Semester I

General Chemistry Paper 101

Unit I : Inorganic Chemistry (14 Marks)

(a) **Lanthanides:-**
Electron configuration, Oxidation states, Magnetic properties, Color and absorption spectra of lanthanide ions, Lanthanide contraction, Separation and purification of Lanthanides**:** Ion-exchange and solvent extraction methods.

(b) **Actinides:-**
Electron configuration, Oxidation states, Magnetic properties, Color and absorption spectra of actinide ions, actinide contraction, Nuclear synthesis of trans uranic elements, Chain reaction, importance of Uranium, Comparison with lanthanide.

Unit II : Organic Chemistry (14 Marks)

(a) **Quantitative Analysis & Determination of Molecular Formula:-**
Determination of Nitrogen by Kjeldahl's method and Kjeldahl's method modified with boric acid . Molecular weight of organic acid by Ag-salt method and organic base by Chloroplatinate method, Numerical based on empirical and molecula formula.

(b) **Fundamentals of Organic Reactions:-**
Fission of covalent bond, types of reagents, Substitution Nucleophilic Unimolecular reaction mechanism (SN^1), Substitution Nucleophilic Bimolecular reaction mechanism (SN^2), Electrophilic Aromatic Substitution – Elementary treatment only (Nitration, Sulfonation, Halogenation & Friedel-Crafts Alkylation and Acylation)

Unit III : Organic Chemistry (14 Marks)

(a) **Alkanes:-** (Saturated Hydrocarbons)
Introduction, IUPAC nomenclature, Reduction of R-X, Wurtz's reaction, Hydrolysis of R-Mg-X, Decarboxylation of acid, Kolbe's electrolytic process, Free radical mechanism (Chlorination of Methane).

(b) **Alkenes & Alkynes**:- (Unsaturated Hydrocarbons)
Introduction, IUPAC nomenclature, Preparations (dehydration, dehalogenation, dehydrohalogenation), Reactions with H_2, X_2, HX, HOCl, H_2SO_4, and Hydroboration; Oxidation reactions: (i) with cold alkaline $KMnO_4$ (Baeyer's reagent), (ii) Oxidative cleavage with acidified or hot $KMnO_4$, (iii) Ozonolysis (O_3); Polymerization; Reactions of terminal Acetylenes: (i) Addition of water, (ii) Na / liquid NH_3.

Unit IV: Physical Chemistry (14 Marks)

(a) **Thermodynamics**:-

Zeroth law, first law, Second law of thermodynamics; proof of 2^{nd} law (Carnot's Cycle); Entropy, of Gas and calculation of entropy for different processes; Kirchhoff's equation.

(b) **Chemical Kinetics**:-

Basic terms: molecularity, order of reactions. Unit for rate constant; Derivation of: first order rate constant, Second order rate constant for (a=b) and ($a \neq b$). Third order rate equation (a=b=c). Determination of Half Life Time for 1^{st}, 2^{nd} and 3^{rd} order reactions.

REFERENCE BOOKS

UNIT I :

1. '**Elements of Quantum Mechanics**' by **Michael D. Fayer**, Oxford University Press, Indian Edition.
2. '**Concise Inorganic Chemistry**' by **J. D. Lee,** 5/E, Oxford University Press, Indian Edition.
3. '**Basic Inorganic Chemistry'** by **F. A. Cotton and G. Wilkinson,** Wiley publication**.**
4. **'Inorganic Chemistry'** by **Shriver & Atkin**s, 4/E, Oxford University Press, Indian Edition.
5. '**Introductory Quantum Chemistry' by A. K. Chandra ,** 4/E , Tata MacGraw Hill Publishing Company Limited, New Delhi.

UNIT II & III :

1**. 'Organic Chemistry'** by **G. Marc Loudon,** 4/E, 2010, Oxford University Press, Indian Edition,
2. '**Organic Chemistry**' by **Robert Thornot Morrison, Robert Neilson Boyd**, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
3. '**Text book of Organic Chemistry**' by **P. L. Soni and H. M. Chawla**, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
4. '**Text book of Organic Chemistry**' by **P. S. Kalsi**, 1999, MacMillan of India Pvt. Ltd.
5. '**Organic Chemistry'** by **Bhupinder Mehta, Manju Mehta**, Prentice Hall of India Pvt. Ltd, New Delhi.

UNIT IV :

1. '**Elements of Physical Chemistry**' by **Peter Atkins & Julio De Paula**, 5/E, Oxford University Press, Indian Edition.
2. '**Physical Chemistry**' by **P. W. Atkins**, 7/E, 2002, Oxford University Press, Indian Edition.
3. '**Physical Chemistry**' by **W. J. Moore**, MacGraw Hill Publication, 1996, 6/E.
4. '**Principle of Physical Chemistry'** by **Puri, Sharma & Pathania,** 41/E, Vishal Publishers.
5. '**Essentials of Physical Chemistry'** by **Bahl & Tuli.** 22/E, S.Chand publication New Delhi .
6. '**Advanced Physical Chemistry**' by **Gurdeep Raj,** 19/E, Goel Publishing House Meerut.

Semester I

Practical Paper 102

(a) Volumetric Analysis (Acid and Base)

(1) Preparation and Standardization of NaOH and HCl

(2) Succinic Acid ---------NaOH

(3) Oxalic Acid ---------- NaOH

(Hydrated & Anhydrous)

(4) Na_2CO_3 ----------HCl

(b) Inorganic Qualitative Analysis (Two Radicals) (Minimum Eight Salts)

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_3^-, O^{2-}**.**

Reference Books

1. '**Vogel's Textbook of Quantitative Chemical analysis'** Revised by **G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney,** 5/E , ELBS (English Language Book Society) Longman.

2. **'Analytical Chemistry'** by **Dhruba Charan Dash,** PHI Learning Private Ltd, New Delhi, 2011.

3. '**Analytical Chemistry'** by **Gary D. Christian ,** 4/E, John Wiley & Sons

4. '**Advanced Practical Inorganic Chemistry'** by **Gurdeep Raj,** 9/E, Goel Publishing House, Meerut.

5. **'Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis',** 5/E, Orient Longman Ltd.

Semester II

General Chemistry Paper 103

UNIT I : Inorganic Chemistry :- (14 Marks)

(a) **Chemical Bonding:-**

Covalent bond-Sidgwick Powel Theory, VSEPR Theory, Examples of NH_3, H_2O, ClF_3, SF_4, SF_6, I_3^-, IF_7; Hybridization of atomic orbitals; Rules for Hybridization; Types of Hybridization and shape of some molecules (sp, sp^2, sp^3, sp^3d, sp^3d^2).

(b) **Complex Compound**:-

Werner's Theory; Labile and inert complexes; Stability of complex compounds; Factors influencing the stability of complexes; Spectrochemical Series; V. B. theory for complexes – Examples of ML_4 & ML_6 type (Fe, Co, Ni, Mn).

UNIT II : Inorganic Chemistry:- (14 Marks)

(a) **Introduction of Wave Mechanics:-**

Wave equation and wave functions, its interpretation, significance of Ψ and Ψ^2, Limitations of acceptable wave functions, Normalized and orthogonal (orthonormal) wave functions, Eigen values and Eigen functions

(b) **Operator Concept in Quantum Chemistry:-**

Operators, type of operators, Hamiltonian Operator for H atom, H_2 molecule, H_2^+ ion, He, Li, Be and B atom.

