Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

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

Empowered Autonomous Institution

w.e.f. June, 2026

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research) in Chemistry** to be effective from the **Academic Year 2026-27.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: - 13/04/2026

Place: Latur

NEP CELL

Rajarshi Shahu Mahavidyalaya, Latur

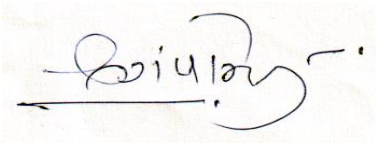
Empowered Autonomous Institution

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 2026-27.**

Date: 11/04/2026

Place: Latur



Prof. Dhananjay Palke

Chairperson
Board of Studies in Chemistry
Rajarshi Shahu Mahavidyalaya, Latur
Empowered Autonomous Institution

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

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	**Dr. Dashrath Munde,** Science College Nanded	Member	V.C. Nominee
3	**Dr. Bapurao Shingate,** Professor, Department of Chemistry, BAMU Chhatrapati Sambhaji Nagar	Member	Academic Council Nominee
4	**Dr. Dipak Dalal,** Professor & Director, KBC NMU, Jalgaon	Member	Academic Council Nominee
5	**Dr. Satish Mitragotri,** Walchand College, Solapur	Member	Expert from outside for Special Course
6	**Dr. Harichandra Parbat** Wilson College, Mumbai	Member	Expert from outside for Special Course
7	**Mr. Amol Bhadule,** Syngene International, Bengaluru	Member	Expert from Industry
8	**Dr. Vinod Jadhav** Aragen Life Sciences, Hyderabad	Member	P.G. Alumni
9	**Dr. K. I. Momin** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
10	**Dr. K. C. Tayade** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member

Sr. No.	Name	Designation	In position
11	**Mr. M. S. Sudewad** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
12	**Mr. A. A. Bhandare** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
13	**Mr. V. M. Dhumal** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
14	**Ms. H. K. Sayyed** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member

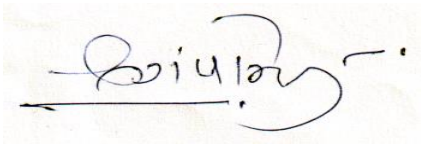
From the Desk of the Chairperson…

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
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

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Empowered Autonomous Institution

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Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Chemistry 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**
I 4.5	I	DSC I: 04 Cr. DSC II: 04 Cr.	NA	NA	GE-I: 04 Cr.	VSC-I: 02 Cr. SEC-I: 02 Cr.	AEC-I MIL: 02 Cr. VEC-I: 02 Cr.	CC-I: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr. (SES-I)/ OJT: 02 Cr. / Mini Project: 02 Cr.	22	44 Cr. UG Certificate
	II	DSCIII: 04 Cr. DSC IV: 04 Cr. (IKS)	NA	NA	GE-II: 04 Cr.	VSC-II: 02 Cr. SEC-II: 02 Cr.	AEC-II MIL: 02 Cr. VEC-II: 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-II: 02 Cr. (SES-II)/ OJT: 02 Cr. / Mini Project: 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. **GE/OE : Generic/Open Elective**
5. **VSEC : Vocational Skill and Skill Enhancement Course**
6. **VSC : Vocational Skill Courses**
7. **SEC : Skill Enhancement Course**
8. **AEC : Ability**
9. **MIL : Modern Indian Languages**
10. **IKS : Indian Knowledge System**
11. **FSRCE : Fostering Social Responsibility & Community Engagement**
12. **VEC : Value Education Courses**
13. **OJT : On Job Training**
14. **FP : Field Projects**
15. **CEP : Community Engagement and Service**
16. **CC : Co-Curricular Courses**
17. **RP : Research Project/Dissertation**
18. **SES : Shahu Extension Services**

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Department of Chemistry and Analytical Chemistry

B.Sc. (Honors/Research) Chemistry

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 4.5	I	101CHE1101 (DSC-I)	Inorganic Chemistry-I	03	45
		101CHE1103	Lab Course-I	01	30
		101CHE1102 (DSC-II)	Organic Chemistry-I	03	45
		101CHE1104	Lab Course-II	01	30
		GE-I	From Basket	04	60
		101CHE1501 (VSC-I)	Systematic Chemistry Laboratory Techniques (SCLT)	02	45
		(SEC-I)	From Basket	02	30
		(AEC-I)	From Basket	02	30
		(VEC-I)	Constitution of India	02	30
		AIPC/OJT-I		02	60
	Total Credits			**22**	
	II	101CHE2101 (DSC-III)	Physical Chemistry-I	03	45
		101CHE2103	Lab Course-III	01	30
		101CHE2102 (DSC-IV)	Inorganic Chemistry -II	03	45
		101CHE2104	Lab Course-IV	01	30
		GE-II	From Basket	04	60
		101CHE2501 (VSC-II)	Analytical Laboratory Techniques	02	45
		(SEC-II)	From Basket	02	30
		(AEC-II)	From Basket	02	30
		(VEC-II)	FSRCE (CBPR)	02	30
		AIPC/OJT-II		02	60
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Programme Outcomes (POs) for B.Sc. Programme	
PO 1	**Core Knowledge in Chemistry** Acquire a comprehensive understanding of fundamental concepts in organic, inorganic, physical, and analytical chemistry
PO 2	**Analytical and Problem-Solving Ability** Develop the ability to apply chemical knowledge to evaluate problems, interpret experimental data, and derive logical conclusions.
PO 3	**Practical Laboratory Competence** Attain proficiency in laboratory techniques, including safe handling of chemicals, use of instruments, and adherence to safety protocols.
PO 4	**Scientific Approach and Methodology** Build skills to design and conduct experiments, systematically collect data, and formulate scientifically valid interpretations.
PO 5	**Application of Modern Tools** Gain experience in using contemporary instruments and digital tools for chemical analysis and research purposes.
PO 6	**Environmental and Sustainability Awareness** Recognize the environmental impact of chemical processes and practice principles of green and sustainable chemistry.
PO 7	**Ethical and Safety Responsibility** Adhere to ethical standards and maintain safety practices in all aspects of chemical experimentation.
PO 8	**Lifelong Learning and Employability** Be equipped for advanced studies and diverse career opportunities in fields such as pharmaceuticals, education, environmental science, and chemical industries.

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	**Advanced Chemical Knowledge** Develop a strong understanding of advanced concepts in organic, inorganic, physical, and analytical chemistry, with the ability to integrate knowledge across these disciplines
PSO 2	**Laboratory and Instrumentation Skills** Acquire proficiency in modern laboratory techniques, including synthesis, purification, qualitative and quantitative analysis, and the operation of advanced analytical instruments.
PSO 3	**Research and Analytical Competence** Demonstrate the ability to design experiments, analyze scientific data, interpret results, and engage in research-oriented and investigative studies.
PSO 4	**Problem Solving and Industrial Application** Apply chemical principles to solve real-world problems in areas such as industry, environmental management, pharmaceuticals, and materials science.
PSO 5	**Sustainability, Ethics, and Safety** Adopt environmentally sustainable practices through green chemistry principles while adhering to professional ethics and laboratory safety standards.
PSO 6	**Career Readiness and Lifelong Learning** Prepare for higher education, competitive examinations, and careers in research, academia, and chemical industries, with a commitment to continuous learning.

