Sant Gadge Baba Amravati University, Amravati

Faculty: Science and Technology

Programme: B.Sc. (Chemistry)

POs:

At the time of graduation, Students would be able to

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSOs:

Upon completion of the programme successfully, the learners would be able to-

1. Understand the scope, methodology and application of modem chemistry.

2. Apply theoretical and practical concepts of instruments that are commonly used-in most chemistry field.

3. Plan and conduct scientific experiments and record the results of such experiments.

4. Get acquainted with safety of chemicals, transfer, and measurements of chemicals, preparation of solutions, and using physical properties to identity compounds and chemical reactions.

5. Describe how chemistry is useful to solve social, economic and environmental problem and issues facing our society in energy, medicine, and health.

Employability Potential of the Programme:

A degree in Chemistry is an intelligent choice for future employability and earning potential for learners. Degree program with Chemistry offers the necessary knowledge, develop skills and nurture creativity to achieve success in virtually any field that's even distantly related in some way to chemistry. A degree in chemistry is recognized as a symbol of quality and commitment by employers both inside and outside the chemical industries. Chemistry provides jobs in cutting-edge technologies within science and research as well as in many fields of distant relations. Chemistry graduates apply their skills within the areas of environmental sciences, medical fields, scientific equipment sales, science communication, teaching or academic research, a few to mention. Thus, a degree in chemistry widens numerous prospects and opportunities for a wide

variety of careers in many different fields like science, research, business and health care, etc. Chemistry inculcates excellent analytical and mathematical skills, which lead to enhanced problem-solving abilities and critical thinking. This improves the likelihoods to secure job in other fields too. Some important skills and abilities honed by chemistry learners include:

- Cutting-edge scientific and numerical skills
- Curiosity to understand and solve
- Attention to collect and analyse details
- Patience and determination
- Research and development skills
- Analytical skills
- Use of ICT enabled techniques
- Written and oral communications skills

The thriving and widely recognized branches of chemistry like Organic, Inorganic, Physical, Analytical, etc. not only expand critical thinking and the ability to understand other scientific and engineering concepts more easily, but also open new horizons to pursue career in different fields. Organic chemistry offers research and development of organic materials, modify and study carbon-based materials to develop a product having a specific purpose for wider use. They also accomplish various scientific studies to identify or find applications for compounds for society. Many industries like pharmaceuticals, agriculture, paints, dyes, and many more prefer to employ organic chemists. Inorganic chemistry has a greater potential in the fields of metallurgy, synthesis of new materials from different elements, bioinorganic, etc. It focusses on solving the fundamental problems associated with structure of atoms, molecules and their properties. Analytical chemists find their role for toxicology examinations, quality control and assessment, analysis of pharmaceuticals, investigations for forensic analysis, development of equipment, etc. Analytical chemists work for a particular private or government laboratory or organization, and also develop particular specialties like food technology, forensics or toxicology, to name a few. Physical chemistry enhances critical ability and inculcates problem solving skills among the learners. All industries rely heavily on physical parameters for manufacturing and quality assurance of products.

Apart from the technical and specific skills, a chemistry graduate also acquires fundamental professional skills throughout the degree program to pursue careers not directly related to the field. These skills include:

- Effective listening and communication skills
- Presentation and interaction skills
- Data collection, analysis and reporting skills
- Modern ICT enabled skills
- Aptitude to work proficiently independently or in a team

Future scope for B.Sc. Chemistry graduates:

- Prestigious institutions like IIT, NIT, IISER, IISc, BARC, TIFR, a few to mention, offer higher studies such M.Sc. and Ph.D.
- Likewise, foreign Universities also accept chemistry graduates for higher studies.
- Chemistry student can become small or medium scale entrepreneur (own industry).
- Union and State Public service commissions like UPSC, MPSC, Bank Probationary officers, other competitive examinations, etc. offer a multitude of jobs and positions like Drug Inspector, Lab chemist, forensic analyst, etc. for chemistry graduates.
- Students can take teaching jobs at Kendriya Vidyalaya, Navodaya Vidyalaya, High Schools after completing B.Ed. or respective eligibility criteria.
- Laboratory technician in various Public Sector Units like ONGC, IOCL, NTPC, BARC, and Private sector industries.
- Students can become Content Developer for IT industries.
- Students can become Quality Control Chemists/ Food Inspector at Food Co-operation of India, Food Safety and Standards etc
- Laboratory technicians to look after sophisticated instruments like NMR, Mass Spectrometer, UV-Visible Spectrophotometer, Single crystal machines, XRD, SEM, AAS, TEM etc. in research laboratory of academic institutions as well as private sector companies

- Research Scientist/ Operations Manager/ Chemists / Quality Manager / Research Manager at various industries like Pharmaceuticals, Cement, Plastic, Drugs, Paint, Dyes, Agricultural sector, etc.
- Employee at Security Printing and Minting co-operation of India
- Employee at Office of Controller general of Patent design and trade work

Syllabus Prescribed for Three Year UG/PG Programme

Programme:

Semester 1

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
CHE(1S)T	**Chemistry 1S**	**84**

COs:

By the end of this course, the students would be able to:

1. Solve the conceptual questions using the knowledge gained by studying periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements.
2. Apply concepts of acids and bases as well as non-aqueous solvents and their industrial usage.
3. Compare different reaction intermediates, functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism.
4. Choose correct synthetic approach to prepare derivatives of industrially important molecules
5. Solve different numerical problem of varying difficulty associated with gaseous and liquid state.
6. Apply the concepts from advanced mathematics to solve the derivation of different chemical formulae.

Unit	Content
Unit I	**Periodicity of Elements:** s and p block elements: Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle. Shapes of s and p orbitals. Electronic configuration for s and p block elements. Detailed discussion of the following properties of the elements, with reference to s and p-block. (a) Nuclear charge and number of shell and its variations (b) Atomic and ionic radii and their variations (d) oxidation states (e) Ionization potential, Successive ionization potential and its variations. (f) Electron affinity and its trends. (g) Electronegativity and its variations. Effect of ionization energy and electronegativity on different properties of elements namely metallic and non-metallic character, relative reactivity, oxidizing and reducing properties. Diagonal relationships: Li with Mg, B with Al. Abnormal behavior of nitrogen. **Periods: 14**
Unit II	**A) Acids and Bases-** Arrhenius, Bronsted-Lowry, and Lewis's theory of acids and bases, Theory of solvent systems and Lux-Flood concept of acids and bases. Hard and soft acids and bases. Pearson's HSAB or SHAB principle with important applications. **B) Nonaqueous Solvents**-Requirements of a good solvent. Water as a universal solvent. Physical properties of solvents namely liquid range, dielectric constant, dipole moment, heat of vaporization and solubility behavior. Classification of solvents. Acid base, precipitation, redox, solvolysis and complexation reactions in liquid ammonia. Merits and demerits of liquid ammonia as a solvent. **Periods: 14**
Unit III	**Basics of Organic Chemistry:** **A) Electronic Displacement and Reactive Intermediates:** Inductive, Electromeric, Resonance, Mesomeric effects, Hyperconjugation and their applications, dipole moment, homolytic and heterolytic fission with suitable examples. Electrophiles and nucleophiles. Types, shape and their relative stability of carbocations, carbanions, free radicals and carbenes and nitrene.

	B) Aliphatic Hydrocarbons: Formation and reaction of alkanes, Formation of alkenes and alkynes by elimination reactions (with mechanism of E1, E2, E1cb), Saytzeff and Hofmann eliminations, Reactions of alkenes and alkynes, Diels-Alder reaction. **C) Structural isomers:** Definition, classification, and examples. **Periods: 14**
Unit IV	**Aromatic Compounds:** **A) Structural Properties:** Aromaticity and Huckel's rule (Benzenoid and Non-Benzenoid compounds), Kekule and Dewar structures, Molecular orbital diagram of benzene, Anti-aromatic and non-aromatic compounds. **B) Orientation effect:** Effect of substituent groups, Activating and deactivating group, Theory of reactivity and orientation on the basis of inductive and resonance effects. **C) Electrophilic aromatic substitution:** Halogenation, nitration, sulphonation and Friedal Craft's alkylation/acylation with their mechanism. **Periods: 14**
Unit V	**Gaseous State:** Postulates of kinetic theory of gases, Maxwell-Boltzmann distribution of velocities (only qualitative treatment), RMS velocity, Average velocity, Most probable velocity, Relationship between RMS velocity and Average velocity, RMS velocity and Most probable velocity, Mean free path, Collision diameter, Collision number or Collision frequency, Deviation of real gases from ideal behaviour, Explanation of deviations, Derivation of van der Waal's equation for real gases. Critical phenomenon, Andrew's experiment (isotherms of carbon dioxide) Critical constant Pc, Tc, Vc in terms of van der Waal's constant (a, b) Derivation of reduced equation of state, Law of corresponding state, Numerical. **Periods: 14**
Unit VI	**A) Liquid State:** Definition of surface tension, Its SI unit and effect of temperature on surface tension, Derivation of expression for relative surface tension by stalagmometer method. Applications of surface tension. Viscosity, definition of coefficient of viscosity, Its SI unit and effect of temperature on viscosity, Derivation of expression for relative viscosity by Ostwald's viscometer method, Applications of viscosity. **B) Physical Properties and Molecular Structure:** **I. Electrical Properties:** (i) Polar and non-polar molecules. Dipole moment. (ii) Induced polarization and orientation polarization. Clausius Mossotti equation (only qualitative treatment). (iii) Measurement of dipole moment by temperature and refractitivity methods. (iv) Applications of dipole moment for the determination of molecular structure. i.e. percentage ionic character of covalent bonding, molecular geometry, cis-trans isomers, ortho, meta and para isomers of a disubstituted benzene. **II. Magnetic Properties:** (i) Paramagnetic and diamagnetic substances, origin of paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism. (ii) Volume, specific, mass and molar susceptibility. Relationship between molar magnetic susceptibility and magnetic moment. (iii) Relationship between magnetic moment and number of unpaired electrons. (iv) Gouy's balance method for determination of magnetic susceptibility. (v) Application of magnetic moment in the determination of molecular structure. (vi) Numerical **Periods: 14**
***SEM:** A) Create models for periodic table or periodic properties, or shape of orbitals, categorization of acids and bases on the basis of various theories, Compare applications of non-aqueous solvents.	

B) Analyze the role of reaction intermediates in different organic reactions, classification of aromatic and non-aromatic compounds with justification. C) Numerical associated with gaseous and liquid state, Applications of van der Waal's equation for other gaseous constants and parameters, Prediction of molecular structures using physical properties, Data collection and analysis for surface tension and viscosity coefficient of different liquids.	
COs: By the end of this module, the students will be able to: 1. Create models associated with periodic table 2. Associate reaction intermediates and functional group chemistry with different types of reaction mechanisms. 3. Solve numerical problem associated with gaseous and liquid state.	
**Activities:	Model creation, Chart preparation, memory maps, Class tests, assignments, project, survey, group discussion, industrial visit, or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

Course Material/Learning Resources

Text books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- Vishal Publications, Delhi.
2. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
3. A Text Book of Chemistry for first Semester of B.Sc. by AUCTA Association and DnyanPath Publication, Amravati

Reference Books:

1. Inorganic Chemistry by A.K. De, Wiley East Ltd.
2. Inorganic Chemistry by Meisler and Tarr, 4th Edition, Pearson Pub.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan, S. Chand & Co.
4. Concise Inorganic Chemistry by J.D. Lee, ELBS.
5. Inorganic Chemistry by J.E. Huheey- and Kettle, Harper & Row.
6. Advanced Inorganic Chemistry, Vol-I, Satya Prakash, Madan, Tuli, Basu.
7. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
8. Organic Chemistry by S.K. Ghosh.
9. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
10. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
11. Organic Chemistry by TWG Solomons, 8th edition, John Wiley
12. Organic chemistry by R. K. Bansal
13. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
14. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
15. Principles of Physical Chemistry: Maron and Prutton.
16. Principles of Physical Chemistry: Puri, Sharma, and Pathania.
17. Physical Chemistry: P.W. Atkins, 6th Edn.
18. Physical Chemistry: Levine
19. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
20. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
21. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.

22. Practical Physical Chemistry: Palit and De.
23. Practical Physical Chemistry: Yadao.
24. Practical Physical Chemistry: Khosla.
25. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.

