Sir P. T. Sarvajanik College of Science

Autonomous

Affiliated to Veer Narmad South Gujarat University, Surat

Re-Accredited 'A+' with CGPA 3.35

SYLLABUS

FOR

SEM III

Program: B. Sc.

Course: Chemistry

Academic year

2025-26

(NEP-2020)

(To be effective from June, 2025)

SEMESTER III

Major Course - V

COURSE NAME: Chemistry Paper - V

COURSE CODE: CHEMJ-S3P5-2CR25 [CREDITS - 02]

Course learning outcome
At the end of this course, Students will be able to 1. Derive and solve the time-independent Schrödinger equation and a particle in a one-dimensional box. 2. Define and derive the key operators including linear, commutator, vector, and Laplacian operators, Eigen value equation, Analyse Hermitian & Hamiltonian operators. 3. Define LS coupling and J-J coupling, Interpret Term Symbols and Microstates, Determine the term symbols for various elements and ions. 4. Describe and analyse the physical and chemical properties of the elements of the first transition series including colour, magnetic, catalytic properties, variable valences etc. 5. Define CFSE and magnetic moment; Understand key concepts including the shape of d-orbitals, crystal field theory (CFT), and the splitting of d-orbitals in different systems. 6. Analyze and calculate CFSE; Analyze the stability of complexes based on their oxidation states.

Module 1	**Quantum Chemistry**	**[15 L]**
Learning Objective: ● To familiarize the student with the fundamental concepts of quantum chemistry, role of operators, L-S coupling, J-J coupling, Term symbols.		
Learning Outcomes: At the end of this module the learner will be able to 1. Derive and solve the time-independent Schrödinger equation and a particle in a one-dimensional box. 2. Define and derive the key operators including linear, commutator, vector, and Laplacian operators, Eigen value equation, Analyse Hermitian & Hamiltonian operators. 3. Define LS coupling and J-J coupling, Interpret Term Symbols and Microstates, Determine the term symbols for various elements and ions.		
1.1	**Quantum Mechanics:** (A) Fundamental equation for the independent Schrodinger equation,	**[10 L]**

	Wave function and probability function, Well behaved wave function, Particle in one-dimensional box. (B) Operators (definition and derivation). Linear operators, Commutator operators. Vector operators, Laplacian operators, Hamiltonian operators, Hermitian operators. Derivation of Hamiltonian equation, Hamiltonian operators for H atom, H_2^+, H_2 molecule, He_2^+ and Li atom. Eigen value equation.	
1.2	**Electronic configuration of atom; L-S coupling:** Introduction, L-S coupling, J-J coupling (introduction), Term symbol, Determination of microstate of P^2, P^3 system, Term symbol of C, N, O, Ni, Ni^{2+}, Fe, Fe^{2+}, Fe^{3+}, Cr, Cr^{3+}, Co^{2+}, V, V^{3+}, Cl^-	**[5 L]**
Module 2	**Coordination Chemistry**	**[15 L]**
Learning Objective ● To study properties of first transition series and coordination chemistry		
Learning Outcomes: At the end of this module the learner will be able to 1. Describe and analyse the physical and chemical properties of the elements of the first transition series including colour, magnetic, catalytic properties, variable valences etc. 2. Define CFSE and magnetic moment, Understand key concepts including the shape of d-orbitals, crystal field theory (CFT), and the splitting of d-orbitals in different systems. 3. Analyze and calculate CFSE, analyze stability of complexes based on their oxidation states.		
2.1	**Chemistry of elements of first transition series** Characteristic properties of d-block elements, physical and chemical properties of the elements of the first transition series [density, melting and boiling point, ionization potential, colour, magnetic properties, spin only magnetic moment, catalytic property, chemical properties], variable valency, complexes illustrating relative stability of their oxidation states.	**[7 L]**
2.2	**Coordination chemistry** Shape of d-orbitals, CFT – Basic assumption, splitting of d-orbitals in Octahedral, Tetrahedral and Square planer complexes, Distribution of	**[8 L]**

	d^x electrons in Octahedral and Tetrahedral complexes, Calculation of CFSE.	

