Progressive Education Society's

Modern College of Arts, Science and Commerce (*Autonomous*),

Shivajinagar, Pune- 5

Second Year of B. Sc. NEP (Chemistry)

2025-26

Semester - III

Course Type	Course Code	Course Name	No. of Credits
Major Core (T+P)	24ScCheU3101	Physical, Inorganic & Organic Chemistry	04 Credits (60L)
	24ScCheU3102	Lab Course on 24ScCheU3101	02 Credits (15 Expt.)
VSC (P)	24ScCheU3501	Lab Course on Chemistry of Cosmetic Ingredients-II	02 Credits (15 Expt.)
IKS (T)	24ScCheU3901	Ancient Metallurgy in India	02 Credits (30L)
FP (P)	24ScCheU3002	Field Project I	02 Credits (30L)
Minor (T+P)	24ScCheU3301	Fundamentals of Biochemistry (T)	02 Credits (30L)
		Lab Course on 24ScCheU3301 (P)	02 Credits (15 Expt.)
OE (T)	24ScCheU3401	General Chemistry - III	02 Credits (30L)
AEC (T)	24CpCopU3703	English Communication Skills II	02 Credits (30L) Centralized
CC (T)	24CpCopU3001	Online Course on Yoga	02 Credits (30L) Centralized
Total Credits			22 Credits

Teaching Scheme: TH: Hours/Week: 10 H: P:12 H

Examination Scheme:

Credits	Total Marks	CIE	ESE
4	**100**	**40**	**60**
2	**50**	**20**	**30**

Prerequisite Courses: F. Y. B. Sc Chemistry

24ScCheU3101: Physical, Inorganic & Organic Chemistry

Course Outcomes:

1. To study the preparation and uses of various classes of organic compounds.
2. To understand the various types of reaction mechanisms.
3. To learn the name reactions, uses of various reagents, and the mechanism of their action.
4. To Study the Principles of Solubility and Qualitative Inorganic Analysis.
5. To know the theories of acids, bases & non-aqueous solvents.
6. Understanding the chemistry of transition and inner transition elements.
7. Understand the kinetics of chemical reactions.
8. Understand the Phase Equilibrium.
9. Study the Catalysis, Adsorption, and Photochemistry.

Physical, Inorganic & Organic Chemistry (24ScCheU3101)	**(60 Lectures, 04 Credits)**
Section I	**Physical Chemistry**
Chapter 1	**Chemical Kinetics** **(10 Lectures)**
	• Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expression for first order, second order (equal initial concentrations) and third order (equal initial concentrations) and their characteristics, numerical for first, second (equal initial concentration) and third order (equal initial concentration). • Methods for determination of order of reaction.

	• Temperature dependence of reaction rates; Arrhenius equation; activation energy.
Chapter 2	**Phase Equilibria (06 Lectures)**
	• Introduction • Concept of phases, components and degrees of freedom, Gibbs Phase Rule. • Phase diagram for one component systems: water system and sulphur system. • Nernst distribution law: its derivation and applications.
Chapter 3	**Catalysis and Surface Chemistry (04 Lectures)**
	• Types of catalyst, specificity and selectivity. • Effect of particle size and efficiency of nanoparticles as catalysts. • Physical adsorption, chemisorption • Adsorption isotherms.
Section II	**Inorganic Chemistry**
Chapter 1	**Inorganic and Organic Qualitative Analysis (5 Lectures)**
	Inorganic Qualitative Analysis • Basic principle, common ion effect, solubility, solubility product, preparation of original solution. • Classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), and detection of acidic radicals. **Organic Qualitative Analysis:** • Types of organic compounds, Characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.
Chapter 2	**Acids and Bases (5 Lectures)**
	• Bronsted-Lowry concept of acid-base reactions, solvated proton, relative

	strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.
Chapter 3	**Chemistry of *d* and *f* Block Elements (10 Lectures)**
	• Position of d-block in the periodic table, electronic configuration. • Trends in properties of these elements w.r.t. • (a) size of atoms & ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex formation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density (j) melting and boiling points. • Introduction of f-block elements - based on electronic configurations, occurrence and reactivity, F-block elements as Lanthanide and Actinide series. • Lanthanides: Position in the periodic table, Name and electronic configuration of lanthanides, Oxidation States, Occurrence, Lanthanide contraction & its effect on the chemistry of Lanthanides and post lanthanide elements, applications of lanthanides. • Actinides: Position in the periodic table, Name and electronic Configuration of actinides, Oxidation States, Occurrence, nuclear fuels- nuclear fission fuels and nuclear fusion fuels, IUPAC nomenclature system for super heavy elements with atomic number greater than 100, comparison between Lanthanides and Actinides.
Section III	**Organic Chemistry**
Chapter 1	**Chemistry of Halogenated Hydrocarbons: (10 Lectures)**
	• *Alkyl halides:* Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and SN_i mechanisms with stereochemical aspects and effect of solvent, etc.; nucleophilic substitution vs. elimination. • *Aryl halides:* Preparation and Aromatic electrophilic substitution reaction, Mechanism & Aromatic Nucleophilic Elimination Addition Reaction (Effect

	of electron withdrawing and electron donating substituents), Energy profile diagram, etc.
Chapter 2	**Name Reactions and Rearrangements (with Mechanism) (10 Lectures)**
	• Pinacol-Pinacolone, Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α substitution reactions, Reimer–Tiemann, Kolbe's–Schmidt, Wittig, Reformatsky, Curtius. • Oxidation and reduction reactions: (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, $KMnO_4$/dil. H_2SO_4, $K_2Cr_2O_7$/dil. H_2SO_4, PDC and PCC) • Michael addition.