Semester - I

Shiv Chhatrapati Shikshan Sanstha's

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Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem I

Course Type: DSC-I
Course Title: Inorganic Chemistry-I
Course Code: 101CHE1101
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 confront students with periodic Properties of s & p block elements
LO 3. To Study the spectral & magnetic Properties of Transition Metals
LO 4. To understand the fundamentals of chemical bonding, including ionic, covalent, and coordinate bonds.

Course Outcomes:

After successful completion of the course, students will be able to:

CO 1. Explain and apply the concepts of electronic configuration, periodicity, and fundamental atomic properties such as ionization energy, electron affinity, and electronegativity.
CO 2. Analyze and compare the properties and chemical behavior of s-block and p-block elements, including their hydrides, oxidation states, and structural features.
CO 3. Interpret and evaluate the characteristic properties of d-block elements, including color, magnetism, oxidation states, and catalytic behavior.
CO 4. Describe and differentiate various types of chemical bonding and acid–base theories, and apply these concepts to explain molecular structure and chemical reactivity.

Unit No.	Title of Unit & Contents	Hrs.
I	**Elements and the periodic Table**	**10**
	1. Electronic configuration: Pauli's exclusion principle, Hund's rule, Aufbau principle and their role in writing the electronic configuration. 2. Periodicity: Periodic law, arrangement of elements in the periodic table period, group, diagonal relationship in the periodic table. 3. General properties of atoms: Size of atoms and ions, atomic radii, ionic radii, covalent radii, trends in Periodic table. 4. Ionization energy: Definition, factors effecting, Inert–pair effect, trends of ionization energy in Periodic table, application to explain the chemical behavior of an atom. 5. Electron affinity: Definition, factors affecting, trends of electron affinity in Periodic table, application to explain the chemical behavior of an atom. 6. Electronegativity: Definition, factors affecting, trends of Electronegativity in Periodic table, application to explain chemical bonding, Numericals Hanny smith equation	
	Unit Outcomes: UO 1. Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity. UO 2. Define Ionization energy, Electron affinity and Electronegativity.	
II	**s and p Block Elements**	**10**
	1. Position of the elements in the periodic table 2. Electronic configuration of elements 3. Hydrides of Alkali & Alkaline earth metals 4. Reducing Properties of S-Block elements 5. Anomalous behavior of first member of group 13 and 14 in P-Block	

Unit No.	Title of Unit & Contents	Hrs.
	elements 6. Atomic and Ionic Size 7. Ionization energy 8. Electronegativity 9. Oxidation state 10. Bonding and shapes of P_4O_{10}, Diamond, Fullerene, Graphite.	
	Unit Outcome: UO 1. Tabulate properties of s & p block elements. UO 2. Identify the different allotropes of carbon.	
III	**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, Colour 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.	
IV	**Chemical Bonding & Acid Base Theories**	**15**
	A) Chemical Bonding 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, numericals, 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-waals forces – Types, Nature and origin of Vander -waals forces. Factors affecting the strength of Vander Waals forces. Application of Vander Waals forces. **B) Acid Base Theories** 1. Lewis acid-base concepts and its limitations. 2.Hard-soft acids and bases (Pearson's classification). 3.HSAB Principle. 4.Lux-Flood and Solvent Concept	
	Unit Outcomes: UO 1. Define Ionic, Covalent and Co-ordinate bond. UO 2. Identify Soft acids and bases & hard acids and bases.	

Learning Resources:

1. Advanced Inorganic Chemistry Satyaprakash, G. D. Tuli, S. K. Basu, R. D. Madan S. Chand Publication 2013
2. Advanced Inorganic Chemistry Gurudeep Raj, Chatwal Anand Goel Publishing House 1974
3. Concepts and Models of Inorganic Chemistry Bodie Douglas, Darl McDaniel Wiley 1983
4. Concise Inorganic Chemistry (5th Edition) J. D. Lee Wiley 2008
5. Inorganic Chemistry J. E. Huheey, E. A. Keiter, R. L. Keiter Pearson 1993
6. Inorganic Chemistry (3rd Edition) Wilkinson, Cotton Wiley 1999
7. Inorganic Chemistry (5th Edition) Duward Shriver, P. W. Atkins Oxford University Press 2002
8. Modern Inorganic Chemistry W. L. Jolly McGraw Hill Book Company 1984
9. Textbook of Inorganic Chemistry Puri, Sharma, Kalia Milestone Publications 2017

Internal Examination Pattern:

CAT – I : Assignments

CAT – II : PPT Presentation/ Online quiz

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	–	1	–	–	–	1	3	–	1	–	–	1
CO2	3	3	–	2	–	1	–	1	3	–	2	2	1	1
CO3	3	3	1	2	2	–	–	1	3	2	3	2	–	1
CO4	3	2	–	2	–	–	–	1	3	–	2	2	–	1

Scale : 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation

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Faculty of Science & Technology
Department of Chemistry and Analytical Chemistry
UG I Sem I

Course Type: DSC
Course Title: Lab Course –I (Based on DSC-I)
Course Code: 101CHE1103
Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To prepare standard solutions and perform accurate titrations using proper laboratory techniques.
LO 2. To estimate the amount of substance / ions in given mixture by volumetrically.
LO 3. To differentiate and estimate ions (Fe^{2+}/Fe^{3+}, Cu^{2+}, etc.) using suitable redox and iodometric methods.
LO 4. To analyze qualitatively two acidic and two basic radicals.

Course outcomes

After completion of course the student will be able to-

CO 1. Prepare and standardize solutions such as Na_2CO_3, HCl, and $K_2Cr_2O_7$, and apply them in quantitative chemical analysis.
CO 2. Analyze the two acidic and two basic radicals qualitatively
CO 3. Estimate the amount of substances in given mixture by volumetric methods.
CO 4. Investigate and identify acidic and basic radicals in inorganic mixtures

Practical No.	Unit
1	Prepare standard Na_2CO_3 solution. Standardize the given HCl solution and estimate the amount of NaOH in the given solution.
2	Estimate the amount of NaOH and Na_2CO_3 in the given mixture using standard HCl solution.
3	Estimate the amount of Fe^{++} and Fe^{+++} separately in the given mixture using standard $K_2Cr_2O_7$ solution.
4	Estimate the amount of Cu^{++} in the given solution using standard $Na_2S_2O_3$ solution.
5	Find out the strength of supplied $AgNO_3$ solution using standard $AgNO_3$ solution. NH_4SCN as link solution (Volhard's method).
6	Find out the strength of supplied NaCl solution using standard NaCl and $AgNO_3$ as link solution (Mohr's method).
7	**Inorganic Qualitative analysis** Qualitative analysis with two acidic radicals and two basic radicals in the form of mixture **(Minimum five mixtures)** containing one interfering radical: **Acidic radicals:** Carbonate, Chloride, Bromide, Iodide, Nitrate, Sulphate. **Basic radicals:** Copper, Bismuth, Ferric, Aluminum, Manganese, Nickel, Zinc, Barium, Calcium, Magnesium, Ammonium, Potassium.

N.B.: Any Ten Practicals from above.