List of Major Textbooks:

1. Concise Inorganic Chemistry by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
2. Basic Inorganic Chemistry by F. A. Cotton and G. Wilkinson, Wiley publication.
3. Inorganic Chemistry by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
4. General and Inorganic Chemistry: Volume I by R. P. Sarkar, New Central Book Agency; 3rd Revised edition (1 July 2011), India
5. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E.A. Keiter, R.L. Keiter, Pearson; 4th edition (1997).

e-Resources:

1. **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/02.physical_chemistry-i__/01._introduction_to_quantum_chemistry/et/7419_et_et.pdf**
2. **https://archive.nptel.ac.in/courses/104/108/104108057/**
3. **https://courses.lumenlearning.com/suny-albany-chemistry/chapter/development-of-quantum-theory-2/**
4. **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/08.physical_spectroscopy/10.zeeman_effect/lm/5578_lm_lm.pdf**
5. **https://www.nat.vu.nl/~wimu/LSCoup.html**
6. **http://wwwchem.uwimona.edu.jm/courses/RScoupling.html**
7. **Swayam Prabha: https://www.youtube.com/watch?v=UbDvWARaVOU ; https://www.youtube.com/watch?v=fZ4s7LKj1d4 ; https://www.youtube.com/watch?v=JAVODjnYiYs**
8. **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/07.inorganic_chemistry-ii/31.magnetic_properties_of_transition_metal_ions/et/6388_et_che___p7_m31_e-text.pdf**
9. **https://courses.lumenlearning.com/chemistryformajors/chapter/coordination-chemistry-of-transition-metals-2/**
10. **Swayam Prabha: https://www.youtube.com/embed/Ota8_FidPJM ; https://www.youtube.com/embed/K2vufV5rkIs**

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.			√				√		
2.	√	√							
3.	√	√							
4.		√	√						
5.	√	√		√					
6.	√	√		√					

SEMESTER III

Major Course - VI

COURSE NAME: Chemistry Paper - VI

COURSE CODE: CHEMJ-S3P6-2CR25 [CREDITS - 02**]**

Course learning outcome
At the end of this course, Students will be able to 1. Define heterocyclic compounds and explain their importance in organic chemistry. Identify and classify different types of heterocyclic compounds. 2. Design a synthesis of condensed heterocyclic compounds. 3. Define elimination reaction and explain general mechanism. Identify the types of elimination reactions and analyze the reaction mechanism of elimination reaction. 4. Identify and explain the difference between elimination and substitution reaction. 5. Define and explain the structure, properties and preparation of diazonium salts. Identify general reaction of diazonium salts. 6. Recognize the importance of diazonium salts in organic synthesis. Apply general reaction condition for coupling and displacement reaction to synthesize dyes. 7. Define and explain the structures, properties and nomenclature of carboxylic acid derivatives. 8. Identify the general method of preparation and reaction of each derivative.

Module 1	**Heterocyclic compounds and Elimination reactions**	**[15L]**

Learning Objective:

- To study synthesis and chemical reactions of condensed heterocyclic compounds.
- To define elimination reactions and write its types and mechanism.

Learning Outcomes:

At the end of this module the learner will be able to:

1. Define heterocyclic compounds and explain their importance in organic chemistry. Identify and classify different types of heterocyclic compounds.
2. Design a of synthesis of condensed heterocyclic compounds.
3. Define elimination reaction and explain general mechanism. Identify the types of elimination reactions and analyze the reaction mechanism of elimination reaction.
4. Identify and explain the difference between elimination and substitution reaction.

1.1	**Heterocyclic compounds** (a) Classification and nomenclature of heterocyclic compounds (b) Synthesis, chemical properties and reaction of (1) Benzopyrrole (Indole) (2) Benzofuran (Coumarone) (3) Benzothiophene (Thionaphthene) (4) Quinoline (5) Isoquinoline	**[10L]**
1.2	**Elimination reactions** Types of elimination reactions**,** β-elimination, E2 mechanism, E1 mechanism, elimination and stereo chemistry, elimination Vs substitution reaction. α-elimination, Generation of carbenes and ketenes.	**[5L]**
Module 2	**Diazonium salt and Carboxylic acid derivatives**	**[15L]**

Learning Objectives:

- To define diazonium salts and to predict the products of reaction involving diazonium salts.
- To identify different carboxylic acid derivatives and to write method formation and chemical reactions.

Learning Outcomes:

At the end of this module the learner will be able to

1. Define and explain the structure, properties and preparation of diazonium salts. Identify general reaction of diazonium salts.
2. Recognize the importance of diazonium salts in organic synthesis. Apply general reaction condition for coupling and displacement reaction to synthesize dyes.
3. Define and explain the structures, properties and nomenclature of carboxylic acid derivatives.
4. Identify the general method of preparation and reaction of each derivative.

2.1	**Diazonium salts** (a) Mechanism of diazotization, reagent for checking completion of diazotization (b) Nomenclature of diazonium salts (c) Reaction of diazonium salts, replacement reaction in which nitrogen is eliminated, reaction in which nitrogen atom are retained, its application in the synthesis of aromatic compounds,	**[9 L]**

	(d) Laws of coupling, coupling agents, synthesis of diazoamino and aminoazo compounds (e) Synthesis and uses of Methyl orange, Methyl red, Congo red and Eriochrome Black-T	
2.2	**Carboxylic acid derivatives** Structure & nomenclature of acid chloride, ester, amides and acid anhydrides, method of formation carboxylic acid derivatives and chemical reactions.	**[6 L]**

List of Major Textbooks:

1. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
2. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt. ltd.
3. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
4. A textbook of Organic chemistry by Arun Bahl and B. S. Bahl, S. Chand & Company Pvt. Ltd.
5. Organic chemistry Vol. I and Vol. II by I.L. Finar (Longman group).
6. Textbook of Organic chemistry by P. L. Soni and H. M. Chawla, S. Chand & Company Pvt. Ltd.
7. Organic chemistry by R. T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson Education India.
8. Organic chemistry Vol. I & II by B.K. Sharma & S.K. Sharma; Goel Pub. House, Merut.
9. Reaction mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh, Macmillan Publishers India Ltd.
10. Fundamentals of Organic chemistry by Soloman, John Wiely & Sons.
11. Organic Chemistry by L. G. Wade, J. W. Simek & M. S. Singh, Pearson Education India.

e-Resources:

1. **https://youtu.be/e-Nkiqr18u0?si=DZjPwqzo_Y40n-ma**
2. **https://youtu.be/FgX98uCFTRw?si=hN3cFUb4wQLVLQpk**
3. **https://youtu.be/MxAbAsmRhFU?si=RBDOAC77Qf8joSJ8**

4. https://www.uou.ac.in/lecturenotes/science/MSCCH-17/CHEMISTRY%20LN.%203%20HETEROCYCLIC%20COMPOUNDS-converted%20(1).pdf
5. https://archive.nptel.ac.in/content/storage2/courses/104103022/download/module7.pdf
6. https://terna.digimat.in/nptel/courses/video/104106131/L27.html

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√	√	√			√			
2.	√	√	√			√		√	
3.	√	√	√			√			
4.	√	√	√			√			
5.	√	√	√			√			
6.	√	√	√			√		√	
7.	√	√	√			√		√	
8.	√	√	√			√		√	

SEMESTER III

Major Course- VII

COURSE NAME: Chemistry Paper - VII

COURSE CODE: CHEMJ-S3P7-4CR25 [CREDITS - 04**]**

Course learning outcome
At the end of this course, Students will be able to 1. Explain the Arrhenius theory and collision theory of reaction rate. Define photochemical laws, photochemical reactions, quantum yield and efficiency, types of luminescence and calculate and solve numerical problems based on these theories. 2. Define and identify the types of conductance, transport number, moving boundary methods. Explain the migration of ions and Kohlrausch law. Calculate the transport number, degree of dissociation, ionic product and solubility product. Solve numerical problems based on these theories. 3. Define the electromagnetic radiation and their terms. Illustrate energy equation of rotational, vibrational and Raman spectra and problems based on it. Distinguish Stoke, Anti-stokes and Rayleigh line and their relation with each other. Calculate and solve numerical problems based on these theories. 4. Explain the compare chemical and instrumental analysis methods. Define factors affecting and the choice of different analytical methods. Distinguish between determinant and in-determinant errors. Apply statistical treatment to experimental data, data analysis by accuracy and precision. Calculate and solve numerical problems based on these theories.
Module 1 | Physical Chemistry I | [15 L]
Learning Objective: ● To familiarize the student with the fundamental concepts of Arrhenius equation, rate of reaction, activation energy and effect of catalyst on activation energy. ● To learn photon, basics of EMR, photochemical laws, photochemical reactions, quantum yield, quantum efficiency, types of luminescence and factors affecting on it, photosensitization process.
Learning Outcomes: At the end of this module the learner will be able to 1. Explain the Arrhenius theory and collision theory of reaction rate. 2. Define photochemical laws, photochemical reactions, quantum yield and efficiency, and

types of luminescence.

3. Calculate and solve numerical problems based on these theories.

1.1	**Theories of reaction rate:** Derivation of Arrhenius equation. Lindemann's theory, Collision theory of reaction rate, Energy of activation including determination, Effect of catalysis on energy activation. Numerical problems	**[5 L]**
1.2	**Photochemistry:** Introduction of photochemistry, Basics of electromagnetic radiations, Photons, Thermal and photochemical laws (a) Grotthuss-Draper's law (b) Lambert Beer's law (c) Einstein's law of photochemical equivalence. Quantum yield or quantum efficiency. Primary and secondary photochemical reactions, Factors affecting quantum yield. (i.e. temperature, light intensity and inert gases). Isomeric changes, Polymerization, Photosensitization, Photo physical process [Fluorescence, Phosphorescence]. Chemiluminescence, Factor affecting fluorescence, phosphorescence. Numerical problems.	**[10 L]**
Module 2	**Electrochemistry**	**[15 L]**

Learning Objective

- To study basic principle and terms of electrochemistry, determination of degree of dissociation, ionic product, solubility product and problems based on it.

Learning Outcomes:

At the end of this module the learner will be able to

1. Define and identify the types of conductance, transport number, moving boundary methods.
2. Explain the migration of ions and Kohlrausch law.
3. Calculate the transport number, degree of dissociation, ionic product and solubility product. Solve numerical problems based on these theories.

2.1	(A) Ions in solution, formation of ion in solution metallic conductance, Electrolytic conductance, Electrolysis migration of ions, Transport number of ions and its determination by moving boundary method, Numerical problems.	

	(B) Kohlrausch law of ionic conductance. Application of Kohlrausch law to: (a) Determination of degree of dissociation of weak electrolyte. (b) Determination of equivalent conductivity of weak electrolyte at infinite dilution. (c) Determination of solubility and solubility product of sparingly soluble salts. (d) Determination of ionic product of water. Numerical Problems.	
Module 3	**Molecular Spectroscopy**	**[15 L]**
Learning Objective: ● To perceive basics of electromagnetic radiation, terms of spectroscopy, types of spectra, derivation of energy equation of vibrational rotational spectra.		
Learning Outcomes: At the end of this module the learner will be able to 1. Define the electromagnetic radiation and their terms. 2. Illustrate energy equation of rotational, vibrational and Raman spectra. 3. Distinguish Stoke, Anti-stokes and Rayleigh line and their relation with each other. 4. Calculate and solve numerical problems based on these theories.		
3.1	Electromagnetic radiation with wavelength and energy, radio frequency, microwave, IR, UV/visible region, pure rotational spectra, vibrational and vibrational-rotational spectra, Raman spectra. Rotational spectra, calculation of bond-length. Vibrational-rotational spectra, Hook's law, vibrational energy level. Numerical Problems.	
Module 4	**Introduction to Analytical Chemistry & Treatment of Analytical data**	**[15 L]**
Learning Objective: ● To study basics of different analytical terms, difference, application between classical and instrumental analytical methods. To understand different errors occurring during analysis and their minimization of errors. To calculate errors by different statistical terms and methods to retain or reject the data.		
Learning Outcomes: At the end of this module the learner will be able to 1. Explain and compare chemical and instrumental analysis methods. 2. Define factors affecting and the choice of different analytical methods.		

3. Distinguish between determinant and in-determinant errors, 4. Apply statistical treatment to experimental data, data analysis by accuracy and precision, Calculate and solve numerical problems based on these theories.		
4.1	**[A] Introduction to Analytical Chemistry:** Chemical and Instrumental analysis (advantages and disadvantages), Overview of methods used in Quantitative analysis (Classification of classical and instrumental analysis), Factors affecting the choice of analytical methods (in brief) **[B] Treatment of Analytical Data:** Definition of error, types of errors: determinates errors, indeterminate errors, constant and proportional errors, define and explain the following terms: accuracy and precision, mean, median, deviation, average deviation, standard deviation, variance, coefficient of variation, relative mean deviation, range, absolute errors, and relative errors. Minimization of determinates errors, Rejection of results from a set of results: 2.5 d rule, 4d rule and Q-test. Numerical.	

List of Major Textbooks:

1. Physical chemistry by Gurdeep Raj.
2. Physical chemistry by K.L.Kapoor vol.-I t o IV [Pub. Macmilan]
3. Advanced Physical chemistry by D.N.Bajpai.
4. Text book of Physical chemistry by S.C. Khetepal & Yogeshwar Sharma. [Pub. R.Chand]
5. Physical chemistry by Puri & Sharma [S.Nagin & Co.]
6. A text book of Physical chemistry by A.S.Negi & Anand [New age International]
7. Physical chemistry by P.L.Soni & O.P.Dharmraj.
8. Physical chemistry by B.K.Sharma.
9. Essential of Physical chemistry by Bahl Tuli &Bahl.
10. Elemental Physical chemistry by Glasston & Lewis.
11. Physical chemistry by K.K.Sharma, L.K.Sharma [Vikas Publication House, New Delhi.]
12. Instrumental Methods of Chemical Analysis by H. Kaur, Pragati Prakashan
13. Instrumental methods of analysis by B.K. Sharma.

14. College analytical chemistry, Mangaonkar, Teckchandani, Sathe, Ghalsasi, Jain, Himalaya Publishing House.
15. Quantitative analysis by R.A. Day & A. L. Underwood, 6th ed. Pub. Prentice Hall of India ltd.
16. Vogel's text book inorganic qualitative analysis, 6th ed.

e-Resources:

1. **https://youtu.be/lx7WpEOP-G8 (Rate of Reaction)**
2. **Photochemistry : Introduction to Basic Theory of Photochemical Process [Part 1] (Photochemistry)**
3. **Elementary Electrochemistry - Course (Electrochemistry)**
4. **Molecular Spectroscopy: A Physical Chemist's perspective - Course (Molecular spectroscopy)**
5. **Sr.Secondary : Chemistry (313) - Course (Basics of Physical Chemistry)**
6. **PPT - STATISTICAL TREATMENT OF ANALYTICAL DATA PowerPoint Presentation - ID:8911648 (Treatment of Analytical data)**

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√	√	√				√		
2.	√	√	√				√		
3.	√	√	√				√		
4.	√	√	√				√		

SEMESTER III

Multidisciplinary Course - I

COURSE NAME: Chemistry in Everyday Life

COURSE CODE: CHEMDC-S3P1-4CR25 [CREDITS - 04**]**

Course learning outcome		
At the end of this course, Students will be able to 1. Define nutrients and its types. 2. Define, write examples and importance of energy sources: carbohydrates, lipids, vitamins, proteins, minerals. 3. Define and write types of adulteration present in common food items. 4. Write different methods to identify adulterants present in common food items. 5. Write composition of edible oils and methods to detect purity of oil sample. 6. Define detergents and classify them. 7. Write anionic detergents and cationic detergents in detail. 8. Define dyes, chromophore and auxochromes. 9. Classify dyes based on source, constitution and application. 10. Define drugs and different terms related to drugs. 11. Classify drugs with definition and examples.		
Module 1	**Nutrients and energy sources**	**[15 L]**
Learning Objective: ● To study the definition and types of nutrients. ● To familiarize the student with the fundamental concepts of energy sources: carbohydrates, lipids, vitamins, proteins, minerals.		
Learning Outcomes: At the end of this module the learner will be able to 1. Define nutrients and its types. 2. Define, write examples and importance of energy sources: carbohydrates, lipids, vitamins, proteins, minerals.		
1.1	Nutrients- definition, types of nutrients: macronutrient and micronutrient, Energy sources (definition, examples and importance): carbohydrates, lipids, vitamins, proteins, minerals, water.	
Module 2	**Adulteration and identification in common food items**	**[15 L]**
Learning Objective		

• To study different types of adulteration in common food items and methods to detect it.		
Learning Outcomes: At the end of this module the learner will be able to 1. Define and write types of adulteration present in common food items. 2. Write different methods to identify adulterants present in common food items.		
2.1	Define Adulteration, reasons of adulteration, types of adulterants, Methods for detection of different adulterants in some common food items: (1) Milk (2) Milk products: Sweet curd, Rabdi, Khoa & its product, Chhana or Paneer, Ghee, Cottage cheese, condensed milk, Khoa, Ghee, Butter (3) Oil and Fats Oil and Fats, Mustard oil, Edible oil, Coconut oil (4) Sweetening agents: Sugar, Pithi sugar, Honey, Jaggery, Bura sugar (5) Food grain and their product: (Wheat, Rice, Maize, Jowar, Bajra, Chhana and Barley etc.), Maida, Wheat flour, Besan, Suji(Rawa) Dal whole and Spilt, pulses. (6) Spices: Wholes spices, Black Pepper, Cloves, Mustard seed and Powdered spices (7) Turmeric whole and Turmeric powder (8) Chilli powder, Asafoetida (9) Miscellaneous Product: Common salt, Tea, Coffee powder	**[15 L]**
Module 3	**Oils, fats and detergents**	**[15 L]**
Learning Objective: • To familiarize students with basic concepts of oils and fats. • To study basic concepts and classification of detergents.		
Learning Outcomes: At the end of this module the learner will be able to 1. Write composition of edible oils and methods to detect purity of oil sample. 2. Define detergents and classify them. 3. Write anionic detergents and cationic detergents in detail.		
3.1	**Oils and Fats** Natural fats, edible and industrial oils of vegetable origin, common	

	fatty acids, glycerides, saponification, saponification value and iodine value of an oil **Detergents** Introduction, principles of detergency, classification of detergents, bio-soft and bio-hard detergents, Anionic detergents and cationic detergents	
Module 4	**Dyes and drugs**	**[15 L]**

Learning Objective:

- To familiarize students with basic concepts of dyes and their classification.
- To study basic concepts, classification and different terms related to drugs.
- To study definition and examples of different types of drugs.

Learning Outcomes:

At the end of this module the learner will be able to

1. Define dyes, chromophore and auxochromes.
2. Classify dyes based on source, constitution and application.
3. Define drugs and different terms related to drugs.
4. Classify drugs with definition and examples.

4.1	**Dyes** Definition, chromophore, auxochromes, classification of dyes based on source, constitution and application **Drugs** Definition of the term drug, drugs obtained from plants, different class of the drugs, explanation of the following terms: Agonist, Antagonist, Receptors, Pharmacophore, Prodrug, Softdrug, CNS depressants, CNS stimulants Classification of drugs on the basis of their therapeutic action.	

List of Major Textbooks:

1. Chemistry of organic Natural Product Vol. I & II by O. P. Agarwal.
2. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998).
3. Chemical Analysis of Foods – H. E. Cox and Pearson.
4. Foods: Facts and Principles. N. Shakuntala Manay and S. Swamy, 4th ed. New Age

International (1998)

5. Organic Chemistry by I. L. Finar, Vol. 1 & 2.
6. Srilakshmi B. (2017): Nutrition Science, 6th Multicolour Ed. New Age International (P) Ltd.
7. Mann J. and Truswell S. (2017): Essentials of Human Nutrition, 5th Ed. Oxford University Press.
8. Chemistry of drugs by Ener and Caldwell.
9. Synthetic drugs by Tyagi and Yadav.

e-Resources:

Module 1: https://openoregon.pressbooks.pub/nutritionscience2e/

Module 2:

https://fssai.gov.in/upload/knowledge_hub/1878035b34b558a3b48DART%20Book.pdf

Module 3:

1. https://chem.libretexts.org/Courses/Eastern_Mennonite_University/EMU%3A_Chemistry_for_the_Life_Sciences_(Cessna)/17%3A_Lipids/17.2%3A_Fats_and_Oils
2. https://edscl.in/pluginfile.php/3950/mod_resource/content/1/pdf.pdf

Module 4:

1. https://dducollegedu.ac.in/Datafiles/cms/ecourse%20content/DYES.pdf
2. https://rushim.ru/books/praktikum/fpdc.pdf
3. https://nios.ac.in/media/documents/SrSec313NEW/313_Chemistry_Eng/313_Chemistry_Eng_Lesson30.pdf

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√								
2.	√								
3.	√								
4.	√								
5.	√								

6.	√								
7.	√								
8.	√								
9.	√								
10.	√								
11.									

SEMESTER III

COURSE NAME: Chemistry Practical – V & Chemistry Practical – VI

COURSE CODE: CHEMJ-S3PR5-2CR25 & **CHEMJ-S3PR6-2CR25** [CREDITS – 2+2]

Learning Objective

- To equip students with the knowledge of gravimetric and volumetric estimation

Course Learning Outcomes

1. Apply analytical techniques including gravimetric and volumetric methods to accurately determine the concentration of metals and other compounds in various chemical solutions, demonstrating proficiency in quantitative chemical analysis and laboratory skills.
2. Identify and classify a diverse range of organic compounds through qualitative analysis, applying knowledge of functional groups and chemical properties, thereby enhancing proficiency in organic chemistry laboratory techniques and analysis.
3. Develop proficiency in experimental techniques such as pH-metry, conductometric titrations, viscosity measurements, chemical kinetics, and partition coefficient determination to analyse physical properties of substances, fostering practical skills

	Gravimetric Estimation and Volumetric Estimation **Chemistry Practical –V (CHEMJ-S3PR5-2CR25)**	
	A. Gravimetric Estimation: (1) Fe^{2+}as Fe_2O_3 (Given solution of Fe-NH_4-SO_4 + H_2SO_4) (2) Ba^{2+}as $BaSO_4$ (Given solution of $BaCl_2$ $2H_2O$ + HCl) (3) Ni^{2+}as Ni $(DMG)_2$ (Given solution of $NiCl_2$ $6H_2O$ + HCl) (4) Al^{+3} as Al_2O_3 from $Al_2(SO_4)_3$ (5) Brass Alloy (Cu volumetrically & Zn gravimetrically) **B. Volumetric Estimation:** (1) To determine the amount of Nickel by EDTA. (2) To determine the amount of Copper by EDTA. (3) To determine the amount of Zinc by EDTA. (4) To determine the amount of Calcium by EDTA. (5) To determine the amount of Magnesium by EDTA.	