UNIT III : Organic Chemistry:- (14 Marks)

(a) **Fundamentals of Stereochemistry**:-

Introduction, Stereochemical aspects of organic molecules, Chirality, Optical isomerism, Enantiomers and Diastereomers, R-S nomenclature, E-Z nomenclature.

(b) **Conformations**:-

Conformational analysis of Ethane, n-Butane & Cyclohexane.

UNIT IV: Physical Chemistry:- (14 Marks)

(a) **Ionic equilibrium**:-

Definition of basic terms: Electrical conductance, Specific conductance Equivalent conductance, Molar conductance, Cell constant & degree of Dissociation; Derivation of Oswald's dilution law , its applications and Limitations; pH Scale, Hydrolysis, Relation between K_a , K_b , K_h , & K_w for

Strong acid → Strong base
Strong acid → Weak base
Weak acid → Strong base

Buffer Solution, (Henderson – Hasselbalch equation), Indicator theory, Useful pH range of indicator for acid base titration.

(b) **Nuclear Chemistry:-**

Radioactivity, Rutherford's disintegration theory, Soddy's group Displacement law, Packing fraction, Factors affecting stability of Nucleus (Mass defect, Binding energy, N / P ratio) .

REFERENCE BOOKS

UNIT I & II :

1. '**Elements of Quantum Mechanics**' by **Michael D. Fayer**, Oxford University Press, Indian Edition,
2. '**Concise Inorganic Chemistry**' by **J. D. Lee,** 5/E, Oxford University Press, Indian Edition.
3. '**Basic Inorganic Chemistry'** by **F. A. Cotton and G. Wilkinson,** Wiley publication**.**
4. **'Inorganic Chemistry'** by **Shriver & Atkin**s, 4/E, Oxford University Press, Indian Edition.
5. '**Introductory Quantum Chemistry' by A. K. Chandra ,** 4/E , Tata MacGraw Hill Publishing Company Limited New Delhi.

UNIT III :

1**. 'Organic Chemistry'** by **G. Marc Loudon,** 4/E, 2010, Oxford University Press, Indian Edition.
2. '**Organic Chemistry**' by **Robert Thornot Morrison, Robert Neilson Boyd**, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
3. '**Text book of Organic Chemistry**' by **P. L. Soni and H. M. Chawla**, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
4. '**Text book of Organic Chemistry**' by **P. S. Kalsi**, 1999, MacMillan of India Pvt. Ltd.
5. '**Organic Chemistry'** by **Bhupinder Mehta, Manju Mehta**, Prentice Hall of India Pvt.Ltd, New Delhi.

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2. '**Physical Chemistry**' by **P. W. Atkins**, 7/E, 2002, Oxford University Press, Indian Edition.
3. '**Physical Chemistry**' by **W. J. Moore**, MacGraw Hill Publication, 1996, 6/E.
4. '**Principle of Physical Chemistry'** by **Puri, Sharma & Pathania,** 41/E, Vishal Publishers.
5. '**Essentials of Physical Chemistry'** by **Bahl & Tuli.** 22/E, S. Chand publication New Delhi .
6. '**Advanced Physical Chemistry**' by **Gurdeep Raj,** 19/E, Goel Publishing House, Meerut.

SEMESTER II

Practical Paper 104

(a) Organic Spotting :- **(06 Solids and 04 Liquids).**

List organic compounds having different mono functional groups:

Solids :

Acids : (i) Benzoic acid (ii**)** Oxalic acid (iii) Succinic acid

Phenols : (i) β-Napthol (ii) α-Napthol

Neutral : (i) Urea (ii) Thiourea (iii) Benzamide (iv) Napthalene

Liquids :

(i) Aniline (ii) Nitrobenzene (iii) Benzaldehyde (iv) Ethanol

(v) Ethylacetate (vi) Chloroform (vii) Chlorobenzene (viii) Acetone

(b) Volumetric Analysis:-

Redox Titrations:-

(1) $KMnO_4$…… $FeSO_4.7H_2O$

(2) $K_2Cr_2O_7$……$FeSO_4$ $(NH_4)_2SO_4.6H_2O$

Complexometric Titration by EDTA:-

(1) Estimation of Ca^{+2} …….. EDTA

(2) Estimation of Mg^{+2}..... …….. EDTA

REFERENCE BOOKS

1. '**Vogel's Textbook of Quantitative Chemical analysis'** Revised by **G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney,** 5/E, ELBS (English Language Book Society) Longman.
2. **'Analytical Chemistry'** by **Dhruba Charan Dash,** PHI Learning Private Ltd, New Delhi, 2011.
3. '**Analytical Chemistry'** by **Gary D. Christian ,** 4/E, John Wiley & Sons.
4. **'Comprehensive Practical Organic Chemistry – Qualitative Analysis'** by **V. K. Ahluwalia, Sunita Dhingra** University Press (India) Private Limited, Hyderabad, First Indian Reprint 2010.
5. **'Organic Analytical Chemistry theory and Practice'** by **Mohan Jag**, Narosa Publication, New Delhi. (2003).
6. '**Elementary Practical Organic Chemistry Part-2, Qualitative Organic Analysis**' by **Arthur I. Vogel**,-CBS Publishers & Distributers, New Delhi.(Second edition, reprint 2004)
7. '**Advanced practical Organic Chemistry**' by **J. Leonard, B. Lygo, G. Procter**, (First Indian reprint , 2004),Publication-Stanley Thornes (Publishers) Ltd.

B.Sc. Semester III

Chem. – 201 [Organic Chemistry]

Unit;- I

[A] Carbohydrates [Marks -8]

Introduction, classification of carbohydrates, osazone formation, epimerization, step up and step down reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose.

[B] Amino acid : [Marks -6]

Introduction of amino acid, Classification and properties of amino acids, Zwitter ion , Isoelectric point, Strecker's and Gabreil pthalimide synthesis of amino acids.

Unit:- II

[A] Electrophilic aromatic Substitution: [Marks -8]

Introduction, effect of substituent groups, determination of orientation and relative reactivity, classification of substituent groups, electrophilic substitution (ES) reactions. (Nitration, Sulfonation, Halogenation, Friedel Craft alkylation and acylation), Orientation in mono and disubstituted benzene.

[B] Polynuclear hydrocarbon [Marks -6]

Nomenclature, structure and synthesis of Naphthalene and its derivatives. Reactions (oxidation, reduction and electrophilic substitution reaction (ESR)) of naphthalene.

Unit III

[A] Heterocyclic Compounds [Marks -8]

Introduction, structure of Pyrrole, Furan and Thiophene, Paal Knorr synthesis and electrophilic substitution of Pyrrole, Furan and Thiophene, reactivity and orientation of electrophilic substitution reactions (ESR) in five membered heterocycles (Pyrrole, Furan and Thiophene) Structure of Pyridine, Electrophilic and Nucleophilic substitution reactions of pyridine. Basicity of pyridine.

[B] β-dicarbonyl compounds [Marks -6]

Introduction, synthesis of Ethyl acetoacetate (EAA) and Diethylmalonate Acidic and ketonic hysrolysis of β-dicarbonyl compounds, Synthetic applications of β-dicarbonyl compounds. (i) Crotonic acid from EAA (ii) Valeric Acid from diethyl malonate

Unit-IV

Chemical Reactivity and Molecular Structure: (Acid- Base Properties) [Marks-14]

Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism . Difference between resonance and tautomerism.