Learning Resources

1. Analytical Chemistry Practical Manual R. T. Sane, S. A. Pishawikar Nirali Prakashan, Pune 2010
2. Quantitative Analysis R. A. Day, A. L. Underwood Prentice Hall of India 2001
3. Senior Practical Physical Chemistry (relevant volumetric sections) B. D. Khosla, V. C. Garg, A. Gulati R. Chand & Co., New Delhi 2006
4. Textbook of Quantitative Chemical Analysis A. I. Vogel Pearson Education India2000
5. Textbook of Quantitative Inorganic Analysis J. Bassett, R. C. Denney, G. H. Jeffery, J. Mendham ELBS / Longman 1989

6. Textbook of Quantitative Inorganic Analysis I. M. Kolthoff, E. B. Sandell CBS Publishers (India reprint available) 1973
7. Vogel's Textbook of Quantitative Chemical Analysis G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney Pearson Education 2000

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	2	1	–	3	1	3	3	2	2	2	1
CO2	3	3	3	2	–	–	3	1	3	3	3	2	2	1
CO3	3	3	3	2	1	–	3	1	3	3	3	3	2	1
CO4	3	3	3	3	1	–	3	1	3	3	3	3	2	1

Scale : 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation

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Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem I

Course Type: DSC - II

Course Title: Organic Chemistry - I

Course Code: 101CHE1102

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To define the fundamental concepts of organic chemistry, nomenclature, and reaction mechanisms.
LO 2. To classify organic compounds based on functional groups and structural features.
LO 3. To apply principles of reaction mechanisms and effects to predict chemical behavior.
LO 4. To analyze the formation, stability, and reactivity of hydrocarbons and related compounds.

Course Outcomes:

After successful completion of the course, students will be able to:

CO 1. Apply and illustrate IUPAC nomenclature rules to represent the structure of organic compounds accurately.
CO 2. Analyze and interpret organic reaction mechanisms, including the role of reactive intermediates.
CO 3. Examine and differentiate preparation methods and chemical properties of hydrocarbons and halogen compounds.
CO 4. Evaluate and interpret the chemical nature and analytical parameters of fats and oils.

Unit No.	Title of Unit & Contents	Hrs.
I	**Nomenclature of Organic Compounds & Introduction to Reaction Mechanism**	**11**
	1. Development of organic chemistry, unique properties of organic compound. 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. 3. Substrate and Reagents, Electrophiles & Nucleophiles. 4. Homolytic and Heterolytic bond fission. 5. Inductive effect & itsTypes, Mesomeric Effect, Hyperconjugation & Steric effect . 6. Formation and Stability of reactive intermediates: Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes & Arynes 7. Types of organic reactions: Substitution, Addition, Elimination and Rearrangement.	
	Unit Outcomes: Student will be able to- UO 1. Describe nomenclature rules and classification of organic compounds. UO2. Differentiate types of reactions, intermediates, and electronic effects.	
II	**Hydrocarbons – I**	**12**
	1. Alkanes: Introduction, Methods of formation of alkanes by i. Kolbe's electrolytic method	

Unit No.	Title of Unit & Contents	Hrs.
	ii.Frankland reaction Chemical Properties: halogenation (mechanism), nitration (mechanism). **2. Cycloalkanes:** Introduction, Formation of cycloalkanes by Freund's method Concept of angle strain, stability and reactivity of cycloalkanes: Bayer's strain theory. Ring opening reaction with H_2 & HI. **3. Alkenes**: Introduction Methods of formation by: 1) dehydration of alcohols (with mechanism) 2) dehydrohalogenation of alkyl halides (with mechanism).Chemical Reactions: (with mechanism) 3) Electrophilic addition of Br_2 to ethane. Free radical addition of HBr to propene (Peroxide effect)	
	Unit Outcome: Student will be able to- UO 1. Explain preparation methods and mechanisms of alkanes, cycloalkanes, and alkenes. UO2. Demonstrate reaction mechanisms involved in substitution and addition reactions.	
III	**Hydrocarbons - II**	**11**
	1. Dienes: a. Introduction & classification of dienes b. Resonance & M.O. structure of 1, 3 – butadiene c. Formation of 1, 3 – butadiene from 1, 4 – butanediol d. Chemical properties: i. Addition of H_2& H_2O on 1,3-butadiene ii. Diels – Alder reaction **2. 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) **3.Benzene:** a. Introduction b. Characteristics of aromatic compounds. c. Kekule structure d. Stability of benzene: resonance and molecular orbital structure of benzene e. Modern theory of aromaticity. f. Huckel's rule & its applications to benzene, naphthalene, Anthracene, furan, pyrrole, pyridine, thiophene, cyclohexene, cyclooctatetrene, cyclopropene, cylclopropenyl cation and cyclopentadienyl anion and	

Unit No.	Title of Unit & Contents	Hrs.
	antiaromaticity. g. Reactions of benzene - Electrophilic substitution reactions (with mechanism), nitration, halogenation, sulphonation, Friedal-craft alkylation and acylation.	
	Unit Outcomes: Student will be able to- UO 1. Discuss structure, stability, and reactions of dienes, alkynes, and benzene. UO2. Correlate aromaticity and reactivity using resonance and Huckel's rule.	
IV	**Halogen Compounds, Fats & Oils**	**11**
	1. Vinyl Chloride: a. Introduction b. Structure- Molecular orbital & Resonance c. Methods of formation of vinyl chloride from: i. Ethene ii. Ethylene dichloride iii.Ethyne. d. Physical properties of vinyl chloride Chemical Reactions of vinyl Chloride: Addition reactions with $Br_2$and HBr. **2. Halo Arenes:** a. Introduction structure and stability of chlorobenzene b. Synthesis of chlorobenzene from: i. Hunsdiecker reaction ii. Gattermann reaction c. Chemical reactions of chlorobenzene: i. Electrophilic substitution reactions ii. Nucleophilic reactions **3. Oils & Fats:** a. Introduction b. Chemical nature c. General chemical properties: i. Hydrolysis **4. Analysis of Fats and Oils:** Saponification number(Saponification value),Iodine number (Iodine value),Acid value	
	Unit Outcomes: Student will be able to- UO 1. Outline synthesis, structure, and reactions of vinyl chloride and haloarenes. UO2. Determine analytical values and chemical properties of fats and oils.	

Learning Resources:

1. A Guidebook to Mechanism in Organic Chemistry – Peter Sykes – Pearson Education – 2003
2. Advanced Organic Chemistry – Arun Bahl, B. S. Bahl – S. Chand Publishing – 2016
3. Advanced Organic Chemistry: Reactions, Mechanisms and Structure – Jerry March – Wiley – 2007
4. Basic Organic Chemistry – Paula Yurkanis Bruice – Pearson Education – 2014
5. Fundamentals of Organic Chemistry – T. W. Graham Solomons – Wiley – 2013
6. Modern Organic Chemistry – M. K. Jain, S. C. Sharma – Vishal Publishing – 2014
7. Name Reactions in Organic Chemistry – V. K. Ahluwalia, R. K. Parashar – Narosa Publishing House – 2010
8. Organic Chemistry – I. L. Finar – Pearson Education – 2005
9. Organic Chemistry – Jonathan Clayden, Nick Greeves, Stuart Warren – Oxford University Press – 2012
10. Organic Chemistry – Morrison and Boyd – Pearson Education – 2010
11. Organic Chemistry – Paula Yurkanis Bruice – Pearson Education – 2016
12. Organic Chemistry – R. T. Morrison, R. N. Boyd – Pearson – 2011
13. Organic Chemistry – R. K. Gupta – Krishna Prakashan Media – 2018
14. Organic Chemistry – T. W. Graham Solomons, Craig B. Fryhle – Wiley – 2011
15. Principles of Organic Chemistry – P. Y. Bruice – Pearson Education – 2013

Internal Examination Pattern:

CAT – I: Home assignment

CAT – II: Seminar with PPT Presentation

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	–	1	–	–	–	1	3	–	1	–	–	1
CO2	3	3	–	2	–	–	–	1	3	–	3	2	–	1
CO3	3	3	–	2	–	1	–	1	3	–	2	2	1	1
CO4	3	3	1	2	1	2	–	1	3	2	3	3	2	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem I

Course Type: DSC

Course Title: Lab Course –II (Based on DSC-II)

Course Code: 101CHE1104

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

Learning Objectives:

LO 1. To identify and classify organic compounds based on their nature, functional groups, and physical constants.
LO 2. To demonstrate various purification techniques such as recrystallization, sublimation, and distillation for organic compounds.
LO 3. To perform organic synthesis reactions using standard laboratory procedures.
LO 4. To analyze the purity and yield of synthesized and purified organic compounds.

