**	10
	1. Cause of chemical bonding, types of bonding, octet rule. 2. Ionic bond – Nature of ionic bond, conditions for the formation of ionic compounds, properties of ionic compounds, ion polarization and Fajan's rule. Born-Haber's cycle 3. Covalent bond – Polar and non– polar covalent bond. Percentage ionic character in a polar covalent bond. Hanny and Smyth equation, numerical, properties of covalent compounds. 4. Coordinate bond – Conditions for the formation of coordinate bond, properties of coordinate bond, and properties of coordinate compounds. 5. Metallic bond – Nature of metallic bond (electron pool theory), properties of metals. 6. Hydrogen bond – Nature of hydrogen bond, properties of hydrogen bonding. 7. Vander-walls forces – Types, Nature and origin of Vander -walls forces. Factors affecting the strength of Vander Waals forces. Application of Vander Waals forces.	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO 1. Define Ionic, Covalent and Co-ordinate bond. UO 2. Define metallic bond and hydrogen bonding	
II	**D Block Elements**	**10**
	1. Definition, Elements of first, second and third transition series, Electronic Configuration of first transition series. 2. General characteristics of d-block elements, properties of d-block elements (First transition series) such as: Metallic character. Atomic and ionic radii, Melting and Boiling Points, Ionization enthalpies, Reactivity, Oxidation states, Standard electrode potentials, Reducing properties, Color of ions, Magnetic properties, Catalytic properties and Complex forming tendency	
	Unit Outcomes: UO 1. Identify paramagnetic and diamagnetic transition metal compound. UO 2. Differentiate between colored and colorless compounds	
III	**States of Matter- Solid, Liquid and Gas**	**10**
	1. Different States of matter and their properties 2.Types of Intermolecular forces- Dipole-dipole interactions, ion-dipole interaction, dipole induced dipole interaction, London dispersion forces , hydrogen bonding 3. Characteristic Properties of Solid – Types of solids, conduction, and magnetism. 4. Characteristic Properties of Liquid –Vapour pressure, Surface tension, Viscosity. 5. Characteristic Properties of Gases- pressure, volume, temperature, amount of gas , Derivation of Ideal Gas equation	
	Unit Outcomes: UO 1. Familiarize with Different States of matter and their Properties UO 2. Explain properties like conduction, magnetism, vapour pressure, Surface tension, Viscosity	
IV	**Hydrocarbons-I**	**15**

Unit No.	Title of Unit & Contents	Hrs.
	1. Alkanes: Introduction, Methods of formation of alkanes by i. Kolbe's electrolytic method ii.Frankland reaction Chemical Properties: halogenation (mechanism), nitration (mechanism). **2. Alkenes**: Introduction Methods of formation by: i.dehydration of alcohols (with mechanism) ii.dehydrohalogenation of alkyl halides (with mechanism). Chemical Reactions: (with mechanism) i. Electrophilic addition of Br_2 to ethane. Free radical addition of HBr to propene (Peroxide effect) **3. Alkynes:** a. Introduction b. Methods of formation of acetylene (ethyne) from: i. Iodoform ii. Hydrolysis of calcium carbide c. Chemical properties: i. Electrophilic addition reactions of ethyne with Br_2& HBr (with mechanism) ii. Nucleophilic addition reactions of ethyne with by HCN (with mechanism)	
	Unit Outcomes: UO 1. Classify organic compounds by structure. UO 2. Predict the products of reactions of alkenes and describe the mechanisms showing how the products are formed	

Learning Resources:

Organic Chemistry:

1. Organic chemistry by – S.M. Mukherji, S.P. Singh, R.P. Kepoor (Vol. I & II)
2. Organic chemistry by – Jagdamba Singh, L.D.S. Yadav (Vol. I & II)
3. A text book of organic chemistry by P.L. Soni.
4. A text book or organic chemistry by – K.S. Tewari, S.N. Mehrotra, N.K. Vishnoi.
5. A text book of organic chemistry by – Arun Bahl & B.S. Bahl.
6. Principal of organic chemistry by – M.K. Jain.
7. Organic chemistry by – Clayden, Greeves, Warren and Wothers.
8. Organic chemistry by – Morrison and Boyd.
9. Organic chemistry by – Carey.
10. Advanced Organic chemistry by – Jerry March.