REFERENCES

1. Robert Thornot Morrison and Robert Neilson Boyd, ***"Organic Chemistry"***, Prentice Hall of India Pvt Ltd, New Delhi, Sixth Edition, 1992.

2. Bhupinder Mehta, Manju Mehta, ***"Organic Chemistry"***, Prentice Hall of India Pvt Ltd, New Delhi, 2005.

3. James B Hedrickson Donald J. Cram and George S. Hammond, ***"Organic Chemistry",*** Mc-Graw-Hill Kogakusha,Ltd., Third Edition.

4. Arun Bahl, B. S. Bahl, ***"Advance Organic Chemistry"***, S. Chand & Company Ltd., New Delhi, First Edition, 2003.

5. I. L. Finar, ***"Organic Chemistry"***, Pearson Education Pet Ltd, New Delhi, First Edition, 2002.

6. G. Marc Loudon, ***"Organic Chemistry"***, Oxford University Press, Forth Indian edition, 2010.

7. P.S.Kalsi, ***"Text book of Organic Chemistry"*,** MacMillan of India Pvt. Ltd., 1999.

8. P.L. Soni and H.M. Chawala, ***"Text book of Organic Chemistry",*** Sultan Chand & Sons Publication, New Delhi, 26th Edition, 1995.

B.Sc. Semester III

Chem. – 202 [Physical Chemistry]

Unit:- I

(A) Thermodynamics **[8 marks]**

Physical significance of entropy; Entropy change during phase change - solid to liquid and liquid to vapor; Entropy of mixing of ideal gases; Entropy change in reversible and irreversible process; Work and free energy functions; Helmoltz function and variation of free energy change with temperature and pressure; Gibbs Helmoltz equation, derivation.

(B) Chemical Kinetics **[6 marks]**

Theories of reaction rates: Collision theory of bimolecular gaseous reactions and Activated Complex theory of bimolecular reactions; Effects of temperature on reaction rates; Derivation of Arrhenius equation.

Unit:- II

(A) Electrochemistry **[8 marks]**

Transport number; Determination of transport numbers by moving boundary method; Conductometric titrations: Principle and advantages; Titration of Strong acid against strong base (HCl vs NaOH); Titration of Weak acid against strong base (CH_3COOH vs NaOH); Titration of Strong acid against weak base (HCl vs NH_4OH); Titration of very weak acid against strong base (H_3BO_3 vs NaOH); Titration of mixture of acids against strong base (HCl + CH_3COOH vs NaOH); Activity and activity coefficient; Ionic strength.

(B) Phase Rule **[6 marks]**

Theoretical derivation of phase rule; One component system : water system and sulphur system; Condensed phase rule; Silver – lead (Ag-Pb) system;

Unit:- III

(A) Adsorption **[8 marks]**

Definition of terms, Types of adsorption (physical, chemical and their difference), Types of adsorption isotherms (5 types), Derivation of Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Applications of adsorption

(B) Catalysis **[6 marks]**

Characteristic of catalysis, Homogenous and heterogeneous catalysis, Enzyme catalysed reaction and derivation mechanism, Marten reaction

Unit –IV

(A) Polymer Chemistry **[8 marks]**

Definition: Monomer, Polymer, Polymerization, Classification of Polymers; Chain polymerization:Free radical and Ionic polymerization [cationic and anionic], Co-ordination polymerization, Step polymerization: Polycondensation and Polyaddition and Ring Opening Polymerization.

(B) Colloids **[6 marks]**

Colloidal Systems; Preparation of Colloidal Solutions; General Properties of Colloidal Systems; Properties of hydrophobic Colloidal Systems

REFERENCES

1. B.R. Puri, L.R. Sharma, Madan S. Pathania, ***"Principles of physical chemistry"***, Vishal publishing-Jalandhar, 44th Edition, 2010-2011.
2. S. Glasstone, ***"Themodynamics for chemistry"***.
3. S. Glasstone, ***"An introduction to electrochemistry"***, Affiliated East-West press Pvt. Ltd, New Delhi, Madras.
4. B.S.Bahl, G.D.Tuli and Arun Bahl, ***"Essential of physical chemistry"***, S.Chand-New Delhi, Reprint, 2006.
5. V.R. Gowarikar, ***"Polymer chemistry"***, New Age International(P) Ltd, Fifteen Reprint, Sep.,1999.

B Sc Semester III

Chem.Pract. – 203 [Inorganic & Physical Practicals]

[A] Inorganic Mixture

Semi micro method of analysis of inorganic mixture containing four radicals (excluding phosphate, arsenite, arsenate and borate)

Minimum eight mixtures should be performed.

Mixture may be partly soluble in water and soluble in acid.

[B] Physical Experiment

1. To determine the relative strength between HCl and H_2SO_4 by studying hydrolysis of methyl acetate.
2. To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate catalyzed by acid.
3. To study the adsorption of an organic acid by Animal Charcoal. (Acetic acid /Oxalic acid).
4. Conductometric titration.
   - (i) Strong acid → Strong base ($HCl \rightarrow NaOH$)
   - (ii) Weak acid → Strong base ($CH_3COOH \rightarrow NaOH$)
   - (iii) Mixture of acids→ Strong base ($HCl+CH_3COOH \rightarrow NaOH$)
5. To determine specific refraction and molar refraction of liquid A,B and its Mixture
6. To determine absolute viscosities of liquid A, B and its Mixture

REFERENCES

1. Vogel's "***Textbook of Quantitative chemical Analysis",*** Pearson Education Ltd. Sixth Edition, 2008.

2. Vogel's "***Qualitative Inorganic Analysis",*** Pearson Education Ltd. Seventh Edition, 2009.

.**3.** Gurdeep Raj, ***"Advanced Inorganic Chemistry"***, Goel Publishing House, Meerut, Volume –I, 24th Revised Edition,1998.

4. J .B.Yadav , ***"Advance Physical Practical Chemistry",*** Goel Publishing House, Meerut

6. P.H.Parsania, ***"Experiments in Physical Chemistry"***, Neminath Printers Rajkot First Edition 2004.

7. A.M.. James and F.E.Prichard ***"Practical Physical Chemistry",*** Longman Group Limited London Third Edition Reprinted 1979

B.Sc. Semester IV

Chem. – 204 [Inorganic Chemistry]

Unit:- I **Wave –Mechanics** **[14 marks]**

Basic postulates of quantum mechanics (Postulates 1,2,3 and 4); Operators: their addition, subtraction and multiplication; Commutators; Particle in a box (One dimensional); Zero potential energy; Characteristics of the wave functions; Electron in a ring.

Unit:-II **Coordination Compounds** **[14 marks]**

Application of valence bond theory to some complexes; Shortcoming of valance bond theory; Crystal Field Theory; Orientation of d-orbitals and Crystal Field Splitting of Energy levels; Crystal Field Splitting in Octahedral complexes; Crystal Field Stabilization Energy (CFSE); Crystal Field Splitting in Tetrahedral Complexes; Crystal Field Splitting in Tetragonal and square Planar Complexes; Magnetic Properties of Metal Complexes and Crystal Field Theory; Factors influences the magnitude of Crystal Field Splitting; Color of Transition Metal Complexes; Crystal Field Effects on Ionic Radii; Crystal Field Effects on Lattice Energies; Jahn- Teller Effect.

Unit:- III **Chemical Bonding** **[14 marks]**

Molecular orbital Theory; LCAO Molecular Orbital Theory; Energy Level Diagram for Molecular Orbitals; Mixing of Orbitals; Filling up of Molecular Orbitals; Electronic Configuration of Heteronuclear Diatomic molecules (CO, NO, HF, HCl); Molecular orbitals of Polyatomic Species (BeH_2, CO_2 , NH_3)(Excluding Walsh diagram); M.O. Theory of $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$; Molecular orbital or Band Theory for metals.

Unit:- IV

[A] Non Aqueous Solvents [08 marks]

Introduction; Classification of Solvents; General Properties of Ionising Solvents
(a) Liquid Ammonia (NH_3): Physical Properties, Auto-ionization , 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.
(b) Liquid SO_2: Physical Properties, solubility of Inorganic materials and Organic Compounds, Electrolytic conductance behavior of solutions, Acid-Base reactions, Solvolysis, Precipitation reactions, Complex formation reactions, Reduction –Oxidation (Redox) reactions
(c) Liquid HF: Physical Properties, Solvent effect, Amphoteric behavior, Precipitation reactions, Reduction –Oxidation (Redox) reactions, Solutions of Compounds of Biological Interest.

[B] Physico chemical principles [06 marks]

Physico chemical principles of Sodium carbonate (Na_2CO_3);
Sodium bicarbonate ($NaHCO_3$); Sodium hydroxide (NaOH)

REFERENCES

1. Gurdeep Raj, ***"Advanced Inorganic Chemistry"***, Goel Publishing House, Meerut, Volume –I, 24th Revised Edition,1998.
2. R.D. Madan, ***"Modern Inorganic Chemistry'***, S. Chand & Co. Ltd., New Delhi, 2nd Edition, 2006.
3. J.D. Lee, ***"Concise Inorganic Chemistry"***, Wiley India Publication, 5th Edition, 1996, Reprint 2011.
4. W.V. Malik, G.D. Tuli, R.D. Madan, ***"Selected Topics in Inorganic Chemistry"***, S.Chand & Co. Ltd., New Delhi, 7th Edition, 2007.
5. A.K. Chandra, ***"Introductory Quantum Chemistry",*** Tata- McGraw Hill Pub. Co. Ltd., New Delhi, 4th Edition.
6. Puri, Sharma, Kalia, ***"Principles of Inorganic Chemistry"***, Milestone Publishers & Distributors, New Delhi, 3rd Edition, 2006.
7. R.K.Prasad, ***"Quantum chemistry"***, New Age International (P) Ltd., Publishers, 4th Edition, 2010.
8. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, ***"Shriver & Atkins' Inorganic Chemistry",*** Oxford University Press, 2011.

B.Sc. Semester IV

Chem. – 205 [Analytical Chemistry]

Unit:- I

[A] Basic concepts of Qualitative and Quantitative Analysis [8 marks]

Introduction, Solubility product principle, Common ion effect, Separation of cations of each groups and separation of anions (acid radicals), Introduction of volumetric titration based on normality and morality of the solution, Conditions for volumetric analysis and types of titrimetric analysis.

[B] Redox titration [6 marks]

Theory of redox titration, study of redox titration by electrochemical potential method, Ways of locating the end point for redox titration

Unit:- II Acid Base Titration [14 marks]

Theory of acid-base titration, Ways of locating the end point of an acid-base titration, Titration of strong acid with strong base, Titration of weak acid with strong base, Titration of weak base with strong acid, Titration of weak base with weak acid, Factors determining the exact form of a pH curve.

Unit:- III

[A] Complexometric Titrations [8 marks]

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 calcium and magnesium by complexometric titration by EDTA

[B] Precipitation Titration [6 marks]

Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility

Unit:- IV Precipitation Gravimetric [14 marks]

Introduction, Precipitation, Digestion, Filtration, Washing of the precipitate, Drying and/or incineration of the precipitate, Weighing, Specific and selective precipitation, Organic precipitants, Masking or sequestering agent, Problems involved in precipitation gravimetry.

REFERENCES

1. Dhruba Charan Dash, ***"Analytical Chemistry",*** PHI Learning Pvt. Ltd., New Delhi, 2011.
2. R.A.Day, A.L.Underwood, "***Quantitative Analysis"***, Prentice-Hall of India Pvt.Ltd., New Delhi, 2004. (Sixth edition)
3. Gary D. Christian, ***"Analytical Chemistry",*** John Wiely & Sons, INC, New York, 1994. (Fifth edition)
4. Douglas A. Skoog, Donald M. West, F.James Holler, ***"Analytical Chemistry An Introduction"***, Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, 1994. (Sixth edition)
5. Y.Anjaneyulu, K.Chandrasekhar, Valli Manickam**, *"A Textbook of Analytical Chemistry",*** Pharma Book Syndicate, Hyderabad, India, 2006.

B Sc Semester IV

Chem.Pract. – 206 [Organic & Analytical Practicals]

[A] Organic Spotting and Estimation

Organic spotting minimum eight compounds (5 solids and 3 liquids)

Acids: Salicylic acid, Cinnamic acid, Anthranilic acid, Sulfanilic acid

Phenols: p-Nitrophenol, β-Naphthol

Bases: m and p – Nitroanilines, p-Toludine

Neutral : Solids:- Acetanilide, Glucose

Liquids:- Acetophenone, Carbon tetrachloride (CCl_4), Methylacetate

Estimations: 1) Glucose

2) Acetamide

3) Phenol/Aniline

[B] Volumetric and Gravimetric Analysis

Volumetric Analysis :

(a) Nitrite by back titration.

(b) Hardness of Water , Ca & Mg (Total Hardness) by EDTA

(c) Estimation of Ni by using EDTA , $MgCl_2$ and Eriochrome Black – T (Back Titration)

Gravimetric Analysis :

(a) Fe as Fe_2O_3

(b) Ba as $BaSO_4$

(c) Al as Al_2O_3

REFERENCES

1. I Vogel, ***"Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis",*** CBS Publishers & Distributers, New Delhi, Second Edition, 2004.
2. I Vogel, ***"Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis",*** CBS Publishers & Distributers, New Delhi, Second Edition, 2004.
3. V.K. Ahluwalia, Sunita Dhingra, ***"Comprehensive Practical Organic Chemistry – Qualitative Analysis"***, University Press (India) Private Limited, Hyderabad, First Indian Edition, 2010.
4. Mohan Jag, ***"Organic Analytical Chemistry theory and Practice",*** Narosa Publication, New Delhi, 2003.
5. J Leonard, B Lygo, G Procter, ***"Advanced Practical Organic Chemistry",*** Stanley Thornes (Publishers) Ltd., First Indian Edition, 2004.
6. John H. Kennedy, ***"Analytical Chemistry : Practice"***, Saunders College Publishing, New York, Second Edition, 1990.
7. R.A.Day, A.L.Underwood, "***Quantitative Analysis"***, Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.
8. Gary D. Christian, ***"Analytical Chemistry",*** John Wiely & Sons, INC, New York, Fifth Edition, 1994.