Reference books:

Section I: For Physical Chemistry

1. Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
6. Zumdhahl, S.S. *Chemistry concepts and applications* Cengage India (2011).
7. Ball, D. W. *Physical Chemistry* Cengage India (2012).
8. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
9. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).
10. Metz, C. R. *Physical Chemistry 2nd Ed.,* Tata McGraw-Hill (2009).
11. Textbook of Physical Chemistry by Samuel Glasstone, Published by Macmillan & co, 1964.

Section II: for Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. F.A. Cotton, G. Wilkinson, *Advanced Inorganic Chemistry*. 6th Edition.
3. A textbook of macro & semi micro qualitative analysis by A.J. Vogel, fifth edition
4. Fundamental Chemistry by A. K. Dee. (3rd Ed.).
5. F.A. Cotton, G. Wilkinson, *Advanced Inorganic Chemistry*. 6th Edition.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
7. Concise Inorganic Chemistry by J. D. Lee 5th Edition.

Section III: for Organic Chemistry

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
5. *Advanced Organic Chemistry, Part A: Structure and Mechanisms*, 5th ed. by,

   Francis A. Carey and Richard J. Sundberg.
6. Organic Chemistry, Second Edition by Jonathan Clayden, Nick Greeves, and Stuart Warren.

Lab Course on 24ScCheU3101 (24ScCheU3102)

Course Outcomes:

1. Verify theoretical principles experimentally.
2. Interpret the experimental data on the basis of theoretical principles.
3. Correlate theory to experiments. Understand/verify theoretical principles by experiment observations; explain practical output / data with the help of theory.
4. Understand systematic methods of identification of substances by chemical methods.
5. Write a balanced equation for the chemical reactions performed in the laboratory.
6. Perform organic and inorganic synthesis and is able to follow the progress of the chemical reaction by suitable method (color change, ppt. formation, TLC).
7. Set up the apparatus / prepare the solutions - properly for the designed experiments.

8. Perform the quantitative chemical analysis of substances explaining principles behind it.
9. Systematic working skills in the laboratory will be imparted to students.

Important Notes: i) Wherever feasible develop and practice micro or semi-micro methods from known / recommended procedures and the reference books. This is to i) minimize the cost of experiment, ii) reduce wastage of chemicals iii) reduce environmental pollution iv) Mentors should promote students to complete the Journal on the same day before leaving the lab. Ensure that the original data is retained and used by the candidate. Students may adjust the data from their lab work to reach close to theoretical values. If a journal is completed before leaving the lab it will not encourage students to "adjust" the facts from their lab work.

(**Ref**-*Journal of Chemical Education*, Min J. Yang and George F. Atkinson, Designing New Undergraduate Experiments, Vol. 75, No. 7, July 1998).

Lab Course on 24ScCheU3101 (24ScCheU3102)	**(15 Experiments, 02 Credits)**
Section I	**Physical Chemistry Practicals (5 Experiments)**
	1. To determine the rate constant (or to study kinetics) of acid catalyzed ester hydrolysis. 2. To determine the energy of activation of the reaction between potassium iodide and potassium persulphate. 3. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it. 4. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal. 5. Construction of phase diagram using cooling curves or ignition tube method for simple eutectic system.
Section: II	**Inorganic Chemistry Practicals (5Experiment)**
	1. **Inorganic Qualitative Analysis of Given Binary Mixture (03 Mixtures)** Basic and Acidic radicals detection with Confirmatory tests. (Detection

	of Phosphate and Borate only and separation of Borate). Preparation of original/ water solution, group detection, group analysis. 4. Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically). 5. Preparation of Hexamminenickel(II)chloride [Ni $(NH_3)_6$] Cl_2 complex. 6. Preparation of Tetraaminecopper(II)sulphate $[Cu(NH_3)_4]SO_4$ complex.
Section: III	**Organic Chemistry Practicals**
	1. Organic Qualitative Analysis (Single Compound) (03 Compounds) (1 solid, 1 sublimable, 1 liquid) To determine type, physical constant, detection of elements and functional group in given organic compounds (Full analysis). 4. Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method. b. Salicylic acid by green approach (using ceric ammonium nitrate). 5. Aldol condensation using conventional methods. **The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.**

Reference Books

Physical Chemistry Practicals:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
4. Ahluwalia, V.K.; Dingra. S.; Gulati. A. *College Practical Chemistry*, Universities Press: Hyderabad (2005).

5. Nad, A. K; Mahapatra, B.; Ghoshal A. *An Advance Course in Practical Chemistry,* New Central Book Agency.: Kolkata (2004).

Inorganic Chemistry Practicals:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition Pearson, 2009.
2. Basic Principles of Practical Chemistry, Venkateswaran, V., Veeraswamy, R., Kulandivelu, A.R.,2nd ed., Sultan Chand &Sons: New Delhi, 1997.
3. An advanced course in Practical Chemistry, Nad A. K., Mahapatra B, Ghoshal A., 3rd ed., New Central Book Agency: Kolkata, 2007.

Organic Chemistry Practicals:

1. Experiments in chemistry, D. V. Jahagirdar, Himalaya Publication.
2. Mann, F. G. & Saunders, B. C. *Practical Organic Chemistry,* Pearson Education (2009).
3. Furniss, B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A. R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
4. Ahluwalia, V. K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V. K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

24ScCheU3501: Lab Course on Chemistry of Cosmetic Ingredients

Course Outcomes:

1. Learn the basics of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
2. Learn the use of safe, economical and body-friendly cosmetics.
3. Learn to prepare different cosmetic ingredients.
4. Learn to extract different cosmetically important ingredients from natural resources.
5. Learn to extract essential oil.

24ScCheU3501: Lab Course on Chemistry of Cosmetic Ingredients (15 Expts, 02 Credits)
1) Preparation of talcum powder. 2) Preparation of shampoo. 3) Preparation of enamels. 4) Preparation of hair remover. 5) Preparation of face cream. 6) Preparation of nail polish and nail polish remover. 7) Extraction and Analysis of eugenol from clove 8) Extraction and Analysis of Jasmone from jasmine 9) Preparation of perfumes. 10) Preparation of hair dye 11) Preparation of Shaving cream 12) Preparation of Hand wash 13) Preparation of Hand sanitizer 14) Preparation of Soap 15) Preparation of Tooth powder and Toothpaste

Reference Books:

1. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).
4. Barel, A.O.; Paye, M.; Maibach, H. I. (2014), Handbook of Cosmetic Science and Technology, CRC Press.
5. Garud, A.; Sharma, P.K.; Garud, N. (2012), Text Book of Cosmetics, Pragati Prakashan.
6. Gupta, P. K.; Gupta, S. K. (2011), Pharmaceutics and Cosmetics, Pragati Prakashan
7. Butler, H. (2000), Poucher's Perfumes, Cosmetic and Soap, Springer
8. Kumari, R. (2018), Chemistry of Cosmetics, Prestige Publisher.

9. Flick, E. W. (1990), Cosmetic and toiletry formulations, Noyes Publications / William Andrew Publishing.
10. Natural Ingredients for Cosmetics; EU Survey 2005
11. Formulation Guide for cosmetics; The Nisshin OilliO Group, Ltd.
12. Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation

24ScCheU3901: Ancient Metallurgy in India

Course outcomes:

1. Analyze the historical significance of metallurgy in ancient India and its impact on society, culture, and economy.
2. Describe the metallurgical processes used in ancient India, including extraction, smelting, alloying, and casting techniques.
3. Identify and understand the significance of key archaeological sites related to ancient metallurgy, such as Mohenjo-Daro, Harappa, Taxila, and others.
4. Examine the types of metals used in ancient India, such as iron, copper, bronze, gold, and silver, and their properties and uses.
5. Assess the technological advancements in metallurgy, including the production of high-quality steel (e.g., Wootz steel) and their influence on global metallurgical practices.
6. Discuss the role of metallurgy in the development of ancient Indian civilization, including its influence on warfare, trade, agriculture, and craftsmanship.
7. Compare and contrast the metallurgical practices of ancient India with those of other contemporary civilizations, such as Egypt, Mesopotamia, and China.
8. Develop research skills to investigate and critically analyze historical texts, inscriptions, and archaeological evidence related to ancient Indian metallurgy.
9. Understand the importance of conserving ancient metallurgical heritage and the ethical considerations involved in archaeological excavations.

24ScCheU3901: Ancient Metallurgy in India	(30 Lectures, 02 Credits)
Chapter 1	**Introduction to Ancient Metallurgy (3 Lectures)**
	• Knowledge of metals, need of metals, strength of metal & alloys in metallurgy
Chapter 2	**Metallurgical heritage (3 Lectures)**
	• Description of gold, silver & other metals like Copper, Iron, tin, mercury and lead in the ancient period. Coinage metals in the ancient period
Chapter 3	**History Overview of metallurgy in the Indian Subcontinent (5 Lectures)**
	• Overview—Hindu, Buddist, Jain, and other texts, Archaeology, Indus Valley Civilization, Metals, early history (200 BCE), early common era, and early modern era.
Chapter 4	**Ancient metallurgical instruments in the extraction of metals (8 Lectures)**
	• Gold, silver and mercury. Crucible furnace, air blowers, binders & glues used in ancient period. Preparation of metal powder.
Chapter 5	**Discovery of Nanotechnology in Ancient Metallurgy (8 Lectures)**
	• Nanotechnology-based material made in Ancient India Application of nanomaterial in statues, coins, colors & weapons.
Chapter 6	**Application of metallurgy in ancient times (3 Lectures)**
	• Weapon technology, sculpture art, metal application on walls and glass for coloring metals in jewelry and ornaments.

Reference Books:

1. Ancient Metal Technology and Archaeology of South Asia (A Pan-Asian Perspective)

by D.P. Agrawal

2. The Rustless Wonder: A Study of the Iron Pillar at Delhi by T.R. Anantharaman
3. Delhi Iron Pillar: New Insights by R. Balasubramaniam
4. Marvels of Indian Iron through the Ages by R. Balasubramaniam
5. The Saga of Indian Cannons by R. Balasubramaniam
6. Minerals and Metals in Ancient India, 2 vols by Arun Kumar Biswas
7. Mining and Metallurgy in Ancient India by Rina Shrivastava
8. India €™s Legendary Wootz Steel: An Advanced Material of the Ancient World by Sharada Srinivasan & Srinivasa Ranganathan
9. History of Iron Technology in India: From Beginning to Pre-Modern Times by Vibha Tripathi
10. Metallurgy in Ancient India by Rajya Marathi Vikas Sanstha, Mumbai 2014 by Dr. Pravin Deshpande

23ScCheU3002: Field Project I

Course Outcomes:

1. To enable the students for scientific literature reading and analyzing the literature data.
2. To link the basic chemistry concepts with current research advancements.
3. To enable the students to identify thrust areas in specific fields of chemistry and plan a research hypothesis.
4. To develop new experimental skills, interpreting a research outcome and enhancing the scientific writing abilities.

23ScCheU3002: Field Project I	**(30 Lectures) (2 Credits)**
	Project: By Individual student

24ScCheU3301: Fundamentals of Biochemistry (T)

Course Outcomes:

1. Recall sources, structures and list the significance of biomolecules.
2. Classify biomolecules with suitable examples and differentiate between their features.
3. Apply the knowledge of membrane composition to correlate with its properties and

different types of transport mechanisms.

4. Analyze the interrelationship between biomolecules and their derivatives. Identify the sequence of steps required to determine hierarchy in the structural organization of macromolecules.
5. Evaluate in-vitro and in-vivo reactions of biomolecules along with their significance.
6. Assemble and tabulate the coenzymes of vitamins and corelate its significance in biochemical reactions. Plan the use of suitable methodologies for characterization of biomolecules.

24ScCheU3301: Fundamentals of Biochemistry	**(30 Lectures, 02 Credits)**
Chapter 1	**Carbohydrates (8 Lectures)**
	● Introduction, classification of carbohydrates, their structures and biological significance. ● Concept of anomers, epimers, reducing and non-reducing sugars, mutarotation, inversion. ● Reactions of glucose with acid, base, phenyl hydrazine, oxidizing agents, reducing agents and its significance, Glycosidic bonds.
Chapter 2	**Amino acids (8 Lectures)**
	● Classification of amino acids. ● Concept of ampholytes, isoelectric point, zwitterions, titration curve of glycine. ● Reactions of amino acids with Ninhydrin, Sanger's, Dansyl chloride, Dabsyl chloride and Edmann's reagents and their significance. ● Peptide bond and its features.
Chapter 3	**Lipids (8 Lectures)**

	• Introduction, classification of lipids, their structures and biological significance. • Reactions of Lipids-saponification, hydrolysis, emulsification and oxidation. • Concept of saponification number, acid number, iodine number and their significance. • Rancidity. • Types of Lipoproteins and their significance. • Blood group substances.
Chapter 4	**Hormones & Vitamins (6 Lectures)**
	• Introduction to endocrine glands and their hormones. • Biochemical nature of hormones. • Mechanism of action of lipophilic and hydrophilic hormones. • Classification-Fat soluble and water-soluble vitamins. • Names, biological functions, deficiency and disorders of vitamins.

Reference Books:

1. Lehninger's, Principles of Biochemistry, by Nelson and Cox Macmillan Publisher 4th Edn..
2. Harper's Illustrated Biochemistry, 26th Edition.
3. Biochemistry by U. Satyanarayana.
4. Biotechnology, B. D. Singh, 3rd edition.
5. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, by Verma and Agarwal, 14th edition.
6. Principal Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, 6th edition.
7. Biophysical techniques by Upadhyay and Nath, 3rd revised edition.

24ScCheU3301 Lab Course on 24ScCheU3301 (P) (15 Expts, 02 Credits)
1. Separation and Identification of metal ions by Column Chromatography. (3 mixtures)

2. Separation of amino acids by TLC.
3. Estimation of Glucose by Fehling solution.
4. Distinguish test for reducing & non reducing sugar.
5. Preparation of buffer & measurement of P^H.
6. Qualitative analysis of carbohydrate (glucose/Fructose /sucrose)
7. Iodine Values of fatty acids.
8. Effect of temperature on salivary Amylase activity.
9. Estimation of Vitamin C.
10. DPPH Assay of free radicals.
11. Isolation of DNA from plant material.
12. Detection of adulteration in food (turmeric powder/ milk/ ghee).
13. Chlorophyll estimation.
14. Estimation of calcium from milk.
15. Acid value from oil sample.

Reference Books:

1. Principles of Biochemistry, Lehninger CRS publication.
2. Biochemistry, Jeremy M. Berg, Gregory J. Gatto Jr., Justin Hines (Author), John L. Tymoczko, Lubert Stryer, 10th edition, 2023.
3. Fundamentals of Biochemistry by Voet Donald Voet, Judith G. Voet, 4th edition.
4. Biochemistry: A problems approach: By William B. Wood, John H. Wilson, Robert M. Benbow, and Leroy E. Hood. 1974. William A. Benjamin, Inc., Menlo Park, California and London.
5. Practical Physiological Chemistry. By Philip B. Hawk, Bernard L. Oser, and William H. Summerson.

Course Code: 24ScCheU3401 General Chemistry-III

Course Outcomes:

1. To study the chemistry of milk carbohydrates and minor milk constituents.
2. To study the significance of lactose in various milk products.
3. To Study the chemical nature of minor milk constituents and their significance in product preparation.

4. To impart knowledge regarding the importance of quality of milk.
5. To inculcate the knowledge regarding recent trends in quality management and quality assurance.
6. Principle and technical aspects of quality control for various dairy equipment.
7. To study various test procedures related to maintenance of quality of milk.
8. To make awareness about statutory regulations.

24ScCheU3401: General Chemistry-III (Dairy chemistry) (30 Lectures, 02 Credits)	
Chapter 1	**Market Milk (12 Lectures)**
	● Introduction, definition, constituents of milk of different species such as cow, buffalo, goat, etc. ● Chemical composition of milk of Indian breed and foreign breeds of cow. ● Factors affecting composition of milk, characteristics of milk of different mammals, lactometer testing. ● Physicochemical properties of milk, acidity, pH, density, specific gravity, color and flavor of milk. ● Food and nutritive value of milk. ● Microbiology of milk, growth of microorganism, stages of growth, product of microbial growth, destruction of microorganisms growth.
Chapter 2	**Common Dairy Processes (Manufacture, storage and packaging)** **(10 Lectures)**
	● Cream separation- basic principles, gravity creaming water dilution and centrifugal creaming method. ● Construction of centrifugal separator, factors affecting percentage of fat, speed of machine, temperature of milk. ● Rate of inflow amount of flushing water formation of separator

	slime pasteurization of milk, flow sheet diagram. ● Process receiving milk, preheating filtration, clarification, cooling and storage raw milk, standardization, pasteurization, homogenization. ● Packing and storage. ● Uses of milk.
Chapter 3	**Preservatives & Adulterants in Milk (4 Lectures)**
	● Preservation of milk- Introduction, common preservatives used. ● Adulterants- Introduction, common adultrants used (urea, formalin, detergents, etc.) ● Modes of Adulteration and their detection such as skimming, addition of separated milk, skim milk, water, starch and cane sugar.
Chapter 4	**Milk Products (4 Lectures)**
	● Cream- definition, classification, composition, food & nutritive value, manufacture and uses of cream. ● Butter- definition, classification, composition, food & nutritive value, manufacture and uses of butter. ● Cheese- definition, classification, food & nutritive value, properties, manufacture and uses of cheese. ● Ice-cream- definition, classification, composition, food & nutritive value, manufacture, packing, hardening & storage, uses of ice-cream.

References

1. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983) 75.
2. Dairy Chemistry and Animal Nutrition- M.M. Rai, Kalyani, Publishers, New Delhi 3rd Edition, 1980.
3. Fundamentals of Dairy Chemistry- B.H. Webb, A.H. Hohsson, J.A. Alford, CBB

Publishers and Distributors.

4. Milk and Milk Products- C.H. Eckles, H. Macy, Tata McGraw Hikk Publishing Company Ltd.
5. Chemistry and Testing of Dairy Products- H.V. Athertion, J.A. New Lander, CBS, Publishers and Distributors.
6. Dairy Microbiology, Dr. K.C. MahantaOmsons Publication New Delhi.

Semester - IV

Course Type	Course Code	Course Name	No. of Credits
Major Core (T + P)	24ScCheU4101	Physical, Inorganic & Organic Chemistry	04 Credits (60L)
	24ScCheU4102	Lab Course on 24ScCheU4101	02 Credits (15 Expt.)
VSC (P)	24ScCheU4501	Lab Course on Drug Analysis	02 Credits (15 Expt.)
CEP (P)	24ScCopU4003	Community Engagement Project	02 Credits (30L)
Minor (T + P)	24ScCheU4301	Fundamentals of Bioinorganic Chemistry (T)	02 Credits (30L)
	24ScCheU4302	Lab Course on 24ScCheU4301 (P)	02 Credits (15 Expt.)
OE (T)	24ScCheU4401	General Chemistry -IV	02 Credits (30L)
SEC (P)	24ScCheU4601	Lab Course on Computer Applications in Chemistry	02 Credits (15 Expt.)
AEC (T)	24CpCopU4701/ 24CpCopU4702	MIL-II (Hindi) / MIL-II (Marathi)	02 Credits (30L) Centralized
CC (T)	24CpCopU4001	Health and Wellness	02 Credits (30L) Centralized
Total Credits			22 Credits

Teaching Scheme: TH: Hours/Week: 10 H; P:12 H

24ScCheU4101: Physical, Inorganic & Organic Chemistry

Course Outcomes:

1. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
2. Stereochemistry of organic molecules – conformation and configuration,

asymmetric molecules and nomenclature.

3. To understand heterocyclic compounds and their reactions.
4. To learn about organometallic compounds and their uses.
5. Understanding chemistry of inorganic polymers, their structures and uses.
6. Understanding Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
7. Understand and apply the laws governing photochemical reactions, such as the Stark-Einstein law and the concept of quantum yield.
8. To understand the concepts of conductance.
9. Explain and differentiate various photophysical processes like fluorescence, phosphorescence, and internal conversion, and their role in photochemical reactions.

24ScCheU4101: Physical, Inorganic & Organic Chemistry (60 Lectures , 04 Credits)	
Section I	**Physical Chemistry**
Chapter 1	**Conductance (10 Lectures)**
	• Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. • Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations and (v) hydrolysis constants of salts.
Chapter 2	**Photochemistry (10 Lectures)**

	• Introduction, thermal reactions and photochemical reactions. • Laws of photochemistry. • Quantum efficiency and quantum yield. Numericals. • Excitation of electrons (Jablonski diagram) • Types of photochemical reactions- photosynthesis, photolysis, photocatalysis, photosensitization, photophysical process-fluorescence, phosphorescence, quenching, chemiluminescence • Photochemical equilibrium. • Application of photochemistry: water splitting, degradation of dyes or toxic chemicals, biomedical applications.
Section II	**Organic Chemistry**
Chapter 1	**Stereochemistry (10 Lectures)**
	• Baeye'rs strain theory, heat of combustion, cycloalkanes, factors affecting the stability of conformation. • Different conformation of cyclohexane - conformational potential energy diagram for cyclohexane, equatorial and axial bonds, Monosubstituted cyclohexane stability with $-CH_3$ and $-C(CH_3)_3$ substitutes. Structures, energy calculations and optical activity (comment) on geometrical isomers of (1,2), (1,3), (1,4)-dimethylcyclohexane.
Chapter 2	**Chemistry of heterocyclic compounds with one hetero atom (10 Lectures)**
	• Definition and classification of heterocyclic compounds, nomenclature and aromatic character. • Synthesis of Pyrrole, Furan, Thiophene, Pyridine by Paal -Knorr and their reactions: nitration, sulphonation, acylation and catalytic reduction. • Structure and synthesis of quinoline and isoquinoline. Introduction to sulphur compounds, thiols, thioethers and sulphonic acids, ylides and their structures.

Section III	Inorganic Chemistry
Chapter 1	**Coordination Chemistry-I (10 Lectures)**
	• Nomenclature of coordination compounds • Werner's Coordination theory • Isomerism: a) Structural isomerism 1. Hydrate isomerism 2. Ionisation isomerism 3. Linkage isomerism 4. positional isomerism b). Stereoisomerism 1. Geometrical isomerism 2. Optical isomerism • Effective Atomic Number • Stability of Complex ions, Stability Constants • Factors affecting the Stability of Complex ions • Determination of Stability constants from thermodynamic data • Irving William Series
Chapter 2	**Coordination Chemistry-II (10 Lectures)**
	• Recapitulation of V. B. Theory • Crystal Field Theory • Crystal Field splitting of Energy Levels • Crystal Field Stabilization Energy • Magnetic Properties of metal complexes and crystal field theory • Factors influencing the magnitude of Crystal Field splitting • Geometry of Coordination Complexes • Crystal Field Effects and Spinel Structures of some oxides • Jahn-Teller Effects • Jahn-Teller Effects and Electronic Spectra of complexes

Reference Books:

Section I: For Physical Chemistry

1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
4. Barrow, G.M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).
8. R. Mukherjee K. K., Fundamentals *of Photochemistry,* New age (revised second edition).

Section II: For Inorganic Chemistry

1. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
2. Concise Inorganic Chemistry – J D Lee 5th edition.
3. Chemistry by Raymond Chang - 5th edition.
4. Inorganic Chemistry by A. G. Sharpe - 3rd edition.
5. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu.
6. Introduction to Coordination Chemistry by Geoffrey Lawrence, wily textbook series.
7. Coordination chemistry by Ajai Kumar, Aaryush education.
8. Concise coordination chemistry by R. Gopalan and V. Ramalingam, Vikas Publishing House.
9. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999 ·
10. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.

Section III: For Organic Chemistry

1. Organic Chemistry by Paula Bruice Pearson Higher Education 7th edition.
2. Organic Chemistry by Clayden, Greeves, Oxford Press.
3. Reactions, rearrangements and reagents - S N Sanyal.
4. Heterocyclic Chemistry by Joule and Keith Mills, Wiley-Blackwell 4th edition.
5. Organic Chemistry - 7th Ed. Morrison, Boyd & Bhattacharjee Pearson Education, 2011.
6. Stereochemistry of carbon compounds - E. L. Eliel.
7. Stereochemistry by Kalsi.
8. Heterocyclic Chemistry 5th Ed. John A. Joule and Keith Mills, Wiley-Blackwell 2010.
9. Heterocyclic Chemistry by V. K. Ahluwalia, Narosa Publishing House.

24ScCheU4102: Lab Course on 24ScCheU4101

Course Objectives:

1. To carry out the Inorganic qualitative analysis with borate removal.
2. To perform different types of titrations and analyze quantitatively the given sample using the technique of volumetric analysis.
3. To understand the concept of conductance.
4. To standardize the conductometer instrument and carry out experiments based on it.
5. Verify theoretical principles of photochemistry experimentally.
6. Interpret the experimental data based on theoretical principles.
7. Correlate theory to experiments. Understand/verify theoretical principles by experiment observations; explain practical output/data with the help of theory.
8. Understand systematic methods of identification of substances by chemical methods.
9. Write a balanced equation for the chemical reactions performed in the laboratory.
10. Perform organic and inorganic synthesis and can follow the progress of the chemical reaction by a suitable method (color change, ppt. formation, TLC).
11. Set up the apparatus / prepare the solutions - properly for the designed experiments.
12. Perform the quantitative chemical analysis of substances explaining principles behind it.

13. Systematic working skills in the laboratory will be imparted to students.

Important Notes: i) Wherever feasible develop and practice micro or semi-micro methods from known/recommended procedures and reference books. This is to i) minimize the cost of the experiment ii) reduce the wastage of chemicals iii) reduce environmental pollution iv) Mentors should encourage students to complete the Journal on the same day before leaving the lab. Ensure that the original data is retained and used by the candidate. Students may adjust the data from their lab work to reach close to theoretical values. If a journal is completed before leaving the lab it will not encourage students to "adjust" the facts from their lab work.

(**Ref**-*Journal of Chemical Education*, Min J. Yang and George F. Atkinson, Designing New Undergraduate Experiments, Vol. 75, No. 7, July 1998).

24ScCheU4102: Lab Course on 24ScCheU4101	**(15 Expts, 02 Credits)**
Section I	**Physical Chemistry Practicals (5 Experiments)**
	1. Determination of cell constant and Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. 2. Perform the following conductometric titrations: i. Strong acid vs. strong base. ii. Strong acid vs. weak base. 3. To determine the concentrations of hydrochloric acid and acetic acid in a mixture by conductometric titration against a standard solution of sodium hydroxide. 4. To determine $\boldsymbol{\lambda}_{max}$ and concentration of a given solution of $KMnO_4$ in 2 N H_2SO_4 solution. 5. To determine $\boldsymbol{\lambda}_{max}$ and concentration of a given solution of copper sulphate-ammonia complex by colorimetry.
Section II	**Inorganic Chemistry Practicals (5 Experiments)**

	1. Mixture with borate and phosphate. (**3 mixtures**) Basic radicals and Acidic radicals detection with confirmatory tests. Preparation of original/ water solution, group detection, group analysis. 4. To determine the amount of manganese (Mn) volumetrically by Volhard's method. 5. Volumetric estimation of NO_2^- by using $KMnO_4$ solution.
Section III	**Organic Chemistry Practicals (5 Experiments)**
	1. **Organic Qualitative Analysis (Binary Mixture)** **(3 Mixtures) (Solid-Solid, Solid-Liquid, Liquid-Liquid)** **Separation of Two Components** from a given binary mixture of organic compounds containing mono-functional groups (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively (type, physical constant, detection of elements and functional groups in given organic compounds). 4. Base catalyzed Aldol condensation (Green approach) (Confirm the conversion by TLC and physical constants.) 5. Preparation of Quinone from hydroquinone (Confirm the conversion by absence of phenolic –OH group in product, physical constants and purity by TLC). 6. Baeyer–Villiger oxidation by using *m*-chloro per benzoic acid. (Confirm the conversion by TLC and physical constant). 7. Acetylation of primary amine (Green approach) (Confirm the conversion by TLC and physical constant).

Reference Books

Physical Chemistry Practicals:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
4. Ahluwalia, V.K.; Dingra. S.; Gulati. A. *College Practical Chemistry,* Universities Press: Hyderabad (2005).
5. Nad, A. K; Mahapatra, B.; Ghoshal A. *An Advance Course in Practical Chemistry,* New Central Book Agency. : Kolkata (2004).

Inorganic Chemistry Practicals:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition Pearson, 2009.
2. Basic Principles of Practical Chemistry, Venkateswaran, V., Veeraswamy, R., Kulandivelu, A.R., 2 nd ed., Sultan Chand &Sons: New Delhi, 1997.
3. An advanced course in Practical Chemistry, Nad A. K., Mahapatra B, Ghoshal A., 3rd ed., New Central Book Agency: Kolkata, 2007.

Organic Chemistry Practicals:

1. Experiments in chemistry, D. V. Jahagirdar, Himalaya Publication.
2. Mann, F. G. & Saunders, B. C. *Practical Organic Chemistry,* Pearson Education (2009).
3. Furniss, B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A. R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
4. Ahluwalia, V. K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V. K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

24ScCheU4501: Lab Course on Drug Analysis

Course Objectives:

1. To understand the chemistry of synthesis of drugs.
2. To understand the different analytical methods of drug analysis.
3. Perform organic and inorganic synthesis and is able to follow the progress of the chemical reaction by suitable method (color change, ppt. formation, TLC).
4. Set up the apparatus / prepare the solutions - properly for the designed experiments.
5. Systematic working skills in the laboratory will be imparted to students.

24ScCheU4501: Lab Course on Drug Analysis	**(15 Expts, 02 Credits)**

1) Synthesis of Aspirin and its analysis.
2) Synthesis of magnesium bisilicate (Antacid) and its analysis.
3) Determination of cholesterol using Liebermann- Burchard reaction.
4) Synthesis of Paracetamol and its analysis.
5) Extraction and Analysis of Curcumin from turmeric powder.
6) Synthesis of Glyceryl trinitrate and its analysis.
7) Synthesis Dapsone and its analysis.
8) Synthesis of Benzimidazole and its analysis.
9) Synthesis of Anthranilic Acid and its analysis.
10) Synthesis of Sulfanilamide and its analysis.
11) Synthesis of benzoic acid from benzyl alcohol and its analysis.
12) Synthesis of 1,4 – dihydropyridine and its analysis.
13) Synthesis of nerolin and its analysis.
14) Synthesis of phenyl benzoate and its analysis.
15) Synthesis of acetanilide and its analysis.
16) Synthesis and characterization of Iodoform.
17) Synthesis and characterization of fluorescent dye.
18) Synthesis and characterization of benzanilide.
19) Synthesis and characterization of methyl orange

Reference Books:

1. *Vogel's Textbook of Quantitative Chemical Analysis*, J. Mendham, R.C. Denney, J. D. Barnes, M. J. K Thomas, 6th Edition, Pearson's Education Ltd.
2. *Advanced Practical Medicinal Chemistry,* Ashutosh Kar, New Age International Ltd. (2004).
3. *Vogel's Textbook of Practical Organic Chemistry,* B. S. Furniss, A. J. Hannaford, P.W.G. Smith, A. R Tatchell, 5th edition (2008), Pearson's Education Ltd
4. Bansal R. K., "*Laboratory Manual of Organic Chemistry*" Edition Fourth, 2007, New Age International (P) Ltd., New Delhi.
5. Rawal J. H., Baldhania S.A., "*Practical in organic chemistry"* Nirav Prakashan pvt. Ltd., Delhi.
6. Ahluwalia V.K., "*Green chemistry environmentally*", Edition first, Published by A. N Books pvt. Ltd.
7. Cohnn J. B., "*A class of organic chemistry*" Nirav Prakashan pvt. Ltd.
8. Mann F. J, Sunders B.C. "*Practical of Organic Chemistry*", Edition fourth, 2007, Dorling Kindersley (India) Pvt. Ltd., Delhi 2009
9. Saluja M.P., "*Pharmaceutical chemistry -II*" Edition Second, 2019, Krishna's Educational Publishers Pvt. Ltd., Meerut
10. Ahluwalia V.K., "*College practical Chemistry*", Edition first, Published by University Press (India) pvt. Ltd. 2005

24ScCopU4003: Community Engagement Project

Course Outcomes:

1. To enable the students to connect and extend knowledge from academic study to community engagement and participation in community life.
2. To provide evidence of experience in community engagement activities.
3. To enable the students to demonstrate independent experience, accompanied by reflective insights.
4. To develop ability and commitment to collaboratively work across and within community context.

24ScCopU4003: Community Engagement Project I	02 Credits (30L)
Project: By Individual student	

24ScCheU4301: Fundamental of Bioinorganic chemistry (T)

Course Outcomes:

1. Basic knowledge of sources, effects of excess and deficiency of trace metals.
2. Understanding the toxicity of certain metal ions, reasons for toxicity and their antidotes.
3. Basic understanding of the use of chelating agents in medicine and the role of cisplatin in cancer therapy.
4. Learn the applications of iron in biological systems with particular reference to hemoglobin.
5. Myoglobin, ferritin and transferrin.
6. Understand the functioning of sodium-potassium pump in organisms.
7.

24ScCheU4301: Fundamental of Bioinorganic chemistry (T) (30 Lectures, 02 Credits)	
Chapter 1	**Metal ions present in biological systems (Ca, Mn, Na, K, Mg, Zn) (10 Lectures)**
	● Classification of elements according to their action in the biological system. ● Geochemical effect on the distribution of metals. ● Sodium / K-pump, carbonic anhydrase and carboxypeptidase. ● Excess and deficiency of some trace metals. ● Reasons for toxicity. ● Use of chelating agents in medicine. ● Ca-Calmodulin & Role of calcium in blood coagulation.
Chapter 2	**Transition Metals in biological system (12 Lectures)**

	• Fe (Iron) and its application in bio-systems. • Metalloproteins: Iron sulphur Proteins. • Transport protein (Transferrin) and storage protein (Ferritin). • Hemoglobin: Storage and transfer of iron. • Myoglobin: Its structure and functions. • Cu-Hemocyanin. • Mg Photosynthesis. • Role of metals in enzymatic process catalase, peroxidase and nitrogenase. • Bioinorganic chemistry of cobalt.
Chapter 3	**Metals, Ions and their Toxicity (Hg, Pb, Cd, As and Cr) (8 Lecture)**
	• Lead toxicity. • Arsenic toxicity. • Mercury toxicity. • Cadmium toxicity. • Chromium toxicity. • Case study: Minamata, Baltimore's Ongoing Lead Poisoning Crisis.