Weblink to Equivalent MOOC on SWAYAM if relevant:
Weblink to Equivalent Virtual Lab if relevant:
Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

Syllabus Prescribed for three Year UG/PG Programme

Programme: B.Sc. with Chemistry

Semester 1

Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
CHE(1S)PR	**Chemistry 1S**	**Total 26 per Semester**

COs

At the end of Lab/Practical course, students would be able to

1. Synthesise different types of organic compounds.
2. Perform the process of filtration, crystallization, melting point, waste management.
3. Understand the effect of orientation effect of a group
4. Skilfully determine the surface tension, viscosity of liquid.
5. Predict the endothermic or exothermic process from heat of solution of a salt.

*** List of Practical/Laboratory Experiments/Activities etc.**

1	Preparation of Acetyl derivative of aromatic primary amine (aniline or toluidine).
2	Preparation of Benzanilide (Benzoylation).
3	Preparation of Benzoic acid from Benzamide (Hydrolysis).
4	Preparation of Benzoic acid from benzaldehyde (Oxidation).
5	Preparation of phenyl–azo–β–naphthol dye (Diazotisation)
6	Base catalysed Aldol Condensation (Synthesis of dibanzal propanone).
7	Preparation of p-nitroacetanilide from acetanilide.
8	Determination of surface tension of a given liquid using Stalagmometer
9	Determination of the parachor value of $-CH_2-$ group (methylene) using Stalagmometer
10	Determination of coefficient of viscosity of aqueous solution of ethanol or polymer at room temperature
11	Determination of unknown percentage composition of given glycerol solution from standard 2%, 4%,6%,8% and 10% solutions of glycerol
12	Determination of the heat of solution of KNO_3 (5% solution)

Note:

a) Student should perform the single stage preparation with the help of given procedure.

b) Melting point and percentage yield should be reported.

c) The sample should be submitted.

d) Students should recrystalize the sample with suitable solvent.

e) Students should know the reaction and its mechanism of given single stage preparation.

Distribution of Marks for Practical Examination

Time: 4 hours (One Day Examination) Marks: 50

Exercise-I …….. 18

Exercise-II ……..18

Viva-Voce …….07

Record …….... 07

Total: 50

Syllabus Prescribed for Three Year UG/PG Programme

Programme: B.Sc. with Chemistry

Semester 2

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
CHE(2S)T	Chemistry 2S	84

COs

By the end of this course, the students would be able to:

1. apply the knowledge gained by studying types of bonding, solvation, hybridization and molecular geometries.
2. Draw the correct molecular structures, bond order and bond length.
3. synthesize commercially important compounds of varying carbon backbone.
4. Choose correct synthetic approach to prepare derivatives of industrially important molecules.
5. Solve numerical problems related to crystalline state.
6. Acquire skills to use chemical kinetics to develop mechanism of chemical reactions.

Unit	Content
Unit I	**A) Ionic bonding:** Definition of ionic bond. Factors affecting ionic bond formation (energetic of ionic bond formation ionization energy, electron affinity and lattice energy). Born-Haber's cycle to determine lattice energy. Solvation and solvation energy, factors affecting solvation energy. **B) Polarization:** Definition, polarizing power, polarizability, effect of polarization on nature of bond. Fajan's rules of polarization and its applications. **C) Valence bond theory:** Directional nature of covalent bond. Hybridization, types of hybridization to explain geometries of $BeCl_2$, BF_3, CH_4, PCl_5, SF_6 and IF_7 **Periods: 14**