Gujarat University

Syllabus for Chemistry at B. Sc. Semester V

(To be effective from 2013)

CHE 301 Organic Chemistry

CHE 302 Inorganic Chemistry

CHE 303 Physical Chemistry

CHE 304 Analytical Spectroscopic Techniques

CHE 305 Subject Elective (Soil Composition and Analysis)

CHE 306 Practical:

(I) Inorganic Qualitative Analysis
&
Physical Chemistry (Kinetics, Solubility and Instruments)

(II) Organic Preparation
&
Analytical Chemistry (Estimations and Chromatography)

Course Structure with respect to credit, hours and marks

Type of Course	Paper No.	Credit	Total Marks	Internal	External	No. of hours per week	Exam hours
Foundation Course (FC-V)	FC - 301	2	100	30	70	3	3
Core Course	CHE 301	4	100	30	70	4	3
	CHE 302	4	100	30	70	4	3
	CHE 303	4	100	30	70	4	3
	CHE 304	4	100	30	70	4	3
Subject Elective Course (SEC)	CHE 305	2	100	30	70	3	3
Practical Core Course – I and II	CHE 306	5	200	60	140	12	12
Total Credit		25					

N.B.**:** The practical batch should be maximum of 10 students with respect to the credit.

Gujarat University

Syllabus for B. Sc. Semester V

CHE - 301 (Organic Chemistry)

UNIT I

(A) Stereo Chemistry (I) [07 Marks]

Optical activity in the absence of chiral carbon (Biphenyls, Allenes and Spirans)

(B) Stereoselectivity and Stereospecificity [07 Marks]

Stereoselective and stereospecific reactions. Mechanism "Addition of halogens to alkenes". Stereochemistry of E2 reaction (syn and anti elimination).

UNIT II

(A) Inorganic reagents for Organic synthesis [07 Marks]

Use of specific reagents and their synthetic applications with mechanism.

(i) Aluminium Isopropoxide (ii) Lithium Aluminium Hydride (iii) Adams's catalyst (PtO_2)

(iv) Selenium Dioxide (v) Osmium Tetroxide (vi) Lead Tetraacetate

(B) Molecular rearrangements and Name Reactions [07 Marks]

Rearrangements occurring through Carbocations, carbenes and nitrenes Principle, Mechanism and Synthetic applications of the reactions:

(i) Wolf rearrangement (ii) Fries migration (iii) Hoffmann reaction

(iv) Oppenauer oxidation reaction (v) Diels-Alder reaction (vi) Birch Reduction

UNIT III

(A) Nucleophilic Substitution at a Saturated Carbon Atom [08 Marks]

Mechanism and scope of reaction-available mechanism, Kinetic Characteristics, Scope of reaction, Stereochemistry of S_N1 and S_N2 reactions, Relative reactivity in substitution, Solvent effect, variation at carbon site, Relative leaving group activity, S_Ni (substitution nucleophilic internal) Mechanism and Neighboring group participation. Elimination Reactions, E1, E2 and E1cB mechanism, Orientation E1and E2 reactions, Elimination Vs Substitution.

(B) Nucleophilic Aromatic Substitution **[06 Marks]**

Nucleophilic aromatic substitution, Bimolecular displacement and its mechanism, Reactivity, Orientation, Electron withdrawal by resonance, Evidence for the two steps-mechanism, Elimination-addition mechanism-Benzyne.

UNIT IV

(A) Carbohydrates **[06 Marks]**

Disaccharides, structure of (+) maltose, (+) cellobiose, (+) lactose and (+) sucrose.

(B) Purine and Pyrimidines **[08 Marks]**

(i) Purines – Synthesis of Purines, Adenine and Guanine.

(ii) Pyrimidines – Synthesis of Pyrimidine, Uracil, Thymine and Cytosine.

Reference Books

(1) Organic Chemistry**:** I. L. Finar, Vol-II, 5th Edition, Pearson Education Ltd.

(2) Organic Chemistry**:** Morrison & Boyd, 6th Edition, Prentice Hall of India Pvt. Ltd.

(3) Stereochemistry of carbon compounds**:** E. L. Eliel, Wiley Eastern Ltd.

(4) Stereochemistry and mechanism through solved problems**:** P. S. Kalsi, New Age International.

(5) Stereochemistry of Organic Compounds: Principles and Applications**:** D. Nasipuri; New Academic Science; 4th Revised Edition.

(6) Organic Chemistry**:** Hendrickson, Cram, Hammond, Mc Graw-Hill.

(7) Organic Chemistry**:** 6th Edition, John Mcmurry, Brooks Cole, International Edition.

(8) Organic Chemistry**:** T.W. Graham Solomons and Craig B. Fryhle Wiley, 8th Edition.

(9) Organic Chemistry**:** Francis A. Carey, Mc Graw-Hill, 7th Edition.

(10) Organic Chemistry**:** Leroy G.Wade, Prentice Hall, 6th Edition.

(11) Organic Chemistry**:** Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.

Gujarat University

Syllabus for B. Sc. Semester V

CHE - 302 (Inorganic Chemistry)

UNIT I

Molecular symmetry **[14 Marks]**

Introduction, symmetry operations and symmetry elements: Cn, σ, Sn, i and E.

Point groups for the molecules (excluding S_{2n} and I_h).

Multiplication tables of C_{2v}, C_{2h} and C_{3v} point groups.

UNIT II

(A) Chemical bonding (I) **[07 Marks]**

VB and MO treatment of H_2 and H_2^+, comparison of VB and MO

MO treatment of $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[V(CN)_6]^{-3}$, $[IrF_6]^{-4}$, $[NiF_4]^{-2}$, $[PtCl_4]^{-2}$ and $[Ni(CN)_4]^{-2}$.

(B) Boron hydrides **[07 Marks]**

Preparation, properties and structure of diborane.

Types of bonds found in higher boranes.

Structure of B_4H_{10}, B_5H_9, B_5H_{11}, B_6H_{10} and $B_{10}H_{14}$.

UNIT III

(A) Co-ordination chemistry **[07 Marks]**

Reaction, kinetics and mechanism. Trans effect and trans influence, Applications of trans effect in synthesis and analysis.

Theories of trans effect: Polarisation theory, π- bonding theory, MO theory.

Lability, inertness, stability and instability.

(B) Kinetics and reaction rates of substitution **[07 Marks]**

Ligand field effect and reaction rates, mechanism of substitution reaction. Nucleophilic substitution reaction (S_N1 and S_N2) in octahedral complexes.

Substitution in square planar Pt (II)complexes. Substitution in octahedral Co (III) complexes. Acid hydrolysis, base hydrolysis. Cis effect.

Electron transfer reaction. Mechanism of redox reaction (inner-sphere and outer-sphere).

UNIT IV

(A) Inorganic polymers **[07 Marks]**

Classification of inorganic polymers.

Polymers containing boron and silicon**:** methods of preparation, physical and chemical properties, structures and their uses.

(B) Mossbauer Spectroscopy **[07 Marks]**

Principle and Instrumentation.

Experimental technique

Application for iron complexes

Reference Books

(1) Concise Inorganic Chemistry**:** J.D. Lee; Wiley India, 5th Edition (1996).

(2) 'Shriver and Atkins' Inorganic Chemistry**:** Atkins, Overton, Rourke, Weller, Armstrong; Oxford University Press, 5th Edition (2011).

