KADI SARVA VISHWAVIDYALAYA
B.Sc Semester 3 (Chemistry Subject's Syllabus)

KADI SARVA VISHWAVIDYALAYA GANDHINAGAR

B.Sc. Curriculum as Per NEP

Chemistry Subject Syllabus
Semester 3

W.E.F. June 2024

KADI SARVA VISHWAVIDYALAYA

B.Sc Semester 3 (Chemistry Subject's Syllabus)

Chemistry Major Course-5

CHM 224-2C INORGANIC & ANALYTICAL CHEMISTRY- I

LEARNING OUTCOMES:

- Understand the concept of various inorganic and analytical reactions.
- Develop an understanding of the inorganic and analytical systems around us.
- Gain knowledge about the structure, function and applications of various Inorganic compounds and Analytical techniques.

Subject Code	Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
						Max Marks		
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Mid Term (CCE)	End Term (SEE)	
CHM 224-2C	Inorganic & Analytical Chemistry- I	4	0	4	2.5	50	50	100

CONTENT:

UNIT	Details
1	**Non Aqueous Solvents** **Teaching Hours: 15** **(Weightage 25%)** • Introduction, Classification of Solvents, General Properties of Ionising Solvents. • **Liquid Ammonia (NH_3):** Physical Properties, Auto-ionization ϖ Acid-Base reactions, Ammonia as a proton-acceptor, Precipitation reactions, Complex formation reaction, Ammonolysis reactions, Reactions of Metal-Ammonia solution, Reduction-Oxidation (Redox) reactions; Advantages and disadvantages of using liquid Ammonia as a solvent. • **Liquid SO_2:** Physical Properties, solubility of Inorganic materials and Organic Compounds, Electrolytic conductance behaviour of solutions, Acid-Base reactions, Solvolysis, Precipitation reactions, Complex formation reactions, Reduction-Oxidation (Redox) reactions
2	**Teaching Hours: 15** **(Weightage 25%)** • **Noble Gases-**Occurrence and uses, rationalization of inertness of noble gases, clathrates; preparation and properties of XeF2, XeF4 and XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds XeO3, XeO4, XeOF2, XeO2F2, XeOF4, [XeO6]4- (VSEPRtheory).

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3	**Teaching Hours: 15** **(Weightage 25%)** • **Errors in Quantitative Analysis** - Accuracy and precision, determinate, indeterminate and accidental errors, precision of a single measurement, precision of mean, rejection of a result, errors in a derived result, methods of checking the accuracy of analysis,significant figures, computation values. • **Acid-Base Titrations** Strong Acid Vs Strong Base, Strong Acid Vs Weak Base, Weak Acid Vs Strong Base, Weak Acid Vs Weak Base, Strong Acid + Weak Acid Vs Strong Base Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility
4	**Teaching Hours: 15** **(Weightage 25%)** • **Potentiometric titration**-The scope of potentiometric titrations, Precipitation and neutralization titrations, Graphical method including Gran's plot for selecting end point, Differential titration, Dead stop titration, Ion selective Electrode, various types of Ion Selective Electrodes • **Solvent extraction-**Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction

REFERENCES BOOKS

- Analytical Chemistry G.D. Christain
- Fundamentals of Analytical Chemistry D.A.Skoog, D.M. West &F.J.Holler
- Principles of Analytical Chemistry J.H. Kennedy
- Analytical Chemistry – Principles & Techniques L.G.Hargis
- Instrumental Methods of analysis: (CBS) H. H . Willard, L.L. Mirrit, J.A. Dean
- Chemical Instrumentation: A Systematic approach- H.A. Strobel
- Principles of Instrumental Analysis: Douglas A. Skoog., F. James Holler, Stanley R. Crouch, Cengage Learning; 6th Edition.
- Quantitative Chemical Analysis: Daniel C. Harris, W H Freeman, New York
- Concise Inorganic Chemistry J.D.Lee, 4th edition
- Principles of inorganic chemistry, Puri, Sharma &Kalia
- Inorganic chemistry by James Huheey, Keiter&Keiter
- Text book of Inorganic Chemistry by Durrant and Durrant.
- Advance Inorganic Chemistry Vol-II Satya Prakash (S.Chand)
- Advanced inorganic chemistry by Cotton and Wilkinson
- Valency and Molecular structure by Cartmell and Fowles.
- Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi
- Advanced Inorganic Chemistry by G. D. Tuli, Madan, Basu and Satyaprakash

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Chemistry Major Course-6

CHM 225-2C ORGANIC & PHYSICAL CHEMISTRY- I

LEARNING OUTCOMES:

- Understand the concept of various organic reactions.
- Develop an understanding of the organic systems around us.
- Gain knowledge about the structure, function and applications of various organic compounds.
- Understand the concept of colligative properties.
- Gain knowledge about properties of liquids like viscosity, surface tension, refractive index etc.

Subject/ Course Code	Course/Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Practical hrs Per Week			Mid Term (CCE)	End Term (SEE)	
CHM 225-2C	Organic & Physical Chemistry- I	4	0	4	2.5	50	50	100

CONTENT:

UNIT	Details
1	**Teaching Hours: 15 (Weightage 25%)** • **Alkanes and Cycloalkanes–Alkanes:** General methods of formation, physical & chemical properties. Mechanism of free radical substitution in alkanes with reference to halogenation, orientation, reactivity and selectivity. **Cycloalkanes:**Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitation, ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings, the case of cyclopropane ring: banana bond.
2	**Teaching Hours: 15 (Weightage 25%)** • **Alkenes, Dienes and Alkynes** - Brief introduction of alkenes, their formation with reference to mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration- oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO4, polymerization of alkenes, substitution at the allylicand vinylic positions of alkenes, industrial applications of ethylene and propene.

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	• Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, structure of allenes and butadiene, methods of formation, polymerization, chemical reactions - 1,2 and 1,4 - additions, Diels -Alder reaction. Acidity of alkynes, mechanism of electrophilic and nucleophilic addition reactions, hydroboration, metal - ammonia reductions, oxidation and polymerization.
3	**Teaching Hours: 15 (Weightage 25%)** • **Chemical Thermodynamics** - Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data.Clapeyron-clausius equation, Integrated form of clapeyron-clausius equation, Application of clapeyron-clausius equation from various phases in equilibrium, Elevation in Boiling point (Kb), Depression of freezing point (Kf), Relative lowering in vapour pressure, Osmotic pressure
4	**Teaching Hours: 15 (Weightage 25%)** • **Surface Chemistry –** Introduction, Physical and Chemical adsorption, Adsorption isotherms, Multi molecular Theory OR **B.E.T** Adsorption Isotherm (No derivation), Gibbs Adsorption Equation (No derivation), Surface active agent OR Surfactants, Micellization, Critical Micellar Concentration (CMC) • **Nuclear Chemistry-** Concept of Nuclear particle, Definition of Isotopes, Isotones, Isobars, Isomers, fission and fusion reactions, Packing fraction, Nuclear binding energy, Nuclear coulomb barrier, Rate of ratio active disintegration, half-life period and Average life period, Rutherford &Sodi's law (Group transfer law),Use of radioisotopes as tracers, Numerical.

REFERENCES BOOKS

- Organic chemistry by Morrison & Boyd Vth Edition
- Advance Organic Chemistry by Jerry March.
- Advance Organic Chemistry by ArunBahal and B.S.Bahal.
- Organic Chemistry Vol. I & II by S.M.Mukherji, S.P.SingR.P.Kapoor.
- Text book of Organic Chemistry by ArunBahal, B.S.Bahal, S.Chand.
- Organic Chemistry by I.L.Finar Vol I &.II Vth Edition
- Organic Chemistry by pine, Hendriction, Cram and Hammond 4th edBy P.S. Kalsi.
- Advance Physical Chemistry by Gurdeep Raj
- Physical Chemistry (Question and Answers) by R.N.MadanG.D.Tully, S.Chand.
- Principles of Physical Chemistry by Puri, Sharma, Pathania.
- Essentials of Physical Chemistry by B.S.Bahal, ArunBahalG.D.Tully.
- Chemical Thermodynamics by R.P.Rastogy and R.R.Misra.
- Physical Chemistry by P.W.Atkins, 5th ed. , Oxford, 1994, 7th ed. ,2002
- Physical Chemistry by R.A.Alberty and R.J.Silbey, John Wiley, 1995.
- Physical Chemistry by G.H.Barrow, 5th ed., Mac Graw Hill, 1998, 6th ed.
- Physical Chemistry by W.J.Moore, 4th ed., Orient Longmans, 1969.
- Concise inorganic Chemistry by J. D. Lee 4th edition.

