AC 28/5/2026/Sci/02 ITEM NO: 1.2.2

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Dadar (W), Mumbai -28

Affiliated to

UNIVERSITY OF MUMBAI

Title of the program

A- U.G. Certificate in BSc

B- U.G. Diploma in BSc

C- F.Y.B.Sc (Degree)

Syllabus for

Semester – Sem I & II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2026-27 Progressively)

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in **Science** Program will be able to	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions
PO3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PROGRAM SPECIFIC OUTCOMES

PSO	Description
A student completing Bachelor's Degree in Science Program will be able to	
PSO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PSO 2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions
PSO 3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally
PSO 4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PSO 5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PSO 6	Personal and professional competence: Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PSO 7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered on national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PSO 8	Environment and Sustainability: Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Sr. No.	Heading	Particulars	
1	**Title of program** **O: _____A**	**A**	**U.G. Certificate in Chemistry**
	O: _____B	**B**	**U.G. Diploma in _____**
	O: _____C	**C**	**B.Sc. (_____)**
2	**Eligibility** **O: _____A**	**A**	HSC (Science) **OR** Passed Equivalent Academic Level 4.0
	O: _____B	**B**	Under Graduate Certificate in _____ **OR** Passed Equivalent Academic Level 4.5
	O: _____C	**C**	Undergraduate Diploma in _____ **OR** Passed Equivalent Academic Level 5.0
3	**Duration of program R: _____**	**A**	One Year
		B	Two Years
		C	Three Years
4	**Intake Capacity** **R: _____**	**120**	

Sign of the HOD & Coordinator
BOS in Chemistry

Sign of the NEP Coordinator, DES's Kirti M. Doongursee College

Sign of Principal
DES's Kirti M. Doongursee College, Mumbai 28.

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Preamble

- Established in 1954, D.E. Society's Kirti M. Doongursee College of Arts and Science, has been enriching lives by imparting higher education. The college has been accredited with an 'A' grade in the 3rd NAAC cycle. Over the years, we have made great strides in the field of education and in 2022, the University Grants Commission and the University of Mumbai has conferred an 'Autonomy Status' at our college
- One of the principal outcomes of being granted autonomy is that we have the opportunity to accommodate a 'student centric system', where we can infuse new methods of teaching with a competitive and dynamic syllabus that keeps up with the changing industry requirements and technology, and the changing aspirations and expectations of a driven society.
- Officially, the syllabus is a document in academic learning that serves to outline, the main components of a subject, and its learning outcomes. It is a roadmap to accomplishing the course objectives. We believe that it is also an opportunity for us to match our educator's passion for teaching with the student's enthusiasm to learn and excel. Therefore, we have devised a 'student centric syllabus' that shifts the focus from simply, "What will be covered in the semester?" to "How can the course further the intellectual and academic growth of the student?" It is our aim to enhance the quality of education, generate enthusiasm amongst students about academic pursuits, improve the ability of the students to research and innovate, by designing a relevant syllabus, relevant courses, better evaluation methods and impart flexibility to choose courses that match their goals, interests and skills.
- The way our syllabus is framed helps the students develop their cognitive skills—such as evaluating, analyzing and understanding how all pieces of a 'concept' fit together, thereby, giving them a strong foundation in the field of their choice.

- Additionally, we have introduced certain extra credits that develop soft skills, (such as emotional intelligence, handling pressure and stress, courage for making tough decisions, conflict resolution, building ethics), inculcate community service and other skills that will help students to successfully navigate their lives and be ready to be local, national and global citizen.
- The new credit-based system will allow the students to obtain maximum benefits from all resources made available to them by the College. A course is assigned credits based on classroom teaching hours and the course of content. It gives the students the benefit of selecting from a wide variety of courses. Apart from assisting the students with the course content, the syllabus will also provide the students with a guide to semester teaching schedule, examination pattern and grading policies.
- Our Board of Studies for each subject is constituted in a manner that will benefit from the diversity and rich experience of renowned individuals from Mumbai and other Universities, industry experts and our alumni.
- Our experienced faculty, along with the guidance of a judicious and perceptive Governing Council, provide meaningful academic experiences and a rewarding career for our students. Thus, we have constructed a syllabus that is designed to enhance the rapport between students and teachers, to motivate and empower the students, to focus on skill development for employability, thereby making them locally relevant and globally competent.