(3) Advanced Inorganic Chemistry**:**. F.A. Cotton and Wilkinson G.; John Wiley, 5th Edition (1988).

(4) Introductory Quantum Chemistry**:** A.K. Chandra; Tata- McGraw Hill, 4th Edition (1994).

(5) Quantum chemistry**:** R.K. Prasad; New Age International, 4th Edition (2010).

(6) Electron and chemical bonding**:** H. B. Grey, W.A.Benjamin. INC, New York.

(7) Inorganic chemistry**:**. James E. Huheey, 4th Edition,Wesley Publishing Company.

(8) Mechanism of Inorganic reaction**:** Basalo and Pearson, 2nd Edition, Wiley Eastern Pvt Ltd.

(9) Introduction to Advanced Inorganic chemistry, Durrant and Durrant, John Wiley.

(10) Advanced Inorganic chemistry**:** (Vol. 1) Satya Prakash, Tuli, Basu and Madan; S. Chand

(11) Advanced Inorganic chemistry**:** Gurdeep Raj; Goel Publishing House, 23rd Edition (1998).

Gujarat University

Syllabus for B. Sc. Semester V

CHE - 303 (Physical Chemistry)

UNIT I

Thermodynamics **[14 Marks]**

Zeroth law of Thermodynamics, Clausius - Clapeyron equation, Trouton's Rule, Craft's equation, van't Hoff's isotherm and isochore equations.

UNIT II

Electrochemistry **[14 Marks]**

Electrochemical cell and Electrolytic cell, Reversible and irreversible electrodes and cell, Poggendorff's compensation method and Weston cell, Reference electrodes (i) Saturated Calomel Electrode (ii) Standard Hydrogen Electrode (iii) Quinhydrone Electrode, Nernst's single electrode potential equation, Applications of emf measurements to calculate ΔG, ΔG^{o}, ΔH, ΔS , K_{eq}, K_{sp}, K_w and K_h.

UNIT III

(A) Chemical Kinetics **[07 Marks]**

Prediction of reaction rate, Primary and secondary salt effect, Heterogeneous reactions, Retarded reaction.

(B) Polymer Chemistry **[07 Marks]**

Polymerization and types of Polymerization, Co-polymers, Bio-polymers, Polymer additives, Thermodynamics of polymer solution, Molecular weight determination of polymers: Number average molecular weight, Weight average molecular weight, Viscosity and Osmotic pressure method.

UNIT IV

(A) Nuclear Chemistry **[07 Marks]**

Detection of isotopes, Velocity focusing mass spectrograph, Bainbridge and Neiers mass spectroscopy, Double focusing mass spectroscopy, Applications of isotopes and trace technique examples

(B) Molecular spectra **[07 Marks]**

Pure rotational spectra, Equation for frequency of pure rotational spectral line, Vibrational-Rotational spectra, Equation for frequency of vibrational-rotational spectral line, Ortho and Para hydrogen.

Reference Books

(1) Physical Chemistry**:** G. M. Barrow, 5th Edition, McGraw-Hill education, India.

(2) Advanced Physical Chemistry**:** Gurdeep Raj, 35th Edition (2009), Goel / Krshina Publishing House.

(3) Principles of Physical Chemistry**:** Puri, Sharma and Pathania, 42nd Edition, Vishal Publishing Company.

(4) Polymer Science**:** Gowariker, Viswanathan and Sreedhar, 1st Edition (2012 reprint) New Age International.

(5) Essentials of Nuclear Chemistry**:** Arnikar, 4th Edition (2012 reprint), New Age International.

(6) Physical Chemistry**:** Atkins, 9th Edition. Oxford University Press.

(7) Advanced Physical chemistry**:** Gurtu and Gurtu, 11th Edition , Pragati Prakashan.

(8) Physical chemistry**:** Levine, 6th Edition, McGraw-Hill education, India.

Gujarat University

Syllabus for B. Sc. Semester V

CHE - 304 (Analytical Spectroscopic Techniques)

UNIT I

(A) Ultraviolet Spectroscopy **[08 Marks]**

Origin of UV Spectra, Principle, Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), relative positions of λmax considering conjugative effect, steric effect, solvent effect, red shift (bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). Aromatic and Polynuclear aromatic hydrocarbons.

(B) Ultraviolet Spectroscopy (**Problems**) **[06 Marks]**

Problems of Dienes and enones using Woodward-Fieser rules. Problems of aromatic ketones, aldehydes and esters using empirical rules.

UNIT II

(A) Infrared Spectroscopy **[08 Marks]**

Introduction, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications. Application of Hooke's law, characteristic stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions; factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).

(B) Raman Spectra **[06 Marks]**

Basic principal, Instrumentation, Application of Raman spectra, Comparison of IR and Raman spectra.

UNIT III

(A) Nuclear Magnetic Resonance **[07 Marks]**

Principal, Magnetic and non magnetic nuclei, absorption of radio frequency. Equivalent and non equivalent protons, chemical shifts, anisotropic effect, relative strength of signals, spin-spin coupling, long range coupling, coupling constant, Deuterium labelling, applications to simple structural problems.

(B) Problems based on Spectral data **[07 Marks]**

Structural problems based on UV, IR and NMR

UNIT IV

(A) Visible Spectroscopy **[06 Marks]**

Introduction, Beer Lambert's law, instrumentation (light source, optical system, wavelength selector, light sensitive device), Accuracy and error of Spectrophotometry.

(B) Atomic Spectroscopy **[08 Marks]**

Introduction, Principle, Flame Emission Spectroscopy (FES) and Atomic adsorption Spectroscopy (AAS), Principal, comparison and applications, Burners (Total consumption burner and Premix burners), Inductively coupled plasma Emission Spectroscopy (ICPES)

Reference Books

(1) Introduction to Spectroscopy**:** Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.

(2) Spectrometric Identification of Organic Compounds**:** Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition.

(3) Infrared spectra of Complex molecules**:** J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.

(4) Spectroscopic Method in Organic Chemistry**:** Dudley Williams, Ian Fleming McGraw-Hill Education; 6th Edition.

(5) Applications of spectroscopic techniques in Organic Chemistry**:** P.S. Kalsi, New Age International; 6th Edition.

(6) Elementary Organic Spectroscopy; Principles And Chemical Applications**:** Y. R. Sharma, S. Chand & Co Pvt Ltd.

(7) Fundamentals of Molecular Spectroscopy**:** C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.

(8) Modern Raman Spectroscopy**:** A Practical Approach; Ewen Smith, Geoffrey Dent., Wiley; 1st Edition.

Gujarat University

Syllabus for B. Sc. Semester V

CHE – 305 (Subject Elective)

Soil Composition and Analysis

Unit I

Introduction to Soil Chemistry [14 Marks]

Importance of soil, soil formation, composition of soil, the soil profile, types of soil, micro and macro plant nutrients.

Unit II

Analysis of Primary Nutrients [14 Marks]

Soil fertility and productivity, techniques for the analysis of soil, soil reaction, determination of total nitrogen in soil, determination of phosphorus in soil, determination of potassium in soil by flame photometry.

Unit III

Analysis of Secondary Nutrients [14 Marks]

Determination of total sulphur in soil, determination of calcium in soil determination of magnesium in soil, determination of lime and liming material in soil. Mechanical analysis of soil.