Course Outcomes:

After completion of the course the students will be able to-

CO 1. Determine the nature and functional groups of unknown organic compounds using systematic qualitative analysis.
CO 2. Execute different purification methods effectively and select suitable techniques based on the properties of compounds.
CO 3. Synthesize organic compounds following proper laboratory techniques, safety measures, and reaction mechanisms.
CO 4. Interpret experimental results, including yield, purity, and physical constants, to draw valid scientific conclusions.

Practical No.	Unit	30 Hrs
1	**A)** Determine the Nature, functional group and physical constant of organic compounds: β -naphthol, benzaldehyde, benzoic acid, p-nitroaniline, acetanilide, nitrobenzene, ethylalcohol and aniline.	
2	**B)** Methods of Purification of organic compounds: a) Recrystallization: Benzoic acid, β–naphthol, cinnamic acid, m–nitroaniline and acetanilide b) Sublimation: Naphthalene, camphor. c) Simple distillation: (any one) i) Separate ethanol & water from mixture ii) Separate acetone & water from mixture	
3	**Organic preparations :** a)Preparation of phthalic anhydride b) Preparation of Phthalimide c) Preparation of Acetanilide d) Preparation of Dibromo Cinnamic acid e) Preparation of benzamide.	

Learning Resources:

1. Advanced Practical Organic Chemistry – N. K. Vishnoi, Vikas Publishing House Pvt. Ltd., 2012.
2. Experimental Organic Chemistry – A. I. Vogel, Longman Group Ltd., 1996.
3. Experimental Organic Chemistry: Principles and Practice – L. M. Harwood and C. J. Moody, Blackwell Scientific Publications, 1989.

4. Laboratory Manual of Organic Chemistry – Raj K. Bansal, New Age International Publishers, 2010.
5. Practical Organic Chemistry – F. G. Mann and B. C. Saunders, Pearson Education, 2009.
6. Practical Organic Chemistry – O. P. Agarwal, Krishna Prakashan Media Pvt. Ltd., 2014.
7. Textbook of Practical Organic Chemistry – Arun Sethi, New Age International Publishers, 2006.

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	1	–	3	1	3	3	3	2	2	1
CO2	3	2	3	2	1	–	3	1	3	3	2	2	2	1
CO3	3	3	3	3	1	–	3	1	3	3	3	3	2	1
CO4	3	3	3	3	1	–	3	1	3	3	3	3	2	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem I

Course Type: VSC-I

Course Title: Systematic Chemistry Laboratory Techniques - I

Course Code: 101CHE1501

Credits: 02 (T=1+ P=1) **Max. Marks: 50** **Lectures: 15 Hrs.**

Learning Objectives:

LO 1. To identify laboratory infrastructure, safety measures, and standard operating procedures.

LO 2. To recognize various laboratory apparatus and their specific functions.

LO 3. To calculate concentrations of solutions using different units and expressions.

LO 4. To prepare standard and working solutions with appropriate accuracy and precision.

Course Outcomes:

After completion of the course the students will be able to-

CO 1. Outline laboratory design, safety rules, and maintenance practices.

CO 2. Distinguish between different types of laboratory apparatus and their uses.

CO 3. Solve numerical problems related to concentration units and conversions.

CO 4. Execute correct procedures for preparation of solutions in laboratory settings.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction of Chemistry Lab**	**04**
	1. General introduction of chemistry laboratory, common instruction for safe working in chemical laboratories. 2. Lab design, Storage, ventilation, lighting, fume, cupboard, arrangement of store, Safety provisions, 3. Organization of practical work, 4. Maintenance of laboratory, equipment/apparatus, cleaning of laboratories and preparation room.	
	Unit Outcomes: Student will be able to- UO 1. Describe laboratory layout, safety guidelines, and organizational practices. UO2. Demonstrate proper maintenance and handling of laboratory facilities.	
II	**Introduction of Lab Apparatus**	**03**
	1. Glass apparatus- Beaker, Test tube, boiling tube, funnel, separating funnel, filtration flask, round bottom flask, flat bottom flask, condenser, Liebig flask, watch glass, measuring cylinder, condenser, petri dish, desiccators etc., Handling and storage of glass apparatus. 2. Volumetric Apparatus - Measuring cylinder, burette, pipette, volumetric flask, etc. 3. Miscellaneous apparatus- Buchner funnel, Bunsen burner, burette stand, china dish, wire gauze, filter pumps, crucible, Mohr's clip, clay pipe triangle, pestle and mortar, sprit lamp, spatulas, thermometer. 4. Apparatus for heating: Bunsen burner, water bath, oil bath hot plate, sand bath, hot air oven, heating mantle etc.	
	Unit Outcomes: Student will be able to- UO 1. Classify laboratory apparatus based on function and application.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Operate common glassware and heating devices safely and effectively.	
III	**Concentration and its units**	**04**
	1. Concentration of solution, methods of expressing concentration of solution 2. Percent by mass, percent by volume, molarity, molality, normality, formality, Numerical 3. Mole fraction, parts per thousand (ppt), parts per million (ppm) and parts per billion (ppb), Numerical	
	Unit Outcomes: Student will be able to- UO 1. Explain different units of concentration and their significance. UO2. Determine concentration values through numerical calculations.	
IV	**Solution Preparation**	**04**
	1. Introduction: Solutions, components of a solution. 2. Types of solution, solubility 3. Concentration of bulk solutions used in the laboratory and preparation of standard Solutions from them. 4. Calculation of masses and volumes for preparation of solutions solids, liquids.	
	Unit Outcomes: Student will be able to- UO 1. Summarize principles of solution formation and solubility. UO2. Formulate laboratory solutions using correct calculations of mass and volume.	