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Chemistry Major Course-7

CHM 226-2C CHEMISTRYPRACTICALS-III

LEARNING OUTCOMES:

- Understand the concept of various inorganic and analytical reactions.
- Develop an understanding of the inorganic and analytical systems around us.
- Gain knowledge about the structure, function and applications of various Inorganic compounds and Analytical techniques.

Subject Code	Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
						Max Marks		
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Mid Term (CCE)	End Term (SEE)	
CHM 226-2C	Chemistry Practicals-III	0	8	4	5	50	50	100

CONTENT

A. Inorganic Mixtures (Minimum Seven) Teaching Hours : 60 (Weightage 50%)

- Inorganic qualitative analysis of a mixture containing 4 radicals(except PO_4^{-3}, BO_3^{-3}, AsO_4^{-3}, SO_3^{-3}, O^{-2})

Water Soluble and Insoluble Inorganic salts of following cations and anions:

Cations: Na^+, K^+, NH_4^+, Mg^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{3+}, Pb^{2+}, Cu^{2+}.

Anions: S^{2-}, SO_4^{2-}, CO_3^{2-}, CrO_4^{2-}, Cl^-, Br^-, I^-, NO_2^-,NO_3^-, $Cr_2O_7^{-2}$.

- **Organic Estimation (Minimum five)**
- To determine the amount of Aniline by Brominating Method.
- To determine the amount of Phenol by Brominating Method.
- To determine the amount of Glucose by oxidation Method.
- Estimation glucose by titration with Fehling's solution.
- Estimation of sucrose by titration with Fehling's solution.
- Estimation glucose and sucrose in a given mixture.
- Estimation of formaldehyde (formalin).

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B. Volumetric Titration (**Minimum Ten**) **Teaching Hours : 60** **(Weightage 50%)**

- To determine the amount of Zn in Zinc sulphate by EDTA titration method.
- To determine the amount of Ni in Nickel chloride by EDTA titration method.
- To determine the amount of Cu in cupric chloride by EDTA titration method.
- Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
- Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
- Estimation of Cu(II) using standard sodium thiosulphate solution (Iodimetrically).
- Estimation of available chlorine in bleaching powder iodometrically.
- To determine the strength of given strong acid and strong base(HCl vs NaOH) by conductometric titrations.
- To determine the strength of given Weak acid vs. strong base (CH_3COOH vs NaOH) by conductometric titrations.
- To determine the strength of given Strong acid vs. weak base (HCl vs NH_4OH) by conductometric titrations.

REFERENCES BOOKS

- Vogel, Arthur Israel. Vogel's textbook of practical chemistry
- Vogel,s qualitative inorganic analysis, 7^{th} edition, textbook of practical chemistry.
- Advanced Practical Chemistry by Jagdamba Singh, R.K.P. Singh, Jaya Singh, LDS Yadav, I. R. Siddiqui, Jaya Shrivastava
- Advanced Inorganic Analysis by Agrawal Keemtilal, Pragati Additions
- Practical Physical Chemistry by B. Vishwanathan and P.S. Ragvan
- Advanced Physical Chemistry Experiments by Gurtu-GurtuPragati Additions
- Textbook of Organic Chemistry by Parashar and Ahluvalia
- Comprehensive Practical Organic Chemistry by K Ahluwalia and Renu Aggarwal

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Multidisciplinary Course (MDC)

MDC 222-2C INTRODUCTION TO CHEMISTRY-III

LEARNING OUTCOMES:

- Student will acquire knowledge regarding the structure, mechanism and various acid–base concept with theories.
- Students will develop a comprehensive understanding of Chemical kinetics and physiochemical properties.

Subject Code	Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Practical hrs Per Week			CCE	SEE	
MDC 222-2C	Introduction to Chemistry-III	2	4	4	2.5	50	50	100

Unit 1: Basics of Organic Chemistry **Teaching Hours: 15**

- Factors affecting to the properties of organic molecule
- Electromeric effect, Inductive effect, Mesomaric effect
- Resonance effect (resonating structures of Nitro benzene, Chlorobenzen, Phenoxide ion, Anillinium ion, Acetate ion)
- Steric effect, Electromeric and field effect, Hyperconjugation
- Aromaticity

Unit 2. Thermochemistry **Teaching Hours: 15**

- Introduction
- System and surrounding- work & heat, state function, thermodynamic process, internal energy, enthalpy, free energy, maximum work function
- Zeroth law, first law, Second law of thermodynamics; proof of 2nd law (Carnot's Cycle)
- Concept of entropy; Entropy change for an ideal gas under different conditions, entropy change for mixture of ideal gases
- Related Numericals

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Unit 3: Chemistry Practical **Teaching Hours: 60**

Inorganic Qualitative Analysis (Four Radicals) (Minimum Ten)

Water Soluble and Insoluble Inorganic salts of following cations and anions:

Cations: Na^{+}, K^{+}, NH_4^{+}, Mg^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{3+}, Pb^{2+}, Cu^{2+}.

Anions: S^{2-}, SO_4^{2-}, CO_3^{2-}, PO_4^{3-}, CrO_4^{2-}, Cl^{-} , Br^{-}, I^{-}, NO_2^{-},NO_3^{-}, O^{2-}.

REFERENCES BOOKS

- 'Physical Chemistry' by P. W. Atkins, 7/E, 2002, Oxford University Press, Indian Edition.
- 'Physical Chemistry' by W. J. Moore, MacGraw Hill Publication, 1996, 6/E.
- 'Principle of Physical Chemistry' by Puri, Sharma &Pathania, 41/E, Vishal Publishers.
- 'Essentials of Physical Chemistry' by Bahl&Tuli. 22/E, S.Chand publication New Delhi .
- 'Advanced Physical Chemistry' by Gurdeep Raj, 19/E, Goel Publishing House Meerut.
- 'Organic Chemistry' by G. Marc Loudon, 4/E, 2010, Oxford University Press, Indian Edition,
- 'Organic Chemistry' by Robert Thornot Morrison, Robert Neilson Boyd, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
- 'Text book of Organic Chemistry' by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
- 'Text book of Organic Chemistry' by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.
- 'Organic Chemistry' by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt. Ltd, New Delhi.
- Vogel, Arthur Israel. Vogel's textbook of practical chemistry
- Vogel,s qualitative inorganic analysis, 7^{th} edition, textbook of practical chemistry.

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Skill Enhancement Course (SEC)

SEC 262-2C INDUSTRIAL CHEMISTRY-I

LEARNING OUTCOMES

- Understand industrial synthesis methods and applications. Familiarize with equipment, technologies, and unit operations.
- Optimize processes for efficiency and waste reduction. Prioritize safety, environmental concerns, and regulatory compliance.

Subject Code	Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term	End Term	
SEC 262-2C	Industrial Chemistry-I	2	0	2	2	25	25	50

CONTENT

Unit : 1 - Industrial Aspects of Organic and Inorganic chemistry. Teaching Hours : 15 (Weightage :50%)

- Nomenclature: Generic names, Trade names
- Raw materials for organic compounds: Petroleum, Natural gas, Fractionation of crude oil, cracking, reforming, hydro forming and Isomerisation.
- Coal: Types of coal, properties, calorific value, distillation of coal, chemicals derived from them.
- Renewable Natural resources: Cellulose, Starch: - properties, modification, important industrial chemicals derived from them. Alcohols, oxalic acid and Furfural.
- Basic Metallurgical operations: pulverization, calcinations, roasting, refining of metals.
- Physicochemical principles of Extraction of: Iron, Copper, Lead, Silver, Sodium, Aluminium and Zinc.
- Inorganic Materials of Industrial Importance: Availability, forms, structure and modifications of – alumina, silicates, clays, mica, carbon, zeolites.

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Unit 2: Chemical Technology Teaching Hours : 15 (Weightage :50%)

- Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption.
- An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators.
- Scaling up operations in chemical industry. Introduction to clean technology

REFERENCES BOOKS

- B. K. Sharma, Industrial chemistry
- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes,Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers,New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & CompanyLtd. New Delhi