	(6) To determine the amount of Bismuth by EDTA. (7) Determination of acetic acid content of Vinegar (8) Determination of the alkalinity of Soda ash (9) Determine the amount of Hydrochloric acid present in given solution (10) Determine the amount of Sodium hydroxide present in given solution	
	ORGANIC SPOTTING and PHYSICAL EXERCISES **(Chemistry Practical –VI) (CHEMJ-S3PR6-2CR25)**	
	A. Organic Spotting **ACID:** Salicylic acid, Cinnamic acid, Phenylacetic acid, Sulphanilic acid. PHENOL: α-Naphthol, β-Naphthol, o-Nitrophenol **BASE:** o-Nitroaniline, m-Nitroaniline, p-Nitroaniline, p-Chloroaniline, Diphenyl amine, Dimethylaniline, Diethylaniline **NEUTRAL:** ALDEHYDE: Glucose KETONE: Methylethyl ketone, Acetophenone ESTER: Ethylacetate, Butylacetate ALCOHOL: Ethanol, Butanol HYDROCARBON: Anthracene, Naphthalene, Diphenyl NITRO HYDROCARBON: m-Dinitrobenzene, Nitrobenzene HALOGENATED HYDROCARBON: Chlorobenzene, Bromobenzene, p-Dichloro benzene AMIDE: Benzamide, Thiourea ANILIDE: Acetanilide **B. Physical Exercises:** **1. pH metry:** To determine the normality of weak acid pH-metrically using strong base. [$CH_3COOH \rightarrow NaOH$] **2. Conductometric Titration:** To determine the normality of strong acid condutometrically using strong base [$HCl \rightarrow NaOH$] **3. Conductometric Titration:** To determine the solubility of $PbSO_4$. **4. Viscosity:** To determine the viscosity of the liquids and the % of unknown mixture 'C'.	

	5. Chemical kinetics- Ester hydrolysis: To study the hydrolysis of methyl acetate at two different concentrations in 0.5N HCl. [mono molecular reaction] **6. Partition co-efficient:** To determine molecular condition of benzoic acid in kerosene by the method of partition coefficient.	

List of Major Textbooks:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.		√		√			√		
2.		√		√	√		√		
3.		√		√			√		

SEMESTER III

COURSE NAME: Food adulteration and type of organic binary mixture

COURSE CODE: CHESEC-S3P1-2CR25 [CREDITS – 2**]**

Learning Objective • To equip students with the knowledge of food adulteration and type of insoluble binary mixture		
Course Learning Outcomes 1. Analyse experimental results to determine the presence and quantity of adulterants in food samples. 2. Interpret data obtained from qualitative tests to make informed decisions regarding the purity and authenticity of food products. 3. Analyse the solid insoluble organic binary mixture and determine the type present in it.		
A	**Food Adulteration**	
	1) Identification of adulterants in milk products (Sweet curd, Rabdi, Khoa & its product, Chhana or Paneer, Ghee, Cottage cheese, condensed milk, Khoa, Ghee, Butter) 2) Identification of adulterants in Oil and fats (Mustard oil, Edible oil, Coconut oil) 3) Identification of adulterants in Sweetening agents (Sugar, Pithi sugar, Honey, Jaggery, Bura sugar) 4) Identification of adulterants in Spices (Whole spices, Black Pepper, Cloves, Mustard seed and Powdered spices) 5) Identification of adulterants in Tea and Coffee powder 6) Identification of adulterants in Turmeric and Chilli powder 7) Identification of adulterants in Asafoetida **Note: Identification to be performed from each category**	
B	**Type of water insoluble organic solid binary mixture**	
	Type of water insoluble organic solid binary mixture	
List of Major Textbooks: 1. http://www.fssi.gov.in/Portals/0/pdf/Final-test-manual-part-II. 2. Vogel's qualitative Inorganic analysis.		