Semester	Course Code	Course Title	Vertical	Credit
I	26CHEMJ111	Fundamental Chemistry	Major	**2**
	26CHEMJP11	Fundamental Chemistry Practical	Major	**2**
	26CHEVSC141	Good Laboratory Practices (GLP)	VSC	**2**
	26CHESE151	Food Chemistry	SEC	**2**
II	26CHEMJ211	Fundamental Chemistry	Major	**2**
	26CHEMJP21	Fundamental Chemistry Practical	Major	**2**
	26CHEOE231	Chemical Technology and Society	OE1	**2**
	26CHEVSC241	Green Chemistry	VSC	**2**
	26CHESE251	Food Chemistry	SEC	**2**

SEMESTER I

Course Code	Course Title	Credits	Lectures/ Week
26CHEMJ111	**FUNDAMENTAL CHEMISTRY-I**	**2**	**2**

Course Objectives CO):

CO1: To develop a fundamental understanding of chemical calculations and concentration terms used in quantitative chemical analysis.

CO2. To introduce the principles of chemical kinetics, reaction mechanisms, and rate laws for interpreting reaction behavior.

CO3. To provide comparative knowledge of main group element chemistry with emphasis on environmental implications.

CO4. To develop conceptual clarity of acid–base theories and their applications in chemical systems. To impart systematic understanding of classification, nomenclature, bonding, and structure of organic compounds. To build analytical thinking for interpreting molecular structure, hybridization, and reaction characteristics of organic molecules.

Course Outcomes (OC):

OC1. Define and list various concentration units (molarity, molality, normality, ppm, ppb, etc.), state rate law terms, identify group I & II oxides/hydroxides, and recall classifications and nomenclature of organic compounds along with basic acid–base theories.

OC2. Explain the concepts of chemical calculations, integrated rate laws, reaction order, environmental effects of oxides of carbon, sulfur and nitrogen, acid–base theories (Arrhenius, Brønsted–Lowry, Lewis), and bonding principles including hybridization and molecular geometry.

OC3. Solve numerical problems involving concentration of expressions and rate laws; apply acid–based theories to chemical systems; and classify organic compounds based on functional groups and hybridization states.

OC4. Analyze reaction mechanisms to determine rate-determining steps, interpret relationships between structure and bonding in organic molecules, compare properties of main group oxides in environmental contexts, and evaluate chemical behavior based on acid–base and structural concept

Unit	Topics	No of Lectures

I	**1.1 Chemical Calculations: (5L)** Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, weight ratio, volume ratio, weight to volume ratio, ppm, ppb, millimoles, milliequivalents (Numerical expected) **1.2 Comparative chemistry of Main Group Elements:(05L)** Comparative chemistry of oxides and hydroxides of group I and group II elements. oxides of carbon, oxides of Sulphur and Nitrogen with respect to environmental aspects like greenhouse effect, photochemical smog and acid rain. **1.3 Acid Base Theories (5L)** Arrhenius, Lowry- Bronsted, Lewis, Solvent – Solute concept of acids and bases, Hard & Soft acid & bases. Application of HSAB.	**15**
II	**2.1 Chemical Kinetics- Rate Laws (5L) :** Rate laws, the relationship between the rate of a chemical reaction and the concentrations of reactants. Rate Determining Step, a reaction mechanism for the determination of the rate of law. Rate Constants, coefficients in the rate of laws, and quantitative information about the rate of reaction. Integrated Rate Laws Order of Reaction. (Numerical expected). **2.2 Classification and Nomenclature of Aliphatic Organic Compounds. 05L** Classification based on functional groups: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines with at least two examples of each. **2.3 Bonding and Structure of organic compounds: (5L)** Hybridization: sp3, sp2, sp hybridization of carbon and nitrogen; sp3 and sp2 hybridizations of oxygen in Organic compounds (alcohol, ether, aldehyde, ketone, carboxylic acid, ester, cyanide, amine and amide) Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, shapes of organic molecules. Shapes of molecules; Influence of hybridization on bond properties (as applicable to ethane, ethene, ethyne)	**15**