Learning Resources:

1. Advanced Practical Chemistry – Jagdamba Singh – Pragati Prakashan – 2012
2. Basic Laboratory Methods for Biotechnology – Lisa A. Seidman, Cynthia J. Moore – Pearson – 2000
3. Experimental Physical Chemistry – V. D. Athawale, P. Mathur – New Age International – 2001
4. Handbook of Chemistry Laboratory Safety – N. V. Krishnamurthy – Universities Press – 2007
5. Introduction to Practical Chemistry – Satya Prakash, D. Keerthi Kumar – S. Chand Publishing – 2015
6. Laboratory Manual in Chemistry – R. K. Gupta – Krishna Prakashan Media – 2018
7. Practical Chemistry – O. P. Agarwal – Goel Publishing House – 2014
8. Practical Chemistry – G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney – Pearson – 1989
9. Practical Organic Chemistry – F. G. Mann, B. C. Saunders – Pearson – 2009
10. Practical Physical Chemistry – A. M. James, F. E. Prichard – Longman – 1974
11. Quantitative Chemical Analysis – Daniel C. Harris – W. H. Freeman – 2010
12. Textbook of Practical Chemistry – Y. R. Sharma – Macmillan India – 2011
13. Vogel's Textbook of Practical Organic Chemistry – A. I. Vogel – Pearson – 2008
14. Vogel's Textbook of Quantitative Chemical Analysis – A. I. Vogel – Pearson – 2000
15. Working in the Chemical Laboratory – J. A. Beran – Wiley – 2010

Internal Examination Pattern:

CAT – I: Home assignment

CAT – II: Seminar with PPT Presentation

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	1	3	2	1	–	3	1	2	3	2	1	3	1
CO2	3	2	3	2	1	–	2	1	3	3	2	1	2	1
CO3	3	3	2	2	1	–	1	1	3	2	3	2	1	1
CO4	3	2	3	3	1	–	3	1	3	3	3	2	2	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

Semester - II

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science & Technology
Department of Chemistry and Analytical Chemistry
UG I Sem II

Course Type: DSC - III

Course Title: Physical Chemistry - I

Course Code: 101CHE2101

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To apply mathematical relations and laws to solve numerical problems in physical chemistry.
LO 2. To analyze the behavior of matter under different physical conditions using theoretical models.
LO 3. To explain the principles governing gaseous, liquid, and solid states along with their properties.
LO 4. To evaluate the significance of physical properties in real world chemical systems.

Course Outcomes:

After completion of the course the students will be able to-

CO 1. Explain and illustrate atomic models and quantum mechanical principles, and discuss their implications in chemistry.
CO 2. Interpret and apply gas laws, kinetic theory, and deviations from ideal behavior in real systems.
CO 3. Describe and apply experimental methods for determining the physical properties of liquids.
CO 4. Analyze and differentiate crystal structures, crystal defects, and their influence on material properties.

Unit No.	Title of Unit & Contents	Hrs.
I	**Atomic Structure**	**11**
	1. Introduction to Atomic Structure Overview of the atom, fundamental concepts, historical development of atomic theories, and the discovery and properties of subatomic particles. **2. Bohr's Atomic Model** Postulates of Bohr's model; derivation of the radius and energy of electron orbits; atomic spectra; application to the hydrogen spectrum; limitations of the model; numerical problems related to orbital radius and energy. **3. Planck's Quantum Theory** Principles of quantum theory of radiation, including relevant numerical applications. **4. Compton and Photoelectric Effects** Explanation of the Compton effect and photoelectric effect based on quantum theory, along with associated numerical problems. **5. de Broglie Hypothesis** Concept of matter waves; derivation of the de Broglie equation; numerical problems. **6. Heisenberg's Uncertainty Principle** Statement and significance of the principle, with related numerical applications. **7. Orbits, Orbitals, and Quantum Numbers** Distinction between orbits and orbitals; types of quantum numbers, their significance, and applications.	
	Unit Outcomes: Student will be able to- UO 1. Summarize the development of atomic theories and quantum	

Unit No.	Title of Unit & Contents	Hrs.
	concepts. UO2. Compute parameters such as energy, wavelength, and uncertainty using relevant equations.	
II	**Gaseous State**	**11**
	1. **Introduction to Gases and Gas Laws** Study of physical properties of gases and fundamental gas laws. 2. **Kinetic Molecular Theory of Gases** Postulates of kinetic theory; derivation of the kinetic gas equation and its significance. 3. **Real and Ideal Gases** Comparison of ideal and real gases; deviation from ideal behavior; compressibility factor (Z); explanation of non-ideal behavior using Van der Waals equation; related numerical problems. 4. **Critical Phenomena** Andrew's isotherms of carbon dioxide; application of Van der Waals equation to explain real gas behavior; relationship between critical constants and Van der Waals constants; numerical problems based on these relations. 5. **Equations of State** Concept and significance of equations of state in describing gas behavior. **Molecular Velocities** Types of molecular velocities: root mean square (RMS), average, and most probable velocity; derivations and numerical problems.	
	Unit Outcome: Student will be able to- UO 1. Discuss gas laws and kinetic molecular theory concepts. UO2. Examine real gas behavior and critical phenomena using equations of state.	
III	**Liquid State**	**11**
	1. **Introduction to Liquids** Overview of intermolecular forces and molecular interactions present in liquids. 2. **Physical Properties of Liquids** Study of the general physical characteristics and behavior of liquids. 3. **Vapour Pressure** Definition, units, and effect of temperature on vapour pressure; determination by static and dynamic methods; relationship between vapour pressure and boiling point; numerical problems. 4. **Surface Tension** Definition, units, and temperature dependence; determination using a stalagmometer (drop number method); numerical problems. 5. **Viscosity** Definition, units, and effect of temperature; measurement using Ostwald's viscometer; numerical problems. 6. **Refractive Index** Concept of specific and molar refraction; determination of refractive index; numerical problems.	
	Unit Outcomes: Student will be able to- UO 1.Outline intermolecular forces and physical properties of liquids. UO2. Determine viscosity, surface tension, and vapour pressure through experimental relations.	
IV	**Solid State**	**12**
	1. **Introduction to Solids** Study of the physical properties of solids. 2. **Classification of Solids** Types of solids; concept of isotropy and anisotropy. 3. **Crystals and Crystal Habit** Crystal habit and symmetry elements of crystals. 4. **Crystal Structure and Lattices** Concept of crystal structure, space lattice, unit cell, and the seven Bravais lattices.	

Unit No.	Title of Unit & Contents	Hrs.
	5. **Cubic Crystal Systems** Types of cubic systems: simple cubic, body-centered cubic (BCC), and face-centered cubic (FCC), with suitable examples. 6. **Metal Crystal Structures** Close-packed structures in metals: hexagonal close packing (HCP) and cubic close packing (CCP). 7. **Crystallography Laws** Fundamental laws of crystallography: a) Law of constancy of interfacial angles b) Law of rational indices c) Law of symmetry 8. **Crystal Indices** Weiss and Miller indices; numerical problems based on crystal planes and directions. 9. **X-ray Diffraction** Diffraction of X-rays by crystals; derivation of Bragg's equation. 10. **Crystal Defects** Types of defects: vacancy defects, interstitial defects, and impurity defects. 11. **Semiconductors and Liquid Crystals** Types, properties, and applications of semiconductors and liquid crystals.	
	Unit Outcomes: Student will be able to- UO 1. Classify solids based on structure and properties. UO2. Correlate crystal structures, defects, and diffraction patterns with material behavior.	

Learning Resources:

1. Advanced Physical Chemistry – Gurdeep Raj – Goel Publishing House – 2014
2. Concepts of Modern Physics – Arthur Beiser – McGraw-Hill Education – 2003
3. Essentials of Physical Chemistry – B. S. Bahl, G. D. Tuli, Arun Bahl – S. Chand Publishing – 2017
4. Fundamentals of Molecular Spectroscopy – C. N. Banwell, E. M. McCash – McGraw-Hill Education – 1994
5. Introduction to Solid State Physics – Charles Kittel – Wiley India – 2005
6. Physical Chemistry – P. W. Atkins, Julio de Paula – Oxford University Press – 2014
7. Physical Chemistry – G. M. Barrow – McGraw-Hill – 1996
8. Physical Chemistry – K. L. Kapoor – Macmillan India – 2012
9. Physical Chemistry – P. C. Rakshit – Sarat Book House – 2010
10. Physical Chemistry – R. P. Rastogi, R. R. Misra – New Age International – 2001
11. Physical Chemistry: A Molecular Approach – Donald A. McQuarrie, John D. Simon – Viva Books – 2008
12. Solid State Chemistry and Its Applications – Anthony R. West – Wiley India – 2007
13. Textbook of Physical Chemistry – Samuel Glasstone – Macmillan India – 2007

Internal Examination Pattern:

CAT – I: Home assignment

CAT – II: Seminar with PPT Presentation

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	–	2	–	–	–	1	3	–	2	–	–	1
CO2	3	3	–	2	–	1	–	1	3	–	3	2	1	1
CO3	3	3	3	3	2	–	2	1	3	3	3	3	2	1
CO4	3	3	2	3	1	2	–	1	3	2	3	3	2	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

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Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem II

Course Type: DSC

Course Title: Lab Course –III (Based on DSC-III)

Course Code: 101CHE2103

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

Learning Objectives:

LO 1. To explain the principles of precipitation, surface tension, viscosity, kinetics, and refractive index involved in laboratory experiments.

LO 2. To demonstrate the preparation of inorganic compounds, buffer solutions, and execution of physico-chemical measurements using standard apparatus.

LO 3. To analyze experimental data to evaluate properties such as viscosity, interfacial tension, heat of reaction, and rate constants.

LO 4. To interpret results to establish relationships between concentration, composition, and physical/chemical properties of systems.

Course Outcomes:

After completion of the course the students will be able to-

CO 1. Perform quantitative and qualitative experiments involving synthesis, titration, and physico-chemical measurements with accuracy.

CO 2. Differentiate the effects of electrolytes, solvents, and concentration on precipitation, buffer action, and interfacial phenomena.

CO 3. Calculate physicochemical parameters such as equivalent weight, surface tension, viscosity, rate constants, and molar refraction using experimental data.

CO 4. Evaluate experimental findings to draw scientific conclusions and relate them to theoretical concepts in chemistry.

Practical No.	Unit
1	Prepare As_2S_3 from As_2O_3 and compare the precipitation power of NaCl and $MgCl_2$.
2	Determine the surface tension of a given liquid by using Stalagmometer/Tensiometer.
3	Determination of interfacial tension between two immiscible liquids (Benzene and Water).
4	Determine the heat of reaction of displacement of copper by zinc.
5	Determine the equivalent weight of magnesium by using Eudiometer.
6	Prepare buffer solutions of different pH values i) Sodium acetate-acetic acid ii) Ammonium chloride-ammonium hydroxide
7	Determine the viscosity of given liquid by using Oswald's viscometer.
8	Determine 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 given) [Any two liquids from: Acetone, CCl_4, Chloroform, Ethyl

	Alcohol. Benzyl alcohol, Ethylene glycol and n-propyl alcohol].
9	Study the variation of viscosity with different concentration of sugar Solutions.
10	Study the kinetics of hydrolysis of methyl acetate in presence of HCl.
11	Determine the refractive index of given liquids & calculate Molar refractions. using Abbes refractometer

Learning Resources:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing House, Meerut, 2000
2. College Practical Chemistry, V. K. Ahluwalia, Sunita Dhingra & Adarsh Gulati, Universities Press,, Hyderabad, 2005
3. Concise Inorganic Chemistry, J. D. Lee, Wiley India Pvt. Ltd., New Delhi, 2010
4. Elements of Physical Chemistry, Samuel Glasstone & David Lewis, Macmillan India Ltd., New Delhi, 1960
5. Experimental Physical Chemistry, R. C. Das & B. Behera, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1983
6. Fundamentals of Analytical Chemistry, Douglas A. Skoog, Donald M. West, F. James Holler & Stanley R. Crouch, Cengage Learning India Pvt. Ltd., New Delhi, 2014
7. Instrumental Methods of Chemical Analysis, Gurdeep R. Chatwal & Sham K. Anand, Himalaya Publishing House, Mumbai, 2007
8. Physical Chemistry, P. W. Atkins & Julio de Paula, Oxford University Press, New Delhi, 2014
9. Practical Chemistry, O. P. Pandey, D. N. Bajpai & S. Giri, S. Chand & Company Ltd., New Delhi, 2009
10. Practical Physical Chemistry, B. D. Khosla, V. C. Garg & A. Gulati, R. Chand & Company, New Delhi, 2008
11. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma & M. S. Pathania, Vishal Publishing Co., Jalandhar, 2017
12. Senior Practical Physical Chemistry, B. D. Khosla, R. Chand & Company, New Delhi, 2011
13. Textbook of Practical Chemistry, A. I. Vogel, Pearson Education India, New Delhi, 2012
14. University Practical Chemistry, C. N. R. Rao & K. Gopalakrishnan, Universities Press, Hyderabad, 1986
15. Vogel's Textbook of Quantitative Chemical Analysis, G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, Pearson Education India, New Delhi, 2000

Internal Examination Pattern:

CAT – I: Home assignment
CAT – II: Seminar with PPT Presentation

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	2	2	–	3	1	3	3	2	2	2	1
CO2	3	3	2	2	1	2	1	1	3	2	3	2	2	1
CO3	3	3	2	3	1	–	1	1	3	2	3	3	1	1
CO4	3	3	3	3	1	–	2	1	3	3	3	3	2	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

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Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem II

Course Type: DSC-IV
Course Title: Inorganic Chemistry-II
Course Code: 101CHE2102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives

LO 1. To Learn the properties of Lanthanides and Actinides
LO 2. To know the reactivity of Noble gases
LO 3. To study Principle and Theory of Volumetric Analysis involving Acid and Base
LO 4. To understand Oxidation – Reduction process and types of corrosion.

Course outcomes

After completion of course the student will be able to-

CO 1. Compare lanthanides and actinides in terms of their chemical properties, complex formation, and reactivity,
CO 2. Describe the reactivity of Noble gases
CO 3. Comprehend the principle of Volumetric analysis
CO 4. Determine oxidation state and concept of corrosion-passivity.

Unit No.	Title of Unit & Contents	Hrs.
I	**F-Block Elements**	**15**
	A) Lanthanides: 1.Definition, position in periodic table 2.Electronic configuration 3.Oxidation states 4. Ionic radii and Lanthanide contraction & its consequences 5.Color of ions 6.Magnetic properties, Oxidation potential. 7. Complexing ability, Important minerals of lanthanides, 8.Separation of lanthanides by ion exchange method. 9.Uses of lanthanides. **B) Actinides:** 1. Definition, position in periodic table. 2. Occurrence of actinides, electronic configuration. 3.Oxidation states 4.IUPAC nomenclature of supra heavy elements with atomic number greater than 100. 5.Uses of Actinides Comparison between Lanthanides and Actinides.	
	Unit Outcomes: UO 1.Write the electronic configurations, oxidation states and periodic trends of lanthanides and actinides. UO 2. Compare lanthanides and actinides in terms of reactivity, magnetic and spectral properties.	
II	**Chemistry of Noble Gases**	**10**
	1.Introduction 2.Position in the periodic table 3.Isolation 4. Compounds of Inert Gases 5.Uses of Noble Gases	
	Unit Outcomes: UO.1 Describe the reactivity of Noble gases.	