11. Organic reactions and their mechanism by – P.S. Kalsi.

12. Organic reactions and their mechanism by – P.S. Kalsi.

13. A guide book to mechanism in organic chemistry by – Peter Sykes.

14. Practical organic chemistry by – A.I. Vogel.

15. Advanced practical organic chemistry by – O.P. Agarwal.

16. Advanced practical organic chemistry by – N.K.Vishnoi.

Inorganic chemistry

1. Text book of inorganic chemistry – Puri Sharma Kalia.

2. Modern Inorganic chemistry – W.L. Jolly (Mc Graw Hill Book company.)

3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,

4. Advanced Inorganic chemistry – Gurudeep Raj, Chatwal Anand.

5. Advanced Inorganic chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan.

Physical chemistry

1. Mathematical Preparation for physical chemistry – By F. Daniel, MC. Graw Hill publication.

2. University General Chemistry – By C.N.R. Raw MC Millan publication.

3. Principles of physical chemistry – By marron and proton 4th edition. Oxford and IBH publication.

4. Physical chemistry – By G.M. Barrow.

5. Essentials of physical chemistry – By B.S. Bahl & G.D. Tul.

6. A Textbook of physical chemistry – By K.L. Kapoor (Vol. 1)

7. Principles of physical chemistry – By Puri, Sharma, Pathania

8. Advanced physical chemistry – By Gurdeep Raj

9. Elements of physical chemistry – By S. Glasstone & D. Lewis

10. Elements of physical chemistry – By P.W. Atkins.

11. Elements of physical chemistry – By Matthew Phili

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Course Type: DSM-II
Course Title: Minor Lab Course II
Course Code: 201CHE4302
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To determine the viscosity, surface tension.

LO 2. 2 To analyze qualitatively two acidic radicals and two basic radicals.

LO 3. To study the purification of organic compound.

Course Outcome:

Upon successful completion of the course, it is expected that students will be able to:

CO 1. To determine the viscosity, surface tension.

CO 2. To analyze the two acidic and two basic radicals qualitatively.

CO 3. Purify the given organic compound by recrystallization, sublimation, distillation.

A) Physical Chemistry:

1)	Determination of the viscosity of given liquid by using Oswald's viscometer.
2)	Determination the viscosity of mixture of two liquids A & B and find the composition of the mixture of two liquids. (Density of liquids, viscosity of water to be give) [Any two liquids from: Acetone, CCl_4, Chloroform, Ethyl alcohol. Benzyl alcohol, Ethylene glycol and n-propyl alcohol].
3)	To determine the surface tension of a given liquid by using stalagmometer.
4)	To study kinetics of hydrolysis of methyl acetate in presence of HCl.
5)	Study the variation of viscosity with different concentration of sugar solutions.
6)	Construction of various crystal modelsof NaCl unit cell.

B) Inorganic Chemistry: Qualitative analysis

	Qualitative analysis with two acidic radicals and two basic radicals in the form of mixture (Minimum five mixtures) containing one interfering radical:
1	**Acidic radicals:** Carbonate, Chloride, Bromide, Iodide, Nitrate, Sulphate.
2	**Basic radicals:** Copper, Bismuth, Ferric, Aluminum, Manganese, Nickel, Zinc, Barium, Calcium, Magnesium, Ammonium, Potassium.