References:

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Rice. Physical Chemistry, 2nd Ed., Oxford University Press: (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
15. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
16. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
17. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002**.**

Course Code	Course Title	Credits	Lectures/Week
26CHEMJP111	**Chemistry Practical**	**2**	**4**

Course Objectives (CO):

CO1. To develop a fundamental understanding of volumetric and gravimetric analytical techniques used in quantitative chemical analysis.
CO2. To train students in preparation, standardization, and handling of chemical solutions for titrimetric experiments.
CO3. To impart practical knowledge of reaction kinetics and determination of rate constants using experimental data.
CO4. To build laboratory skills for estimation of inorganic and organic substances using appropriate analytical methods. To enable students to perform qualitative analysis for identification of elements in organic compounds.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. List standard laboratory procedures, reagents, indicators, and formulas used in volumetric, gravimetric, and kinetic experiments.
OC2. Explain the principles of titrimetric analysis, gravimetric estimation, and reaction kinetics, including the role of indicators and reaction conditions.
OC3. Perform experiments such as solution preparation, standardization, titration (acid-base, redox), gravimetric analysis, and kinetic studies to determine concentration, purity, and rate constants.
OC4. Analyze experimental data to calculate strengths, purity percentages, and rate constants; interpret titration curves and reaction behavior; and deduce the composition or characteristics of given samples.

Sr. No.	Topics	
1	To prepare 0.1N succinic acid solution and standardize the supplied NaOH solution of two different concentrations volumetrically.	60 Hours
2	To determine the strength of a commercial sample of mineral acid (hydrochloric acid) by titrimetric method	
3	To Determine the strength of commercial sample of organic acid (acetic acid) by titrimetric method.	
4	Chemical kinetics: To determine the rate constant K of acid catalyzed hydrolysis of methyl acetate by using the first order rate equation.	

5	Chemical Kinetics: To determine the rate constant K, of the reaction between KI and $K_2Cr_2O_7$ in acidic medium using a second order rate equation.	
6	To determine the percentage purity of sample of $BaSO_4$ containing NH_4Cl gravimetrically.	
7	To determine the percentage purity of a sample of ZnO containing $ZnCO_3$ gravimetrically.	
8	To analyze the solution of sodium carbonate and sodium bicarbonate using double indicators.	
9	Estimation of Fe^{+2} ion in the given solution by titrating against $KMnO_4$ in presence of H_2SO_4.	
10	Preparation of FAS from $FeSO_4$ and $(NH_4)_2SO_4$	
11-15	Characterization of organic compound containing C, H,(O), N, S, X elements (minimum six compounds)	

References:

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V.K. Ahluwalia and Renu Aggarwal, Universities Press India, Ltd., 2000
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York

Course Code	Course Title	Credits	Lectures/Week
26CHEVSC141	**GLP -: Good Laboratory Practices (VSC)**	**2**	**4**

Course Objectives (CO):

CO1. To develop proficiency in the preparation and standardization of solutions of varying concentrations (molar, molal, normal, and percentage).

CO2. To train students in the proper use and calibration of essential laboratory instruments such as burettes, pipettes, and analytical balances. Knowledge of MSDS

CO3. To impart practical knowledge of instrumental techniques including pH measurement, conductometry, potentiometry, and colorimetry

CO4. To introduce the principles and applications of chromatographic separation techniques. To enhance skills in qualitative and quantitative analysis using modern laboratory methods.

Course Outcomes (OC):

OC1. Recall definitions, units, and formulas related to solution concentrations, and identify laboratory instruments and chromatographic techniques.

OC2. Explain the working principles of analytical instruments (pH meter, conductometer, potentiometer, colorimeter) and the theory behind paper chromatography. Write MSDS of compounds.

OC3. Prepare and standardize solutions, operate laboratory instruments accurately, and perform paper chromatographic separation of metal ions such as Co(II), Ni(II), and Cu(II).

OC4. Analyze experimental data to determine solution concentrations, interpret instrument readings, and evaluate chromatographic separations based on Rf values and resolution of components.