3. Vogel's qualitative Organic analysis.

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.		√		√			√		
2.		√		√			√		
3.		√		√			√		

SEMESTER III

Indian Knowledge System (IKS)

COURSE NAME: Chemical Science in Ancient India-I

COURSE CODE: CHEIKS-S3P1-2CR25 [CREDITS – 2**]**

Course Learning Outcome
After the successful completion of the course, the learner will be able to 1. Demonstrate an understanding of the development of chemistry in ancient India. 2. Identify and describe ancient Indian chemical techniques and their relevance today. 3. Discuss the scientific contributions of Indian chemists and their legacy. 4. Explain the role of ancient Indian metallurgy, dyes, and cosmetics in shaping modern chemistry. 5. Recall and discuss key contributions of Prof. P. C. Ray to Indian chemistry, and list traditional Indian practices in metallurgy, mining, and metal extraction techniques including copper, zinc, iron, and Wootz steel. 6. Explain the significance of ancient Indian metallurgical techniques, including Wootz steel, gold and copper extraction, and relate their impact on modern scientific research and traditional knowledge systems.

Module 1	**CHEMISTRY IN ANCIENT INDIA**	**[15L]**

Learning Objectives:

This module is intended

- To understand the fundamental aspects of chemistry as practiced in ancient India.
- To explore the evolution of chemical techniques in Indian history.
- To analyze the contributions of ancient Indian chemists and their impact on modern science.
- To learn about the role of Ayurveda and its chemical formulations.
- To appreciate the significance of metallurgy, dyes, and cosmetics in ancient chemistry.

Learning Outcome:

After the successful completion of the module, the learner will be able to

1. Demonstrate an understanding of the development of chemistry in ancient India.
2. Identify and describe ancient Indian chemical techniques and their relevance today.
3. Discuss the scientific contributions of Indian chemists and their legacy.
4. Explain the role of ancient Indian metallurgy, dyes, and cosmetics in shaping modern chemistry.

1.1	Chemistry In Ancient India - General Introduction, Alchemy - main objectives, Chemical Techniques In Ancient India, Metallurgy In Ancient India, Chemistry of Dyes In Ancient India, Pigments In Ancient India, Cosmetics In Ancient India, Ayurveda, Charaka Samhita – Structure. Ancient Indian chemists : Contributions and books:- Maharshi Acharya Kanad, Acharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadeva, Gopalbhatta, Indian chemist of 19th century "Acharya Prafulla Chandra Ray"	
Module 2	**ANCIENT INDIAN METALLURGY AND CHEMISTRY**	**[15L]**

Learning Objectives:

This module is intended to

Understand the historical contributions of Prof. P. C. Ray and recognize ancient Indian advancements in metallurgy, mining, and metal extraction techniques, including Wootz steel and Ayurvedic copper use, highlighting their relevance to modern science and traditional practices.

Learning Outcome:

After the successful completion of the module, the learner will be able to

1. Recall and discuss key contributions of Prof. P. C. Ray to Indian chemistry, and list traditional Indian practices in metallurgy, mining, and metal extraction techniques including copper, zinc, iron, and Wootz steel.
2. Explain the significance of ancient Indian metallurgical techniques, including Wootz steel, gold and copper extraction, and relate their impact on modern scientific research and traditional knowledge systems.

2.1	Prof. P. C. Ray: A Pioneer in Reviving Ancient Indian Metallurgy and Chemistry Contribution: Prof. Prafulla Chandra Ray, the "Father of Indian Chemistry," highlighted India's advanced metallurgical practices and linked ancient mining and metalworking techniques showcasing India's scientific achievements and inspiring modern research. Wootz steel: The rise and fall of a great Indian technology. Mining and ore extraction.	

	Metal and metal working technology. Gold extraction process. Zinc production Copper mining and extraction process. Extraction of copper for Ayurvedic purposes. Copper alloys, Mercury, Lead and silver. Iron and steel in India.	

REFERENCE BOOKS:

1. A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D. by Prof. P. C. Ray, (1902) published by The Bengal Chemical and Pharmaceutical Works.
2. History of Science and Technology in Ancient India: Volume II – Metal Technology by Debiprasad Chattopadhyaya (1986) published by Firma KLM, Calcutta.
3. The Rustless Wonder: A Study of the Iron Pillar at Delhi
4. Introduction to Indian knowledge system concepts and Applications by B. Mahadevan, Vinayak Rajat Bhatt, Nagendra Pavana R. N.
5. "The Ayurvedic Pharmacopoeia of India" - Govt. of India
6. "History of Chemistry in Ancient India" - P.C. Ray
7. "Charaka Samhita"- Maharshi Charaka

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.	√	√				√					
2.	√	√				√					
3.	√	√				√					
4.	√	√				√					
5.	√	√				√					
6.	√	√				√					