C) Organic Chemistry:

Methods of Purification of organic compounds:	
1	Recrystallization: Benzoic acid, β–naphthol, cinnamic acid, m–nitroaniline and acetanilide. (any 3)
2	Sublimation: Naphthalene, camphor.
3	Simple distillation: (any one) i) Separation of ethanol & water from mixture ii) Separation of acetone & water from mixture

Learning Resources:

Physical chemistry

1. Mathematical Preparation for physical chemistry – By F. Daniel, MC. Graw Hill publication.
2. University General Chemistry – By C.N.R. Raw MC Millan publication.
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4. Physical chemistry – By G.M. Barrow.
5. Essentials of physical chemistry – By B.S. Bahl & G.D. Tul.
6. A Textbook of physical chemistry – By K.L. Kapoor (Vol. 1)
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8. Advanced physical chemistry – By Gurdeep Raj
9. Elements of physical chemistry – By S. Glasstone & D. Lewis
10. Elements of physical chemistry – By P.W. Atkins.
11. Elements of physical chemistry – By Matthew Philips.

Inorganic chemistry

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3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,
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5. A text book of organic chemistry by – Arun Bahl & B.S. Bahl.
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16. Advanced practical organic chemistry by – N.K.Vishnoi

Baskets of Common Courses

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG Second Year (Semester III / IV)

Basket I: Open Elective (OE)

(GEs offered to the Humanities and Social Sciences students in Sem III/IV)

Sr. No.	BoS Proposing OE	Course Title	Credits	Hrs.
1	Biotechnology	Food and Nutrition	2	30
2	Botany	Plant Diversity and Human Welfare	2	30
3	Information Technology	Multimedia and Foundation of Animation	2	30
4	Computer Science	Introduction to Computer Programming	2	30
5	Chemistry	Chemistry for Society	2	30
6	Physics	Physics of Daily Life	2	30
7	Information Technology	Introduction to Computer Network	2	30
8	Electronics	Electronic Components	2	30
9	Commerce	Digital Marketing	2	30
10.	Commerce	Introduction to Personal Taxation	2	30
11.	Commerce	Fundamentals of Accounting	2	30

Note: Student can choose any one OE from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG Second Year (Semester III / IV)

Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Humanities and Social Sciences students in Sem.-I& II)

Sr. No.	BoS Proposing SEC	Course Title	Credits	Hrs.
1	Commerce	Financial Management	2	30
2	Analytical Chemistry	Skills In Chemistry	2	30
3	Commerce	Wealth Management	2	30
4	Biotechnology	Good Laboratory Practices	2	30
5	Biotechnology	Dairy Technology	2	30
6	Botany	Herbal Technology	2	30
7	Information technology	Software Development Techniques	2	30
8	Information technology	Information Security	2	30
9	Computer Science	Web Development using WordPress	2	30
10	Electronics	Internet of Things	2	30
11	English	English for Careers	2	30
12	Geography	Disaster Management	2	30
13	Commerce	Business Law	2	30
14	Microbiology	Production of Bio fertilizers	2	30
15	Physics	Applied Optics	2	30
16	Political Science	Political Journalism	2	30
17	Chemistry	Chemistry of Biomolecules	2	30
18	Mathematics	Essential Statistics for Data Science	2	30
19	Information Technology	Android Aap Development	2	30
20	English	English for Competitive Examinations	2	30

Note: Student can choose any one SEC from the basket.

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UG Second Year

Basket III: Ability Enhancement Courses (AEC)

(AEC offered to the Humanities and Social Sciences students in Sem III)

Sr. No.	BoS Proposing AEC	Course Title	Credits	Hrs.
1.	English	English Communication I	2	30
2.	English	English for Professionals III	2	30

Note: Student can choose any one AEC from the basket.

(AEC offered to the Humanities and Social Sciences students in Sem IV)

Sr. No.	BoS Proposing AEC	Course Title	Credits	Hrs.
1.	English	English Communication II	2	30
2.	English	English for Professionals IV	2	30

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UG First Year

Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken Tutorial Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.

4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

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Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs, best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks.