



KADI SARVA VISHWAVIDYALAYA
B.Sc Semester 4 (Chemistry Subject's Syllabus)

KADI SARVA
VISHWAVIDYALAYA,
GANDHINAGAR



B.Sc. Curriculum as Per NEP
Chemistry Subject Syllabus
Semester 4

W.E.F. June 2024



KADI SARVA VISHWAVIDYALAYA

B.Sc Semester 4 (Chemistry Subject's Syllabus)

Chemistry Major Course- 8

CHM 236-2C INORGANIC & ANALYTICAL CHEMISTRY- II

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 Per Week		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term (CCE)	End Term (SEE)	
CHM 236-2C	Inorganic & Analytical Chemistry- II	4	0	4	2.5	50	50	100

UNIT	
1	Teaching Hours: 15 (Weightage 25%) <ul style="list-style-type: none">• Coordination Compounds –Introduction of coordination compounds Ligands and their classification, Werner's coordination theory and its experimental verification, electric neutrality principle, effective atomic number concept, nomenclature of coordination compounds, isomerism in coordination compounds, chelate and chelate effects. Valence bond theory of transition metal complexes- Octahedral, tetrahedral, square planer
2	Teaching Hours: 15 (Weightage 25%) <ul style="list-style-type: none">• Crystal Field Theory-Introduction, Orientation of d-orbitals and Crystal Field Splitting of Energy Levels, Crystal Field Splitting in Octahedral complexes, Tetrahedral and square planer complexes. Crystal Field Stabilization Energy (CFSE), Factors influences the magnitude of Crystal Field Splitting. Crystal Field Effects on Lattice Energy; Jahn-Teller effect



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3	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Complexometric Titrations -Theory of Complexometric titration involving EDTA, Study of EDTA complex formation taking disodium salt of EDTA and effect of pH, Ways of locating the end point, Estimation of Nickel and copper by complexometric titration by EDTA• Redox titration-Theory of redox titration ∞ Study of redox titration by electrochemical potential method. Ways of locating the end point for redox titration
4	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Chromatography-A. Classification of chromatographic methods: Principle of differential migration, description of the chromatographic process, distribution coefficients, modes of chromatography, performing column chromatography. B. Chromatography – theory and practice: Introduction, the chromatograph (elution time and volume), capacity factor, column efficiency and resolution, sample preparation C.• Paper chromatography: experimental modifications, various modes of development, nature of the paper, detection of spots, retardation factors, factors that affect the reproducibility of R_f values (due to paper, solvent system, sample, development procedure), selection of solvent, quantitative analysis.

REFERENCES BOOKS

- 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.
- Principles of Analytical Chemistry J.H. Kennedy
- Analytical Chemistry – Principles & Techniques L.G.Hargis
- Principles of Instrumental Analysis: Douglas A. Skoog., F. James Holler, Stanley R. Crouch, Cengage Learning; 6th Edition.
- 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.
- Inorganic Chemistry by G. D. Tuli.
- Advance Inorganic Chemistry Vol-II Satya Prakash (S.Chand).
- Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi.
- Advanced inorganic chemistry by Cotton and Wilkinson.
- Quantum mechanics by R K Prasad.



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Chemistry Major Course-9

CHM237-2C ORGANIC & PHYSICAL CHEMISTRY- II

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.
- Develop an understanding of electrochemistry and various electrodes.
- Develop an understanding of nuclear chemistry.

Subject Code	Subject Title	Teaching Scheme Per Week		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term (CCE)	End Term (SEE)	
CHM237-2C	Organic & Physical Chemistry- II	4	0	4	2.5	50	50	100

CONTENT

UNIT	
1	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Alcohols Nomenclature, methods of preparation, physical and chemical properties, identification of primary, secondary, and tertiary alcohols Unsaturated alcohols- Vinyl and Allyl alcohol Dihydric alcohol - Nomenclature, method of formation and chemical reactions of vicinal glycols. Trihydric alcohols- methods of formation, chemical reactions of glycerol.• Phenols – Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols (without mechanism)- Electrophilic aromatic substitution, acylation and carboxylation, Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, LedererManasse reaction and Reimer-Tiemann reaction.



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2	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Carboxylic Acids - Nomenclature, structure and bonding, acidity of carboxylic acids, effects of substituents on acid strength, mechanism of decarboxylation, Methods of formation, physical properties and chemical reactions of dicarboxylic acids - oxalic, succinic and phthalic acid.• Substituted Acids –Methods of formation & chemical reactions of halo acids, hydroxy acids, malic, tartaric, citric and salicylic acids. Unsaturated Acids - Acrylic and cinnamic acid. Introduction to acids derivatives - Preparation, properties and uses of acid halides, amides, anhydrides and esters. Interconversion of acid derivatives by nucleophilic acyl substitution. HVZ reaction, Hofmann - bromamide reaction and ester hydrolysis (without mechanism).
3	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Ionic Equilibria - Arrhenius theory of electrolyte and its application, Ostwald's dilution law, its uses and limitations. Debye - Huckle theory of strong electrolytes, asymmetric, electrophoretic, DebyeFalkenhagen and Wein effects, Activity coefficient, mean activity coefficient, ionic strength, DebyeHuckel limiting law. Resistance, Conductance, Specific conductance, Equivalent Conductance, Molar Conductance, Equivalent Conductance at Infinite Dilution• Chemical Equilibrium - Equilibrium constant and free energy, thermodynamic derivation of law of mass action, distribution law and phase rule, Le Chatelier's principle, Nernst's distribution law for solute, principle of extraction of solute from solution and washing of precipitate
4	<p>Teaching Hours: 15 (Weightage 25%)</p> <ul style="list-style-type: none">• Electrochemistry-Introduction of terms: Oxidation, Reduction, Redox, Anode, Cathode, Electrode, Half Cell, Oxidation & Reduction Potential. Electrochemical cell (Galvanic Cell) & Representation cell. Electrochemical Series and its Significance. Nernst Equation of Cell EMF and single electrode potential. EMF of a cell and its measurements, computation of cell EMF. Numerical• Description of the following electrode Standard Hydrogen Electrode. Calomel Electrode. Glass Electrode.

REFERENCES BOOKS

- Organic chemistry by Morrison & Boyd Vth Edition
- Advance organic chemistry by R.K. Bansal.
- Organic chemistry by I.L. Finar Vol I & II Vth Edition
- Organic chemistry by Pine, Hendrikson, Cram and Hammond IVth edition...
- Advanced organic chemistry by Jerry March.
- Stereo chemistry: conformation and mechanism VIth edition by P.S. Kalsi.
- Advanced organic chemistry by Arun Bahal and B.S. Bahal.



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- Organic chemistry Vol, I, II, III by S.M.Mukherjee, S.P.Singh, R.P.Kapoor.
- Stereo Chemistry by Nasipuri.
- 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.
- 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.



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B.Sc Semester 4 (Chemistry Subject's Syllabus)
Chemistry Major Course-10

CHM238-2CCHEMISTRYPRACTICALS-IV

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 Per Week		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term (CCE)	End Term (SEE)	
CHM238-2C	Chemistry Practical's - IV	0	8	4	5	50	50	100

A. Organic Practicals

Teaching Hours : 60 (Weightage 50%)

- **Single step Organic preparation (Minimum Five)**
- Preparation of m-Dinitro benzene from Nitrobenzene
- Preparation of p-Nitro acetanilide from Acetanilide
- Preparation of Acetanilide from Aniline (Green Preparation)
- Preparation of Benzilic Acid from Benzil (Green Preparation)
- Preparation of Di-benzal acetone from Benzaldehyde
- Preparation of p-bromo acetanilide from Acetanilide

- **Separation of Organic Mixture (Water Insoluble) (Minimum Seven)**
- Separation and qualitative determination of binary organic mixture (Only Water Insoluble Solid Compounds taken), derivative of any one compound.
Acid: Benzoic acid, phthalic acid, Salicylic acid, Cinnamic acid. Anthranilic acid, Nitro benzoic acid.
Phenol: 1-Naphthol, 2- Naphthol, o-nitro phenol, m-nitro phenol, p-nitro phenol,

Base: Diphenyl amine, p-toluidine , o-nitro aniline, m-nitro aniline, p-nitro aniline,
Neutral: Naphthalene, anthracene, acetanilide, m-di nitro benzene,



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B. Physical Practicals (Minimum Ten) Teaching Hours : 60 (Weightage 50%)

- Determination of cell constant
- Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- Determination of distribution coefficients of:
 - (a) Iodine between water and carbon tetrachloride.
 - (b) Acetic/ benzoic acid between water and cyclohexane
- Study the equilibrium of at least one of the following reactions by the distribution method:
$$\text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3^-(\text{aq})$$
$$\text{Cu}^{2+}(\text{aq}) + n\text{NH}_3 \rightarrow \text{Cu}(\text{NH}_3)_n$$
- Calibration of pH meter using 4 pH buffer solution and determine the strength of the given acid/base using pH metric titrations (HCl Vs NaOH)
- To determine the Dissociation constant of the acid of mixtures of CH_3COONa and CH_3COOH by pH meter
- To study the kinetics of the reaction of decomposition of H_2O_2 catalysis by iodine ion (Clock reaction)
- Find the solubility and heat of solution of the given organic acid at two different Temperatures
- Demonstration related to optical activity of organic compound by Polari meter.

References Book

- 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-Gurtu Pragati Additions
- Textbook of Organic Chemistry by Parashar and Ahluvalia
- Comprehensive Practical Organic Chemistry by K Ahluwalia and Renu Aggarwal



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B.Sc Semester 4 (Chemistry Subject's Syllabus)
Chemistry Minor Course- Semester 4
CHE222-2C CHEMISTRY IN DAILY LIFE-AGRICULTURE
CHEMISTRY

Subject Code	Subject Title	Teaching Scheme Per Week		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term	End Term	
CHE222-2C	Chemistry in Daily Life-Agriculture Chemistry	2	4	4	2.5	50	50	100

Contents

Unit: 1 SOIL CHEMISTRY & FERTILIZERS Teaching Hours : 15 (Weightage :50%)

- Chemical (elemental) composition of the earth's crust and soils. Cation Exchange Capacity and Anion Exchange Capacity Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components
- Plant Nutrients, Major Nutrients, Minor Nutrients, Trace Nutrients
- Definition of Fertilizer • Classification of Fertilizer
- Synthesis of N Containing Fertilizer i.e. $(\text{NH}_4)_2\text{SO}_4$, $\text{Ca}(\text{CN})_2$, and Urea
- Synthesis of P Containing Fertilizer i.e. Super Phosphate, Tripal Super Phosphate Mix

Unit 2: INSECTICIDE & PESTICIDES Teaching Hours : 15 (Weightage :50%)

- Introduction • Inorganic Insecticide • Organic Insecticide, Natural or Plant Insecticide • Synthesis of DDT, BHC
- General Introduction to Pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture, and uses of representative pesticides in the following classes:
 - Organophosphates (Malathion, Parathion)
 - Carbamates (Carbofuran and carbaryl)
 - Quinones (Chloranil)
 - Anilides (alachlor and Butachlor).