Unit No.	Title of Unit & Contents	Hrs.
	UO 2. Explain different chemical bonds and van der Waals forces, properties, preparation and structure of different inert gases.	
III	**Principles involved in volumetric Analysis:**	**10**
	1. Definition of terms: Titrant, standard titrant, titrand, analyte, end point and equivalence point, indicator and titration. 2.Types of titrations: **i) Acid-base titration:** Theory of acid base indicators, Theory of acid-base titration, titration of strong acid-strong base, weak acid-strong base, strong acid-weak base with titration curve and choice of indicators. **II) Redox Titration:** Theoretical basis of volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine and theory of indicators. **III) Precipitation titration:** Titration curve for precipitation reaction, end point detection, Mohr's method and Volhard's method and theory of adsorption indicators. **IV) Complexometric Titration:** Theory of complexometric titration, indicators for EDTA titration, Types of EDTA titration direct and back titration and Theory of metal ion indicators	
	Unit Outcome: UO.1: Able to define Redox, Precipitation and Complexometric Titration UO.2: Able to explain Basic Terms in volumetric analysis	
IV	**Oxidation-Reduction and Corrosion-Passivity**	**10**
	A) Oxidation-Reduction 1.Definition of oxidation, reduction, oxidizing agent and reducing agents according to electronic concept 2. Definition of oxidation, reduction, oxidizing agent and reducing agents according to oxidation number concept. 3. Rules for assigning oxidation number. 4 Balancing of redox reaction by 1) Ion – electron method and 2) Oxidation number method. **B) Corrosion-Passivity:** 1.Definition of corrosion of metal 2.Types of corrosion – i) Atmospheric ii) Immersed 3Theory of corrosion – Electrochemical theory 4 Factors affecting corrosion : i) Position of metal in electro chemical series ii) Purity of metal iii) Effect of moisture iv) Effect of oxygen v) Effect of pH 5 Methods of prevention of corrosion of metals: i) Purification of metal ii) Alloy formation iii) Making metal cathodic. **Passivity:** Definition Theories of Passivity: i) Oxide film theory ii) Gaseous film theory	
	Unit Outcomes: UO1. Can find out the oxidation number of various elements. UO2.Understand about types of corrosion, theory of corrosion, factors affecting on corrosion	

Learning Resources:

1. Advanced Inorganic Chemistry – F. A. Cotton & G. Wilkinson – Wiley India Pvt. Ltd., New Delhi – 1999
2. Analytical Chemistry – Gary D. Christian, P. K. Dasgupta & Kevin Schug – Wiley India Pvt. Ltd., New Delhi – 2013
3. Basic Concepts of Analytical Chemistry – S. M. Khopkar – New Age International Publishers, New Delhi – 2008
4. Concise Inorganic Chemistry – J. D. Lee – Wiley India Pvt. Ltd., New Delhi – 2010
5. Engineering Chemistry – P. C. Jain & Monica Jain – Dhanpat Rai Publishing Company, New Delhi – 2012
6. Fundamentals of Analytical Chemistry – D. A. Skoog, D. M. West & F. J. Holler – Saunders College Publishing – 1996
7. Inorganic Chemistry – J. E. Huheey, E. A. Keiter & R. L. Keiter – Pearson Education, New Delhi – 2006
8. Inorganic Chemistry – H. C. Khera – Pragati Prakashan, Meerut – 2004
9. Inorganic Chemistry – Shriver & Atkins – Oxford University Press, New Delhi – 2010
10. Modern Approach to Inorganic Chemistry – R. D. Madan – S. Chand & Company Ltd., New Delhi – 2011
11. Modern Analytical Chemistry – W. F. Pickering – Marcel Dekker Inc., New York – 1976
12. Principles of Inorganic Chemistry – B. R. Puri, L. R. Sharma & K. C. Kalia – Vishal Publishing Co., Jalandhar – 2017
13. Principles of Instrumental Analysis – D. A. Skoog, F. J. Holler & S. R. Crouch – Cengage Learning India Pvt. Ltd., New Delhi – 2014
14. Textbook of Quantitative Chemical Analysis – A. I. Vogel – Pearson Education India, New Delhi – 2012
15. University Chemistry – B. H. Mahan – Narosa Publishing House, New Delhi – 2009

Internal Examination Pattern:

CAT – I: Home assignment
CAT – II: Seminar with PPT Presentation

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	–	2	–	1	–	1	3	–	2	2	1	1
CO2	3	2	–	1	–	1	–	1	3	–	1	1	1	1
CO3	3	3	3	3	1	–	2	1	3	3	3	3	2	1
CO4	3	3	2	2	1	3	2	1	3	2	3	3	3	1

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem II

Course Type: DSC
Course Title: Lab Course –IV (Based on DSC-IV)
Course Code: 101CHE2104
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives:

LO 1. Understand the principles and procedures of volumetric analysis, including acid–base, redox, precipitation, and complexometric titrations.
LO 2. Develop skills in preparation, standardization, and handling of standard solutions and reagents used in quantitative analysis.
LO 3. Gain knowledge of gravimetric analysis techniques for estimation of metal ions and compounds.
LO 4. Learn analytical methods for separation, estimation, and characterization of metal ions, including lanthanides, using classical and modern techniques.

Course Outcomes

After completion of course the student will be able to-

LO 1. Prepare and standardize solutions accurately and perform various titrimetric analyses (acid–base, redox, precipitation, and complexometric).
LO 2. Determine the concentration of metal ions and chemical species using volumetric and gravimetric methods with precision.
LO 3. Analyze experimental data, calculate results quantitatively, and interpret findings in chemical analysis.
LO 4. Apply separation and estimation techniques for metal ions, including lanthanides, while demonstrating good laboratory practices and safety.

Practical No.	Unit
1	Preparation of standard solution of potassium hydrogen phthalate and standardization of sodium hydroxide solution.
2	Preparation of standard solution of $K_2Cr_2O_7$ and standardization of given FAS solution.
3	Preparation of standard solution of oxalic acid and estimation of given KMnO4 solution.
4	Preparation of Iodine solution and its standardization using Sodium Thiosulphate.
5	Preparation of standard solution of NaCl and standardization of given $AgNO_3$ solution.
6	Assay of commercial sodium hydroxide/barium hydroxide.
7	Estimation of H_2O_2 solution.
8	Determination of alkalinity of water sample.
9	Preparation of standard solution of Zinc Sulphate and estimation of given EDTA solution.
10	Estimation of Nickel by EDTA Titration.
11	. Estimation of Cu^{2+} ions using EDTA
12	Estimation of Calcium as Calcium Oxide Gravimetrically.
13	Estimation of Lead as Lead Sulphate Gravimetrically.
14	Estimation of Magnesium as Magnesium Pyrophosphate Gravimetrically.
15	Estimation of Aluminium as Aluminium Oxide

16	Estimation of Cu^{2+} Iodometrically
17	To study the formation of complexes by lanthanide ions through the precipitation of lanthanide oxalates and observe their characteristics.
18	Separate and quantitatively estimate a lanthanide element from its mixture by gravimetric precipitation as lanthanide oxalate.

Learning Resources:

1. A Text Book of Practical Chemistry for B.Sc. V. V. Nadkarny, A. N. Kothari, Y. V. Lawande Popular Prakashan 2000
2. Advanced Experimental Chemistry Vol. I, II and III J. N. Gurutu, R. Kapoor S. Chand & Company 1980
3. Practical Chemistry B. D. Khosla, V. C. Garg R. Chand & Company 2004
4. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce Balwantrai Himalaya Publishing House 2012
5. Systematic Experimental Physical Chemistry S. W. Rajbhoj, Chondekar Anjali Publishing House 2008

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CO4	3	3	3	3	2	1	3	1	3	3	3	3	2	1

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Faculty of Science & Technology

Department of Chemistry and Analytical Chemistry

UG I Sem II

Course Type: VSC - II

Course Title: Systematic Chemistry Laboratory Techniques - II

Course Code: 101CHE2501

Credits: 02 (T=1+ P=1) **Max. Marks: 50** **Lectures: 15 Hrs.**

Learning Objectives:

LO 1. To recognize various laboratory hazards and safety protocols.

LO 2. To understand principles underlying separation and purification techniques.

LO 3. To apply appropriate laboratory methods for separation of solid and liquid mixtures.

LO 4. To analyze the effectiveness of purification techniques in chemical processes.

Course Outcomes:

After completion of the course the students will be able to-

CO 1. Explain laboratory safety practices and hazard management.

CO 2. Classify different separation and purification techniques based on their principles.

CO 3. Demonstrate laboratory skills in performing separation and purification processes.

CO 4. Evaluate the suitability of techniques for specific chemical applications.

Unit No.	Title of Unit & Contents	Hrs.
I	**Chemistry Laboratory Safety**	**03**
	1. Fire Hazards: Causes of fires, classification of fires, fire prevention protocols and measures, fire alarms, fire escapes, fire Extinguishers and their uses. 2. Chemical Hazards: Classification and handling of hazardous chemicals, storage of chemicals, transfer through large containers. 3. Gas Hazards: Usage of LPG and CNG safer in the laboratory, detection and handling of Gas Leakage, health hazards of gases.	
	Unit Outcomes: Student will be able to- UO 1. Identify various types of laboratory hazards and safety equipment. UO2. Implement precautionary measures for safe handling of chemicals and gases.	
II	**Common Separation Techniques for solids**	**04**
	1.Definition and importance of separation in daily life and industry 2.Types of mixtures (homogeneous vs. heterogeneous) 3.Basis of separation: Particle size, Density, Magnetic properties, Solubility 4. Handpicking and Basic Mechanical Methods, Sedimentation and Decantation 5. Sieving and Screening, Magnetic Separation	
	Unit Outcomes: Student will be able to- UO 1. Describe methods of separating solid mixtures based on physical properties. UO2. Distinguish between different solid separation techniques and their applications.	
III	**Common Separation Techniques for liquids**	**04**

Unit No.	Title of Unit & Contents	Hrs.
	1. Refluxing: Principle and purpose of refluxing, Apparatus with interchangeable ground glass joints (Quick fit), Applications in organic synthesis, Precautions, and safety measures 2. Filtration: Principles of filtration, Types: simple filtration and vacuum filtration, Filter media: filter paper, sintered glass, Buchner funnel, Selection of filter paper and common errors	
	Unit Outcomes: Student will be able to- UO 1. Illustrate principles of refluxing and filtration techniques. UO2. Operate laboratory apparatus used for liquid separation effectively.	
IV`	**Purification Techniques**	**04**
	1. Recrystallization: Principle of purification by recrystallization, Criteria for selection of solvent, Steps involved in recrystallization, Use of activated charcoal, Precautions with flammable solvents 2. Distillation: Principle of distillation, Types: simple distillation, fractional distillation, distillation under reduced pressure, Recovery of solvents, Determination of boiling point, Applications, and limitations	
	Unit Outcomes: UO 1. Summarize recrystallization and distillation processes. UO2. Select appropriate purification techniques for given substances.	

Learning Resources:

1. Advanced Practical Chemistry *Jagdamba Singh* Pragati Prakashan, 2012
2. Experimental Organic Chemistry *O. P. Agarwal* Goel Publishing House, 2015
3. Experimental Physical Chemistry *V. D. Athawale, P. Mathur* New Age International, 2001
4. Introduction to Practical Chemistry *Satya Prakash, D. Keerthi Kumar* S. Chand Publishing, 2015
5. Laboratory Manual in Chemistry *R. K. Gupta* Krishna Prakashan Media, 2018
6. Practical Chemistry *G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney* Pearson, 1989
7. Practical Chemistry *O. P. Agarwal* Goel Publishing House, 2014
8. Practical Organic Chemistry *F. G. Mann, B. C. Saunders* Pearson, 2009
9. Practical Physical Chemistry *A. M. James, F. E. Prichard* Longman, 1974
10. Quantitative Chemical Analysis *Daniel C. Harris* W. H. Freeman, 2010
11. Textbook of Practical Chemistry *Y. R. Sharma* Macmillan India, 2011
12. Vogel's Textbook of Practical Organic Chemistry *A. I. Vogel* Pearson, 2008 Vogel's Textbook of Quantitative Chemical Analysis *A. I. Vogel* Pearson, 2000
13. Handbook of Laboratory Safety *R. P. Singh* Pointer Publishers, 2010 Working Safely in a Chemical Laboratory *J. A. Young* Wiley, 2006

Internal Examination Pattern:

CAT – I: Home assignment

CAT – II: Seminar with PPT Presentation

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CO4	3	3	2	3	1	1	2	1	3	2	3	3	2	1

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UG I

Basket I: Generic/Open Elective (GE/OE)

(GEs offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing GE/OE	Code	Course Title	Credits	Hrs.
1	Commerce		Mutual Fund Management	04	60
2	Commerce		Fundamentals of Statistics	04	60
3	English		English for Science and Technology	04	60
4	Geography		General Geography	04	60
5	Commerce		Personal Financial Management	04	60
6	Marathi		स्पर्धापरीक्षाआणिमराठीभाषा	04	60
7	Political Science		Human Rights	04	60
8	Biotechnology		Nutrition, Health and Hygiene	04	60
9	Music		Indian Vocal Classical & Light Music	04	60
10	NCC Studies		Introduction to NCC	04	60
11	Sports		Counseling and Psychotherapy	04	60

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

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UG I

Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing SEC	Code	Course Title	Credits	Hrs.
1	Chemistry		Pesticides and Green Chemistry	02	30-45
2	Information Technology		Basics of Python Programming	02	30-45
3	Physics		Physics Workshop Skills	02	30-45
4	Biotechnology		Food Processing Technology	02	30-45
5	Botany		Mushroom Cultivation Technology	02	30-45
6	English		Proof Reading and Editing	02	30
7	Information Technology		PC Assemble and Installation	02	30-45
8	Marathi		कथा/पटकथालेखन	02	30
9	Zoology		Bee Keeping	02	30-45

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

UG I

Basket III: Ability Enhancement Courses (AEC)

(AEC offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing AEC	Code	Course Title	Credits	Hrs.
1	Marathi		भाषिक कौशल्य भाग – १	02	30
2	Hindi		हिंदी भाषा शिक्षण भाग – १	02	30
3	Sanskrit		व्यावहारीक व्याकरण व नितिसुभाषिते	02	30
4	Pali		उपयोजित व्याकरण	02	30
5	English*		Communicative English-I	02	30

Note:

1. **Student (other than Computational Science, Computer Applications & Biotechnology) can choose any one AEC (Sr. No. 1 to 4) from the basket.**
2. ***This course is applicable only for Computational Science, Computer Applications & Biotechnology students.**

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UG I

Extra Credit Activities

Sr. No.	Course Title	Course Code	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 English 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.