Unit IV

Analysis of Micro Nutrients [14 Marks]

Determination of total manganese in soil, determination of Fe (II) and Fe (III) in soil, determination of silica in soil, determination of soluble salts in soil, determination of sodium in soil by flame photometry.

Reference Books

(1) Environmental Chemistry**:** H. Kaur, Pragati Prakashan, 2nd Edition.
(2) Soils in our Environment**:** Raymond W. Miller, Duane T. Gardiner, Prentice Hall, 8th Edition.

GUJARAT UNIVERSITY

Syllabus for B. Sc. Chemistry Semester V

CHE - 306

Practical [I] (Inorganic and Physical Practicals)

[A] Inorganic Qualitative Analysis:

Inorganic Qualitative Analysis of mixture containing six radicals only.
(Minimum 08 mixtures to be done)

[B] Physical Chemistry (Kinetics, Solubility & Instruments)

(1) Kinetics and solubility:

Investigate the order of reaction in experiments no. 1, 2 and 3 by graphical method.
Exp 1: Reaction between $K_2S_2O_8$ and KI ($a \neq b$)
Exp 2: Reaction between $KBrO_3$ and KI ($a = b$)
Exp 3: Reaction between H_2O_2 and HI ($a \neq b$)
Exp 4: Determine the heat of solution of a given substance (Oxalic acid and Benzoic acid) by solubility method.

(2) Instruments:

Exp 1: Determine dissociation constant of monobasic acid (CH_3COOH) using pH meter.
Exp 2: Determine the amount of bases in given mix ($NaOH+NH_4OH$) Conductometrically using standard solution of HCl
Exp3: Determine the amount of ferrous in the given solution of Ferrous Ammonium Sulphate potentiometerically using standard $KMnO_4$ solution.
Exp 4: Determine the concentration of Cu^{2+} and Fe^{3+} in the given solution by Colourimetry.

Reference Books

(1) Vogel's "Textbook of Quantitative Chemical Analysis"**:** Pearson Education Ltd. 6th Edition, 2008.
(2) Vogel's "Qualitative Inorganic Analysis"**:** Pearson Education Ltd. 7th Edition, 2009.
(3) Gurdeep Raj, "Advanced Practical Inorganic Chemistry"**:** Krishna Prakashan, Meerut, 21st Edition, 2009.
(4) J. B. Yadav, "Advanced Practical Physical Chemistry"**:** Krishna Prakashan, Meerut, 29th Edition, 2010.
(5) P. H. Parsania, "Experiments in Physical Chemistry"**:** Neminath Printers Rajkot 1st Edition 2004.
(6) A. M. James and F. E. Prichard, "Practical Physical Chemistry"**:** Longman Group Limited London 3rd Edition Reprinted 1979.

Semester V
CHE - 306
Practical [II] (Organic and Analytical Practicals)

[A] Organic Preparation:

(i) Nitration of Acetanilide
(ii) Acetanilide from Aniline (Green Preparation)
(iii) Benzilic Acid from Benzil (Green Preparation)
(iv) 1,5-Diphenyl-penta-1,4-diene-3-one from Benzaldehyde and Acetone(Green Preparation)
(v) Diels-Alder reaction between furan and maleic acid (Green Preparation)

[B] Analytical:

(B-1) Organic Estimation:

(i) Unknown Acid (e.g., Oxalic, Succinic, Citric, Tartaric, Benzoic, Phthalic and Cinnamic acid)
(ii) Ketone (Acetone)
(iii) Ester

(B-2) Chromatography [TLC]

Analysis of the following drugs by Thin Layer Chromatography.

(i) Aspirin (ii) Paracetamol (iii) Ibuprofen

Reference Books

(1) A. I. Vogel, "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(2) A. I. Vogel, "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(3) Hand book of Organic qualitative analysis by H. T. Clarke.
(4) Practical Organic Chemistry**:** F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS, Longman.
(5) V.K. Ahluwalia, Sunita Dhingra, "Comprehensive Practical Organic Chemistry – Qualitative Analysis"**:** University Press (India) Private Limited, Hyderabad, 1st Indian Edition, 2010.
(6) "Advanced Practical Organic Chemistry"**:** Stanley Thornes Publishers Ltd., J Leonard, B Lygo, G Procter, 1st Indian Edition, 2004.
(7) "Quantitative Analysis"**:** R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt. Ltd., New Delhi, 6th Edition, 2004.

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Syllabus for Chemistry at B. Sc. Semester VI

(To be effective from 2013)

CHE 307 Organic Chemistry

CHE 308 Inorganic Chemistry

CHE 309 Physical Chemistry

CHE 310 Analytical Chemistry

CHE 311 Subject Elective (Nanomaterials and Nanotechnology)

CHE 312 Practical:

(I) Inorganic Quantitative Analysis
&
Physical Chemistry (Kinetics and Instruments)

(II) Organic (Separation and Identification)
&
Analytical Chemistry (Volumetric Analysis)

Course Structure with respect to credit, hours and marks

Type of Course	Paper No.	Credit	Total Marks	Internal	External	No. of hours per week	Exam hours
Foundation Course (FC-VI)	FC - 302	2	100	30	70	3	3
Core Course	CHE 307	4	100	30	70	4	3
	CHE 308	4	100	30	70	4	3
	CHE 309	4	100	30	70	4	3
	CHE 310	4	100	30	70	4	3
Subject Elective Course (SEC)	CHE 311	2	100	30	70	3	3
Practical Core Course – I and II	CHE 312	5	200	60	140	12	12
Total Credit		25					

N.B.**:** The practical batch should be maximum of 10 students with respect to the credit.

Gujarat University

Syllabus for B. Sc. Semester VI

CHE - 307 (Organic Chemistry)

UNIT I

(A) Stereo Chemistry (II) **[08 Marks]**

Concept of prostereo isomerism and chiral synthesis (Asymmetric Induction), Cram's rule, Prelog's generalization, Prelog's rule and assignment of configuration.

(B) Stereochemistry of compounds other then Carbon **[06 Marks]**

Stereo chemistry of the compounds containing Nitrogen. Phosphorus and Sulphur

UNIT II

(A) Alkaloids **[07 Marks]**

Classification, General method of determining structure, analytical and synthetic methods, structure of Coniine, Nicotine, Atropine and Papaverine.

(B) Isoprenoids (Terpenoids) **[07 Marks]**

Classification, General method of determining structure, Isoprene rule, Chemistry of Citral, α-Terpineol, Camphor and their synthesis, study of reactions of β-carotene (No Synthesis).

UNIT III

(A) Synthetic Dyes **[06 Marks]**

Classification of Dyes- Anionic and Cationic dyes, Mordant and Vat dyes, Reactive and Dispersed dyes, Synthesis of Alizarin, Malachite green, Indigo, Congo red, Eosin.

(B) Explosives **[04 Marks]**

Preparation of RDX, PETN, Nitroglycerine, Tetryl.

(C) Pesticides **[04 Marks]**

Preparation of Aldrine, Malathion, Parathion, Methoxychlor.