Sr No.	Experiments	Hours
1	Preparation of solutions of different strengths (Molar, molal, normal, and percentage solutions) and their standardization. (4-5 Experiments).	60
2	Calibration and Use of burettes, pipettes, standard measuring flask, thermometer, etc. (2-3 experiments).	
3	Calibration and Use of pH meter, Conductometer, Potentiometer, Colorimeter (4 experiments)	

Chromatographic techniques (Paper Chromatography)		
4	Paper chromatographic separation of Co(II) & Ni(II).	
5	Paper chromatographic separation of Cu(II) and Ni(II).	
6	Paper chromatographic separation of Cu(II) and Co(II)	

References:

1. A.I.Vogel's Quantitative Analysis 6th Ed., Pearson, 2009 CBCS: B. Sc. (Honours) with CHEMISTRY.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4. Vocational skill course in chemistry by Kalpana P. Jain, Gurumeet C. Wadhawa, Sajid F. Shaikh, Dinesh V. Bhagat, Himalaya Publishing House
5. Chromatography | H. Kaur | Pragati Prakashan, Meerut

Self-Study ICT Backup

1. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/video-lectures/
2. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/
3. https://ocw.mit.edu/courses/chemistry/5-111sc-principles-of-chemical-science-fall-2014/
4. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-84j-atmospheric-chemistry-fall-2013/
5. https://ocw.mit.edu/courses/chemistry/
6. https://ocw.mit.edu/courses/captioned/
7. https://ocw.mit.edu/courses/captioned/#chemistry
8. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-33/
9. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-1/
10. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-7/
11. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-16/
12. https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-1/
13. https://www.youtube.com/user/MIT/search?query=chemistry
14. http://mit.uvt.rnu.tn/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/organic-materials/27-introduction-to-organic-chemistry/
15. http://ifs.se/IFS/Documents/Other/Video%20Lectures%20book%20Organic%20Chemistry_Atta-ur-

Rahman%20and%20Syeda%20Sadia%20Khatoon.pdf
16. https://www.coursera.org/learn/physical-chemistry

Course Code	Course Title	Credits	Lectures/ Week
26CHESE151	**FOOD CHEMISTRY (SEC)**	**2**	**4**

Course Objectives (CO):

CO1. To familiarize students with common food adulterants, present in spices, oils, grains, and processed foods.

CO2. To develop practical skills for qualitative detection of adulterants using simple chemical and visual tests

CO3. To enable identification of adulteration in food products such as milk derivatives, honey, tea, coffee, and edible oils.

CO4. To impart knowledge of chemical reactions involved in detecting synthetic colors and harmful additives. To enhance observational and analytical skills in evaluating food quality and safety. To promote awareness of public health issues related to food adulteration

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. List common food adulterants (e.g., metanil yellow, chalk powder, urea, artificial colors) and identify the standard tests used for their detection.

OC2. Explain the principles and reactions involved in detecting adulterants in food items such as chilli powder, honey, turmeric, tea, coffee, and oils.

OC3. Perform laboratory and field-level tests to detect adulterants in various food samples, including grains, pulses, fruits, vegetables, and cooked foods.

OC4. Analyze test results to differentiate between pure and adulterated food samples, interpret observations, and assess the quality and safety of food products.

Sr No.	Experiments	No of hours

	1. Detection of adulterant in red chili powder. 2. Detection of different adulterants (sugar/dextrose) in Honey 3. Identification of adulterant added in fruits (any three fruits). 4. Detection of artificial colors in green pea 5. Detection of chalk powder/urea/washing soda from sugar. 6. Detection of adulterant in turmeric powder 7. Detection of adulterant in tea powder 8. Detection of adulterant in coffee 9. Visual identifications of adulterant in different food grains 10. Detection of sodium Bicarbonate in cooked food samples 11. Detection of adulterant in cooking oil 12.Detection of adulterant in pure ghee 13. Detection of adulterants in pulses **(**Kesari dal, artificial colors, and sand/stones) 14. Identification of adulterant added in Vegetables (any two vegetables) 15. Identification of adulterants (Metanil yellow) in sweets.	**60**

References

1. Food safety and standard authority of India (FSSAI) New Delhi
2. www.rjptonline.org. Research Journal of Pharm and Tech.Sept.2017.
3. Manual of methods of analysis of foods honey& other bee hive products (FSSAI)
4. Manual of methods of analysis of foods food safety and standards authority of India ministry of health and family welfare government of India new Delhi 2015
5. Food Adulteration Testing Manual (14th Revised Edition) –Consumer Guidance Society of India (CGSI) Mumbai-2019

SEMESTER-II

Course Code	Course Title	Credits	Lectures/ Week
26CHEMJ211	**FUNDAMENTAL CHEMISTRY (Major)**	**2**	**2**

Course Objectives (CO):

CO1. To develop a clear understanding of fundamental thermodynamic concepts, laws, and their applications in chemical systems. To impart knowledge of thermochemistry and enable quantitative interpretation of heat, work, and energy changes in reactions.

CO2. To provide a conceptual understanding of chemical bonding theories and molecular geometry in relation to structure and reactivity.
CO3. To introduce principles of qualitative analysis based on precipitation equilibria and solution behavior. To develop an understanding of organic reaction mechanisms, electronic effects, and classification of organic reactions.

CO4. To enhance analytical thinking for predicting reactivity, stability of intermediates, and structure–property relationships in organic compounds

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Define thermodynamic terms (system, surrounding, state functions, etc.), state laws of thermodynamics, list types of chemical bonds, and recall key concepts of organic reaction mechanisms and qualitative analysis principles.
OC2. Explain thermodynamic laws, enthalpy concepts, heat capacity relations, molecular geometry (VSEPR theory), precipitation equilibria, electronic effects, and mechanisms of basic organic reactions.
OC3. Solve numerical problems involving heat, work, enthalpy, solubility product, and thermochemical data; apply VSEPR theory to predict molecular shapes; and use mechanistic concepts to explain organic reactions such as substitutions, additions, and eliminations.
OC4. Analyze thermodynamic and precipitation data to interpret reaction feasibility; evaluate stability of reactive intermediates; compare ionic and covalent bonding behavior; and interpret the role of electronic effects in determining organic reactivity and reaction pathways.

Unit	Topics	No of Lectures
I	**1.1 Thermodynamic terms:(5L)** System, surrounding, boundaries, open, closed and isolated system, intensive	**15**

	and extensive properties, state functions and path functions, Concept of heat (q), work (w), internal energy (U), **1.2 Chemical Bond and Reactivity:(5L)** Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis's dot structure, Sidgwick Powell Theory, basic VSEPR theory for ABn type molecules with and without lone pair of electrons, isoelectronic principles, applications and limitations of VSEPR theory. **1.3 Concept of Qualitative Analysis (5L)** Precipitation equilibria-: solubility product, effect of common ions, uncommon ions, oxidation states, buffer action, complexing agents on precipitation of ionic compounds (Balanced chemical equations and numerical problems expected)	
II	**2.1 Thermodynamics:(5L)** zeroth, First and second law of thermodynamics: statement of the first law, enthalpy, the relation between heat capacities, sign conventions, calculations of heat (q), work (w), internal energy (U), and enthalpy (H) (Numerical expected) Thermochemistry: Heats of reactions, standard states, enthalpy of formation of molecules, enthalpy of combustion and its applications, calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equation (Numerical expected) **2.2 Fundamentals of organic reaction mechanism: (5L)** Electronic Effects: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; relative strengths. Bond fission: Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types (primary, secondary, tertiary, allyl, benzyl), shape and relative stability of reactive intermediates: Carbocations, Carbanions and Free radicals. Introduction to types of organic reactions: Addition, Elimination, and Substitution reaction. (With one example of each) **2.3 Chemistry of Aliphatic Hydrocarbons (5L)** **Chemistry of Alkanes:** Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, free radical substitution (chlorination of methane with mechanism) **Reactions of alkenes:** Eletrophilic additions and their mechanisms (Markownikoff/AntiMarkownikoff addition), Ozonolysis, Diel's-Alder reaction.	**15**

	Reaction of alkynes: acidity, electrophilic and nucleophilic additions.	

References-:

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Rice. Physical Chemistry, 2nd Ed., Oxford University Press: (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
15. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
16. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
17. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
18. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
19. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
20. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
21. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
22. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Agem International, 20

Course Code	Course Title	Credits	Lectures/Week
26CHEMJP21	**Fundamental Chemistry Practical**	**2**	**4**

Course Objectives (CO):

CO1. To develop understanding of thermodynamic concepts through determination of enthalpy changes in chemical processes. To impart practical skills in the preparation and analysis of buffer solutions using pH metry. To train students in the use of analytical instruments such as colorimeters, conductometers, and potentiometers.

CO2. To provide hands-on experience in quantitative analysis using instrumental and titrimetric techniques.

CO3. To develop competence in qualitative inorganic analysis for identification of cations and anions.

CO4. To introduce techniques of organic synthesis, purification, and characterization using crystallization and melting point determination.

Course Outcomes (OC):

OC1. Recall principles, formulas, and standard procedures related to enthalpy determination, buffer preparation, instrumental methods, and qualitative analysis.

OC2. Explain the theoretical basis of thermochemistry, buffer systems, colorimetry, conductometry, potentiometry, and organic reactions such as nitration and hydrolysis.

OC3. Perform experiments to determine enthalpy of dissolution, prepare buffer solutions and measure pH, estimate concentrations using colorimetry, and conduct titrations using conductometric and potentiometric methods; carry out qualitative analysis and organic synthesis with purification.

OC4. Analyze experimental data to calculate enthalpy changes, interpret titration curves and instrumental readings, identify ions in mixtures, and evaluate purity of synthesized compounds using melting point and yield.

Unit	Experiments	Hours
1	To determine enthalpy of dissolution of salt (like KNO3)	60
2	**pH metry**- To Prepare various compositions of buffer solutions of different pH using sodium acetate and acetic acid solutions and determine their pH values by using pH meters	

3	**Colorimetry-**: Determination of the Concentration of an Unknown KMnO4 Solution by calorimetrically.	
4	**Conductometry-**: Determination of concentration of a strong acid (HCl) by titration with a strong base (NaOH) by Conductometric Titrations	
5	**Potentiometry** -: Titration of a strong acid/weak acid mixture using a potentiometer to observe a sharp change in potential by Potentiometric Titrations	
6	Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. **(minimum five mixtures)**	
7	To crystallize the given organic compound and find the weight and purity of crystals by melting point. **(minimum three)**	
8	To prepare p-nitroacetanilide from acetanilide (nitration)	
9	To prepare p-nitroaniline from p-nitroacetanilide (hydrolysis)	

References:

1. Experimental Physical ChemistryAuthors: R.C. Das, B. Behera, Publisher: Tata McGraw-Hill / CBS.
2. Comprehensive Practical Chemistry, Author: V.K. Ahluwalia, Publisher: Universities Press / Ane
3. Vogel's Textbook of Quantitative Chemical Analysis, Author: Arthur Israel Vogel Publisher: Pearson / Prentice Hall
4. Practical Inorganic Chemistry, Author: G. Svehla, Publisher: Pearson
5. Advanced Practical Chemistry, Author: Jagdamba Singh, Publisher: Pragati Prakashan / Goel Publishing

Course Code	Course Title	Credits	Lectures/Week
26CHEOE231	**CHEMICAL TECHNOLOGY AND SOCIETY**	**2**	**2**

Course Objectives (CO):

CO1. Develop a conceptual and practical understanding of common laboratory separation and purification methods, including **filtration**, crystallization, and distillation techniques. Develop **chemical literacy** to critically analyze everyday issues related to air and water quality, including the identification and impact of pollutants.

CO2. Apply principles of **fractional crystallization** and **distillation (simple, fractional, and reduced pressure)** to separate components based on physical properties such as solubility and boiling point. Understand the chemical principles behind different **energy sources**, including fossil fuels, renewable energy (such as solar), and nuclear fission.

CO3. Understand and perform **solvent extraction**, **solid–liquid leaching**, and **liquid–liquid extraction** for isolating compounds from mixtures. Examine the structure, properties, and applications of **materials** such as plastics, polymers, proteins, and nucleic acids.
Explore **chemical reactivity and transformations**, from simple processes like combustion to advanced applications such as drug synthesis and genetic engineering.