Unit II	**A) VSEPR Theory:** Various rules under VSEPR theory to explain molecular geometry (following examples may be taken to explain various rules- $SnCl_2$, CH_4, NH_3, H_2O, SF_4, ClF_3, XeF_4, XeO_3, PCl_3. Limitations of VSEPR theory **B) Molecular Orbital Theory:** Postulates of MO theory. LCAO approximation. Formation of bonding and antibonding MOs. Rules for LCAO. MO energy level diagram. Concept of bond order. MO structure of homonuclear diatomic molecules of namely He_2, H_2, N_2 and O_2. Stability sequence of species of O_2 i.e. O_2, O_2^+, O_2^{2+}, O_2^- and O_2^{2-}. Paramagnetic nature of O_2. MO structure of heteronuclear diatomic molecules viz. NO, HF and CO (Coulson's structure). Explanation of important properties of CO viz. – triple bond, almost nonpolar nature, electron donor and acceptor behavior. Comparison of VB and MO theories. **Periods: 14**
Unit III	**A) Haloalkanes:** Vinyl chloride - Synthesis from acetylene and ethylene dichloride, reactions with aqueous and alcoholic KOH, polymerization. Allyl chloride - Synthesis from propylene, reactions with aqueous and alcoholic KOH. Allyl bromide - Synthesis from propylene using NBS, reaction with HBr. Comparison of reactivity of vinyl and allyl chloride. **B) Haloarenes:** Chlorobenzene - Synthesis from phenol, reaction with acetonitrile. Bromobenzene - Synthesis from silver salt of benzoic acid (Hunsdiecker reaction), Wurtz-Fittig reaction. Iodobenzene - Synthesis from benzene diazonium chloride, Ullmann reaction. Benzyl chloride - Synthesis from toluene and benzene, reactions with Mg and NaCN. Comparison of reactivity of chlorobenzene and benzyl chloride, benzyne intermediate mechanism. **C) Polyhydric alcohols:** Ethylene glycol - Synthesis from ethylene and ethylene dibromide, reactions with PCl_5, CH_3COOH and acetone, dehydrations using conc. H_2SO_4, $ZnCl_2$ and phosphoric acid. Pinacol - Synthesis from acetone and α-diketone, Pinacol-Pinacolone rearrangement (mechanism). Glycerol - Synthesis from propylene and 3-chloropropylene, reactions with HNO_3, HCl and Na, dehydration using $KHSO_4$ **Periods: 14**
Unit IV	**A) Phenols:** Phenol - Synthesis from toluene, cumene and salicylic acid, Kolbe's carboxylation reaction, Fries rearrangement, Reimer-Tiemann reaction, bromination, acidity of phenol. **B) Ethers and epoxides:** Diethyl ether - Synthesis from ethanol, Williamson's synthesis, reactions with cold and hot HI and acetic anhydride. Crown ethers - Brief introduction to crown ethers and its applications. Ethylene oxide - Synthesis from ethylene, ring opening reactions with Grignard reagent, HCN and H_2S, reduction with Zn + CH_3COOH, dimerization to dioxane (mechanism). Styrene oxide - Synthesis from styrene, ring opening reactions with acid and alkali, reduction with $LiAlH_4$. **C) Thiols and thioethers:** Ethanethiol - Synthesis from ethyl iodide, oxidations with I_2 and H_2O_2. Diethyl sulphide - Synthesis from ethyl bromide, Williamson's synthesis, desulphurization with Raney Ni, decomposition with alkali. **Periods: 14**
Unit V	**Crystalline state:** Symmetry in crystal, plane of symmetry, axis of symmetry and point of symmetry. Law of constancy of interfacial angles. Elements of symmetry in cubic crystals. Laws of symmetry. Law of rational indices, Weiss and Miller indices of a lattice planes, calculation of interplanar distance d(h,k,l) from Miller indices in a cubic system. Seven crystal systems and fourteen Bravais lattices, Bravais lattices of cubic system. Simple cubic system (S.C.C.), body centered cubic system (B.C.C.) and face centered cubic system (F.C.C.). Calculation of number of constituent units in S.C.C., B.C.C. and F.C.C. Ratio of interplanar distances for 100, 110 and 111 lattice planes in S.C.C., B.C.C. and F.C.C. (No geometrical derivation). Derivation of Bragg's equation for X-ray diffraction, Bragg's X-ray spectrometer

	method for the determination of crystal structure of NaCl and KCl. Anomalous behavior of KCl towards X-ray. Numerical. **Periods: 14**
Unit VI	**Chemical Kinetics:** Explanation of terms like rate of reaction, order of a reaction and molecularity. Definition with one example of zero, first and second order reaction. Half-life period of a reaction. Derivation of rate equation for first and second order reaction with equal initial concentration and different initial concentration of a reactant. Characteristics of first and second order reaction. Examples of first and second order reaction and their kinetics study with modified rate equation viz. the reactions (i) decomposition of H_2O_2, (ii) reaction between $K_2S_2O_8$ and KI, (iii) hydrolysis of methyl acetate catalyzed by acid, (iv) saponification of ethyl acetate by NaOH and (v) inversion of cane sugar. Determination of order of a reaction by integration, graphical, equifractional change, vant Hoff's differential method and Ostwald's isolation method. Effect of temperature on reaction rates. Arrhenius equation, activation energy and its determination using Arrhenius equation. Numerical. **Periods: 14**
***SEM:** A) Classify molecules using hybridization, VSEPR theory to predict molecular geometries, sketch Molecular orbital diagram for different molecules. B) Comparative reactivity of halobenzene and benzyl halide, determine industrial uses of phenol, diethyl ether and ethylene epoxide. C) Numerical associated with crystalline state and chemical kinetics, Determination of crystal structure of NaCl and KCl, Determination of order of reactions, and reaction kinetics.	
COs: By the end of this module, the students will be able to: 1. Create models associated with molecular geometries, hybridization, MO diagrams. 2. Develop synthetic routes for halobenzenes and benzyl halides. 3. Solve numerical problems associated with crystalline state and chemical kinetics.	
**Activities:	Model creation, Chart preparation, memory maps, Class tests, assignments, project, survey, group discussion, industrial visit, or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