Reference Books

1. Coordination chemistry by Ajai Kumar, Aaryush education.
2. Principles Of Bioinorganic Chemistry, by Lippard Panima Publishing Corporatio
3. Concise Inorganic Chemistry – J D Lee 5th edition.
4. Cotton, F. A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999
5. Shriver and Atkins' Inorganic Chemistry, fifth edition.
6. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi.

24ScCheU4302: Lab Course on 24ScCheU4301 (P)	**(15 Expts, 02 Credits)**
	Experiments

	1. Determination of Copper by Neocuproine complex method (colorimetric). 2. Determination of Fe by 8-hydroxyquinolate method (colorimetric). 3. Determination of Na_2CO_3 content in washing soda. (titrimetric). 4. Determination of Ca in presence of Ba using EDTA as a titrant. (titrimetric). 5. Determination of Cu in crystallized $CuSO_4$. (titrimetric). 6. Determination of Zn by 8-hydroxyquinolate method (colorimetric). 7. Synthesis of Tetraamminecopper (II) sulfate complex. 8. Synthesis of Potassium dioxalatodiaquochromate (III) complex. 9. Synthesis of Tetraamminecarbonatocobalt (III) nitrate complex. 10. Synthesis of Potassium tri(oxalato)ferrate(III) complex. 11. Synthesis of Hexaamminenickel(II)chloride complex. 12. Determination of Mg as magnesium ammonium phosphate. (gravimetric). 13. Determination of Na as sodium zinc uranyl acetate. (gravimetric). 14. Determination of K as potassium tetraphenylborate. (gravimetry). 15. Determination of Co as cobalt oxalate. (gravimetric).

References:

1. Vogel's textbook of quantitative chemical analysis (Fifth Edition).

24ScCheU4401: General Chemistry -IV

Course Outcomes:

1. To study about different types of natural resources.
2. Knowledge and concept of biodiversity and its conservation.
3. Basic knowledge and concept of causes, effects and control of different types of environmental pollution.
4. To study population growth and its impact on the environment.

24ScCheU4401: General Chemistry -IV	**(30 Lectures, 02 Credits)**
Chapter 1	**Water treatment and effluent management (10L)**
	● Domestic sewage, wastewater treatment: primary, secondary and tertiary treatments.

	• Aerobic, anaerobic and up flow anaerobic sludge bed treatment processes • Industrial wastewater treatment i) filtration method ii) ion-exchange method iii)membrane techniques: ultrafiltration, reverse osmosis and electrodialysis. • Treatment of drinking water.
Chapter 2	**Greenhouse Effect and Global Warming (08 Lectures)**
	• Introduction. • Greenhouse gases, radiative forcing, sources and sinks of CO_2. • Causes of fluctuations in global temperature. • Global warming and climate changes. • Implications of climate changes.
Chapter 3	**Water the ultimate Green solvent (08 Lectures)**
	• H_2O: simple formula and complex molecule. • Important properties of water. • The hydrologic cycle. • Bodies of water and life in water. • Chemical process in water. • Fizzy water from underground, oxygen in water, natural water contents. • Soil alkalinity: natural and man-made. • Metal ions in water, water interactions with other phases.
Chapter 4	**Energy Relations (04 Lectures)**
	• Radiant Energy from the sun. • Storage and release of energy by chemicals.

	• Energy sources. • Conversions between forms of energy. • Conversion of chemical energy. • Renewable energy sources

Reference books

1. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers).
2. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York).
3. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House).
4. Analytical Chemistry – G. D. Christian 4th Edition (John Wiley and Sons).
5. Environmental Chemistry – H. Kaur 2nd Edition 2007, Pragati Prakashan, Meerut, India.
6. Environmental Chemistry with Green Chemistry A. K Das, Books and Allied (P) Ltd.

24ScCheU4601: Computer Applications in Chemistry

Course Outcomes:

1. Apply the basic operations of spreadsheet applications.
2. Study the application of various software in chemistry.
3. Understand the application of various chemical techniques and their analysis.
4. Learn to plot graphs using various software.
5. Use of various online software to perform virtual practicals.
6. Understanding PowerPoint presentations.

24ScCheU4601: Computer Applications in Chemistry	**(15 Expts, 02 Credits)**
	1. Application of MS-Excel for common Scientific calculations. (Addition, Subtraction, Multiplication, Division, Average and Percentage).

	2. To plot the various types of graphs using MS-excel from given data. (Bar, Column, Pie, Line). 3. Use of Chemdraw software for drawing the structures of given organic compounds. (Any 10) 4. Use of Chemdraw software to draw the structures of following drug molecules: Taxol and Reserpine. 5. Use of Origin software to plot the graphs from given data. (Bar, Column, Pie, Line) 6. To draw an IR spectrum from given data by using Origin software and indicate the major bands in it. 7. To draw an UV spectrum using Origin software and indicate major absorption peaks in it. 8. Convert the given IUPAC names to structures using Chemdraw software. 9. Measure the size of particles given in the SEM image and plot a particle size distribution plot using MS-excel software. 10. To calculate various errors and precision parameters using Ms-excel software. 11. Review of various Android based chemistry name reaction softwares. 12. Preparation of MS PowerPoint presentation from given data and present it. 13. Use EBAS online stoichiometric calculator software for balancing chemical reactions. 14. To carry out practical using Online Virtual Simulation lab. 15. Predict the ^{1}H NMR of given compounds and correlate the signals with the structures. (Any 4)

Reference books

1. ChemDraw user guide, PerkinElmer Informatics Inc.
2. Microsoft© Office Connect and Collaborate Virtually Anywhere, Anytime by KATHERINE MURRAY, Microsoft Press A Division of Microsoft Corporation One Microsoft Way Redmond, Washington 98052-6399

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