CO4. Explain the scientific basis of **absorption and adsorption** and their roles in chemical separation processes. Build foundational laboratory skills, including safe handling of chemicals, proper use of apparatus, and accurate observation and recording of results. Foster informed decision-making and responsible attitudes toward sustainability and the use of chemical resources.

Course Outcomes (OC): After successful completion of this course, students would be able to

OC1. Recollect - Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption.

OC2. Understand - Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants)

OC3. Apply Different - types of equipment needed in chemical technology

OC4. Interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs

Unit	Topics	No of Lectures
I	Basic Analytical Techniques: Purification of solids. Filtration, filtration under suction, crystallization, Fractional crystallization, Basic principles of distillation, Simple distillation, Fractional distillation, Distillation under reduced pressure, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by	**15**

	absorption and adsorption.	
II	Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and Interconversions from simple examples like combustion to complex instances like genetic engineering and manufacture of drugs.	**15**

References::

1. John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed.

Course Code	Course Title	Credits	Lectures/ Week
26CHEVSC241	**Green Chemistry**	**2**	**4**

Course Objectives (CO):

CO1. To introduce principles of green chemistry through environmentally friendly synthesis and extraction methods

.

CO2. To develop skills in preparation and application of natural indicators for acid–base titrations.

CO3. To impart practical knowledge of green synthesis of nanoparticles and alternative solvent systems.

CO4. To train students in the formulation of herbal products using naturally derived ingredients. To promote sustainable laboratory practices and analytical thinking in chemical experimentation.

Course Outcomes (OC):

OC1. List natural sources of indicators, green synthesis methods, and standard procedures for estimation of vitamin C and iron.

OC2. Explain the principles of natural indicator behavior, green synthesis of nanoparticles, deep eutectic solvents, and titrimetric estimation techniques.

OC3. Perform extraction of natural pigments and use them in titrations, synthesize nanoparticles using green methods, prepare herbal formulations, and carry out estimations of vitamin C and iron in given samples.

OC4. Analyze experimental results to evaluate indicator effectiveness, assess nanoparticle synthesis outcomes, determine concentrations of analytes, and interpret the efficiency and sustainability of green chemistry processes.

Unit	Topics	Hours
1	To extract natural pigments from sources such as beetroot, red cabbage, turmeric etc. and to utilize them as acid-base indicators in acid-base titrations (Minimum five experiments)	60
2	To prepare copper nanoparticles using a green synthesis approach.	
3	To prepare iron oxide nanoparticles using green chemistry principles	
4	Green Synthesis of Zinc Oxide Nanoparticles.	
5	To prepare a choline chloride-based deep eutectic solvents using suitable	

	hydrogen bond donors (Maximum three experiments can be done)	
6	To prepare a herbal hand wash using neem leaves and other naturally derived ingredients.	
7	To prepare a herbal face wash using turmeric and other naturally derived ingredients.	
8	To prepare herbal shampoo using aloe vera and other naturally derived ingredients.	
9	To estimate the amount of vitamin C (Ascorbic acid) present in a given lemon juice by titration with standard iodine solution.	
10	To estimate the amount of iron present in spinach leaves by redox titration using standard $KMnO_4$ solution.	

References:

1. Sharma B. K. - *Analytical Chemistry*, Krishna Prakashan, Meerut
2. Chatwal G. R. and Anand – *Instrumental Methods of Chemical Analysis*, Himalay Publishing House.
3. Senger R. S. - *Laboratory Manual of Biochemistry*, Narosa Publishing House
4. Ahaluwalia V. K. -*Green Chemistry*, Narosa Publishing House.
5. Varshney P. K. -*Cosmetic Science*, CBS Publishers, New Delhi.
6. *Basics and Properties of Deep Eutectic Solvents*: A review Published: 20 April 2021, Volume 19, pages 3397–3408, (2021)
7. *A Mini Review on Synthesis, Properties and Applications of Deep Eutectic Solvents*, Journal of the Indian Chemical Society Volume 98, Issue 11, November 2021, 100210.
8. *Deep Eutectic Solvents: A Review of Fundamentals and Applications*, Chem. Rev. 2021, 121, 3, 1232–1285.

Course Code	Course Title	Credits	Lectures/Week
26CHESE251	**FOOD CHEMISTRY II**	**2**	**4**

Course Objectives (CO):

CO1. To familiarize students with common types of milk adulterants and their chemical properties.