Course Material/Learning Resources

Text books:

1. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
2. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
3. A Text Book of Chemistry for first Semester of B.Sc. by AUCTA Association and DnyanPath Publication, Amravati

Reference Books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan, S. Chand & Co.
4. Concise Inorganic Chemistry by J.D. Lee, ELBS.
5. Inorganic Chemistry by J.E. Huheey- and Kettle, Harper & Row.
6. Advanced Inorganic Chemistry, Vol-I, Satya Prakash, Madan, Tuli, Basu.
7. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
8. Organic Chemistry by S.K. Ghosh.

9. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.

10. Organic Chemistry by J.M. Hornback, 2nd Edition, Brooks Cole Pub

11. Organic Chemistry by TWG Solomons, 8th edition, John Wiley

12. Organic chemistry by R. K. Bansal

13. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.

14. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.

15. Principles of Physical Chemistry: Maron and Prutton.

16. Principles of Physical Chemistry: Puri, Sharma, and Pathania.

17. Physical Chemistry: P.W. Atkins, 6th Edn.

18. Physical Chemistry: Levine

19. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.

20. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.

21. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.

22. Practical Physical Chemistry: Palit and De.

23. Practical Physical Chemistry: Yadao.

24. Practical Physical Chemistry: Khosla.

25. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.

Weblink to Equivalent MOOC on SWAYAM if relevant:

Weblink to Equivalent Virtual Lab if relevant:

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

Syllabus Prescribed for three Year UG/PG Programme

Programme: B.Sc. with Chemistry

Semester 2

Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
CHE(2S)PR	**Chemistry 2S**	**26 per Semester**

COs

At the end of Lab/Practical course, students would be able to -

1. Analyse the given organic compound qualitatively by different tests.
2. Prepare the derivative of the provided substance.
3. Illustrate the practical skills in volumetric analysis.
4. Differentiate types of titrations e.g. acid-base, redox, etc.
5. Comprehend the kinetics of reactions and interpret the experimental data.
6. Calculate, communicate and analyse the result.

*** List of Practical/Laboratory Experiments/Activities etc.**

	Complete analysis of simple organic compounds (like urea, thiourea, benzoic acid, Salicylic acid, oxalic acid, glucose, naphthalene, para-toluidine, benzamide, etc.) containing one or two functional groups involving following steps. i) Preliminary examination ii) Detection of elements iii) Detection of functional groups iv) Determination of melting point v) Preparation of derivative and determination of its melting point vi) Performance of spot test, if any
1	Qualitative analysis of compound-1
2	Qualitative analysis of compound-2
3	Qualitative analysis of compound-3
4	Qualitative analysis of compound-4
5	Qualitative analysis of compound-5
6	To determine the strength of oxalic acid by titration with $KMnO_4$.

7	To determine strength of FAS by titration with $KMnO_4$ using internal indicator.
8	Determination of temporary hardness of water sample.
9	To determine the strength of oxalic acid by titration with $KMnO_4$.
10	To determine strength of FAS by titration with $KMnO_4$ using internal indicator.
11	Determination of order of reaction of hydrolysis of methyl acetate by an acid.
12	To study kinetics of saponification of ethyl acetate by NaOH.

Distribution of Marks for Practical Examination

Time: 4 hours (One Day Examination) Marks: 50

Exercise-I …….. 18

Exercise-II ……..18

Viva-Voce …….07

Record …….. 07

Total: 50