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UNIT 3: Practical

(Minimum Ten)

Teaching Hours : 60

- To determine Physical and chemical analysis of soil.
- Volumetric estimation of fertilizers. (N, P, K)
- To determine bulk density of different samples of soil.
- To determine moisture of different samples of soil.
- To determine water holding capacity of different samples of soil.
- To determine humus analysis of different samples of soil.
- To determine Ca^{+2} and Mg^{+2} amount in the soil samples.
- Colorimetric analysis of Sulphur (gravimetrically) and phosphorous in the given soil sample.
- Colorimetric analysis of N, P, K in the given soil sample.
- To determine conductance of different samples of soil.
- To determine conductance chloride ion of different samples of soil. (by AgNO_3 .Mohr's method)

REFERENCES:

- Research methods in plant sciences: Allelopathy Vol I, soil analysis by S. S. Narwal, S. S. Dahiya and J.P. Singh.
- Practical manual chemical analysis of soil and plant samples by Ummed Singh C S Praharaj, ICAR-Indian institute of pulses research Kanpur, Uttar Pradesh
- Practical Manual, Introductory Agro Meteorology and Climate change by Dr. R. R. Pisal, Dr. A. P. Patel, Dr. V. M. Patel, Prof. S S Sonawane, Prof. H. P. Dholariya
- Industrial Chemistry by B.K.Sharma.
- A source book of Agricultural chemistry by Charles Albert Browne
- Methods in Agricultural chemical analysis – A practical Handbook by N.T.Faithfull.
- Bear RE. 1964. Chemistry of the Soil. Oxford and IBH.
- Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.
- Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.
- Greenland DJ & Hayes MHB. Chemistry of Soil Constituents. John Wiley & Sons.
- McBride MB. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.
- Sposito G. 1981. The Thermodynamics of Soil Solutions. Oxford Univ. Press.
- Sposito G. 1984. The Surface Chemistry of Soils. Oxford Univ. Press.
- Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press. nd
- Stevenson FJ. 1994. Humus Chemistry. 2 Ed. John Wiley & Sons.
- Van Olphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons.
- Cremlyn, R. Pesticides, Preparation and Modes of Action, John Wiley & Sons, New York, 1978.



KADI SARVA VISHWAVIDYALAYA
B.Sc Semester 4 (Chemistry Subject's Syllabus)
Chemistry Skill Enhancement Course (SEC)

SEC266-2C INDUSTRIAL CHEMISTRY -II

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 Per Week		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						Mid Term	End Term	
SEC266-2C	Industrial Chemistry-II	2	0	2	2	25	25	50

Content

<p>Unit: 1 Industrial Aspects of Physical and Material Chemistry Teaching Hours : 15 (Weightage :50%)</p> <ul style="list-style-type: none"> • Surface chemistry and Interfacial phenomena: Adsorption isotherm, Sols, Gels, Emulsions, Micro emulsions, Micelles, Aerosols, Effect of surfactants, Hydrotropes. • Catalysis: Introduction, Types, Basic principles, mechanisms, factors affecting the performance, introduction to phase transfer catalysis, Enzymes catalyzed reactions- ratemodel, industrially important reactions. • Dimensions and Units: Basic chemical calculations – atomic weight, molecular weight, equivalent weight, Mole concept, composition of liquid and gaseous mixtures. • Material Balance without chemical reactions: Flow diagram for material balance, simple material balance with or without recycle or bypass for chemical engineering operations such as distillation, absorption, crystallization, evaporation, extraction etc.
<p>Unit 2: Utilities in Industry Teaching Hours : 15 (Weightage :50%)</p> <ul style="list-style-type: none"> • Fuel: Types of fuels – advantages and disadvantages. Boilers: Types of boilers and their functioning. • Water: Specifications for Industrial use, various water treatments. Steam: Generation and use. • Air: Specifications for Industrial use, processing of air. • Fluid Flow: Fans, Blowers, Compressors, vacuum pumps, Ejectors. Pumps: Reciprocating pumps, Gear pumps, Centrifugal pumps. • Heat Transfer: Heat exchangers- shell and tube type, finned tube heat exchangers, plate heat exchangers, refrigeration cycles.



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REFERENCE BOOKS

- 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 & Company Ltd. New Delhi