CO2. To develop practical skills in qualitative analysis for detecting adulterants in milk samples.

CO3. To enable students to perform standard laboratory tests for identification of chemical contaminants in milk.

CO4. To build competence in comparing adulterated and pure milk samples using analytical techniques.

Course Outcomes (OC):

OC1. Recall the types of common milk adulterants (urea, detergent, starch, nitrates, etc.) and list the corresponding laboratory tests used for their detection.

OC2. Explain the principles and chemical reactions underlying various tests (iodine test, Barfoed test, etc.) used to detect adulterants in milk samples.

OC3 Perform laboratory procedures to detect different adulterants in milk and accurately compare results with pure milk samples.

OC4. Analyze experimental results to differentiate between pure and adulterated milk, interpret test outcomes, and infer the presence of specific contaminants.

Unit	Topics	Hours
1	To detect Urea adulteration in milk samples and compare it with pure milk.	60
2	To detect the presence of Detergent in milk sample and compare it with pure milk.	
3	To detect Starch adulteration in milk samples and compare it with pure milk.	
4	To determine the presence of Nitrates in milk samples and compare it with pure milk	
5	To detect Ammonium salt in the milk sample as an adulterant and compare it with pure milk	
6	To detect Sulphate in the milk sample as an adulterant and compare it with pure milk	

7	To detect Sodium Chloride in the milk sample as an adulterant and compare it with pure milk	
8	To detect Hydrogen peroxide in the milk sample as an adulterant and compare it with pure milk	
9	To detect Maltodextrin (by iodine test) in the milk sample as an adulterant and compare it with pure milk	
10	Detection of Glucose in milk as an adulterant by using Barfoed test and compare it with pure milk	
11	To detect formaldehyde in the milk sample as an adulterant and compare it with pure milk	
12	To detect sugar adulteration in milk samples and compare it with pure milk.	
13	To detect the coloring matter in milk samples and compare it with pure milk	
14	To determine the presence of organic acids like benzoic acid and salicylic acid in the milk samples.	
15	To detect Alkali adulterants in the milk sample and compare it with pure milk.	
16	To detect Borax and Boric acid in the milk sample as adulterants and compare it with pure milk	

References:

1. Manual of methods of analysis of foods: Milk and milk products D.G.H. Services (Ed.) 2005
2. Detection of adulterants in milk, A laboratory manual in N.D.R. Institute (Ed.) Karnal Haryana India 2012.
3. Handbook of "Qualitative Test for detection of Common Adulterants in Milk", Anand Agricultural University, Anand

Evaluation Scheme for First Year 2026-27 (UG)
under NEP 2020 (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment (CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment (CIA) ONLINE / OFFLINE Unit Test – 10 marks - 15 Minutes

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hour

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

NOTE: To pass the examination, attendance is compulsory in both Internal and External Theory Examinations.

FY2026-27 Evaluation pattern and Question paper pattern for Semester End Practical Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60%(30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test /Small experiments (15 Marks), Overall performance (5 Marks) = 20 Marks	As per paper pattern	1.5 hr

FY2026-27 Evaluation pattern and Question paper pattern for Semester End Practical Examination of Vocational Skill Courses and Skill Enhancement Courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test /Small experiments (15 Marks), Overall performance (5 Marks) = 20 Marks	As per paper pattern	1.5 hr

Signatures of Team Members

SR.No.	Name	Signature
1.		
2.		
3.		
4.		
5.		
6		
7		
8		
9		
10		
11		
12		

13		

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	**% of Marks**	**Alpha-Sign/ Letter Grade Result**	**Grading Point**
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Justification for Bachelors in 2026-27

1.	Necessity for starting the course:	.
2.	Whether the UGC has recommended the course:	**Yes**
3.	Whether all the courses have commenced from the academic year 2023-24.	The course has already commenced in the university and in the academic year 2023-24 it is restructured under NEP 2020
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	This course is aided / self-financed based on the sanction given by University of Mumbai to affiliated colleges time to time.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	The duration of the program is three years (6 semesters). It is not possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	120 per division
7.	Opportunities of Employability / Employment available after undertaking these courses:	