UNIT IV

(A) Synthetic Drugs **[08 Marks]**

General Classification, Chemotherapy, Antipyretics, Analgesics, Hypnotics, Sedatives, Anaesthetics, Antimalerials, Antiseptics, Cardiovascular drugs. (Minimum two illustrations of each, only names without structures). Methods of preparation and uses of Antipyrine, Phenacetin, n-Hexyl resorcinol, Alprazolam, Zaleplon, Benzocaine, Lidocaine, Chloroquine, Atenolol, Sulphadiazine, Trimethoprim and Tolbutamide.

(B) Vitamins **[06 Marks]**

Structure and Biochemistry of Vitamin-A (A_1) (Retinol), Vitamin-B_6 (Pyridoxine).

Reference Books

(1) Organic Chemistry**:** I. L. Finar, Vol-II, 5th Edition, Pearson Education Ltd.

(2) Organic Chemistry**:** Morrison & Boyd, 6th Edition, Prentice Hall of India Pvt. Ltd.

(3) Stereochemistry of carbon compounds**:** E. L. Eliel, Wiley Eastern Ltd.

(4) Stereochemistry and mechanism through solved problems**:** P. S. Kalsi, New Age International.

(5) Stereochemistry of Organic Compounds: Principles and Applications**:** D. Nasipuri; New Academic Science; 4th Revised Edition.

(6) Organic Chemistry**:** Hendrickson, Cram, Hammond, Mc Graw-Hill.

(7) Organic Chemistry**:** 6th Edition, John Mcmurry, Brooks Cole, International Edition.

(8) Organic Chemistry**:** T.W. Graham Solomons and Craig B. Fryhle Wiley, 8th Edition.

(9) Organic Chemistry**:** Francis A. Carey, Mc Graw-Hill, 7th Edition.

(10) Organic Chemistry**:** Leroy G.Wade, Prentice Hall, 6th Edition.

(11) Organic Chemistry**:** Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.

Gujarat University

Syllabus for B. Sc. Semester VI

CHE - 308 (Inorganic Chemistry)

UNIT I

(A) Term symbol **[07 Marks]**

Russel Saunders coupling and determination of Term symbols of the ground state. Calculation of number of microstates. Pigeon hole diagram of p^2 and d^2 configurations. Hund's rule. Hole formulation.

(B) Electronic spectra of metal complexes **[07 Marks]**

Electronic spectra of transition metal complexes, Laporte orbital and spin selection rules. Orgel energy level diagram of d^5 and combined diagrams of d^1 - d^9, d^2 – d^8, d^3 – d^7, d^4 – d^6 and their spectra. Jahn Teller distortion. Spectrochemical series.

UNIT II

Quantum chemistry **[14 Marks]**

Setting up of operators for different observables, Hermitian operator, important theorems concerning Hermitian operator, Particle in a three dimensional box, The rigid Rotator, The Schrodinger equation in spherical polar coordinates for hydrogen atom, separation of variables, solution of R, Θ and Φ equations.

UNIT III

Chemical bonding (II) **[14 Marks]**

The Huckel Molecular Orbital (HMO) theory, variation principle, solution of Secular equation, HMO treatment to ethylene molecule, allylic cation, allylic free radical and allylic anion, Hybridization: Hybridization wave functions of sp, sp^2 and sp^3.

UNIT IV

(A) Metal carbonyls **[07 Marks]**

Mono and poly-nuclear metal carbonyls: $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$, $Ir_4(CO)_{12}$, $Co_4(CO)_{12}$.

Metal nitrosyl and metal carbonyl hydrides. Application of IR spectra in the determination of structure of metal carbonyls.

(B) Organometallic compounds **[07 Marks]**

Definition, classification, synthesis (general methods), properties, structure and application of organometallic compounds of Mg, Al and Be, Structure of Ferrocene and dibenzene chromium.

Reference Books

(1) Concise Inorganic Chemistry**:** J.D. Lee; Wiley India, 5th Edition (1996).

(2) 'Shriver and Atkins' Inorganic Chemistry**:** Atkins, Overton, Rourke, Weller, Armstrong; Oxford University Press, 5th Edition (2011).

(3) Advanced Inorganic Chemistry**:**. F.A. Cotton and Wilkinson G.; John Wiley, 5th Edition (1988).

(4) Introductory Quantum Chemistry**:** A.K. Chandra; Tata- McGraw Hill, 4th Edition (1994).

(5) Quantum chemistry**:** R.K. Prasad; New Age International, 4th Edition (2010).

(6) Electron and chemical bonding**:** H. B. Grey, W.A.Benjamin. INC, New York.

(7) Inorganic chemistry**:**. James E. Huheey, 4th Edition,Wesley Publishing Company.

(8) Mechanism of Inorganic reaction**:** Basalo and Pearson, 2nd Edition, Wiley Eastern Pvt Ltd.

(9) Introduction to Advanced Inorganic chemistry, Durrant and Durrant, John Wiley.

(10) Advanced Inorganic chemistry**:** (Vol. 1) Satya Prakash, Tuli, Basu and Madan; S. Chand

(11) Advanced Inorganic chemistry**:** Gurdeep Raj; Goel Publishing House, 23rd Edition (1998).

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Syllabus for B. Sc. Semester VI

CHE – 309 (Physical Chemistry)

UNIT I

Thermodynamics **[14 Marks]**

Colligative properties: Boiling point elevation and freezing point depression. Molal elevation constant (K_b) and Molal depression constant (K_f), Calculation of absolute value of entropy using third law of thermodynamics, Law of mass action using chemical potential, Partial molar quantity.

UNIT II

Electrochemistry **[14 Marks]**

Concentration cell: Cell with and without transference, Electrode concentration cell, Gas electrode concentration cell, Activity and activity coefficient determination, Define liquid junction potential and how it can be avoided, Equation for liquid junction potential, Decomposition potential, Overvoltage, Tafel equation

UNIT III

(A) Phase Rule **[07 Marks]**

Binary system : Zn-Cd and Pb-Ag ,Zeotropic and azeotropic mixtures, Steam distillation, Zone refining.

(B) Osmosis **[07 Marks]**

Desalination and reverse osmosis, Electrodialysis, Electrochemistry and pollution control, Removal of Cu, Ag and Fe from waste water.

UNIT IV

(A) Photochemistry **[07 Marks]**

Laws of Photochemistry : Grotthuss-Draper Law, Einstein Law, Quantum yield ,Reasons for high and low quantum yield, Fluorescence and Phosphorescence, Chemiluminescence, Photosensitized reactions.

(B) Metallic Corrosion **[07 Marks]**

Types of corrosion, Electrochemical series, Corrosion in acidic and neutral medium, Differential aeration principle, Atmospheric corrosion, Prevention of corrosion by various factor.

Reference Books

(1) Physical Chemistry**:** G. M. Barrow, 5th Edition, McGraw-Hill education, India.

(2) Advanced Physical Chemistry**:** Gurdeep Raj, 35th Edition (2009), Goel / Krshina Publishing House.

(3) Principles of Physical Chemistry**:** Puri, Sharma and Pathania, 42nd Edition, Vishal Publishing Company.

(4) Polymer Science**:** Gowariker, Viswanathan and Sreedhar, 1st Edition (2012 reprint) New Age International.

(5) Essentials of Nuclear Chemistry**:** Arnikar, 4th Edition (2012 reprint), New Age International.

(6) Physical Chemistry**:** Atkins, 9th Edition. Oxford University Press.

(7) Advanced Physical chemistry**:** Gurtu and Gurtu, 11th Edition , Pragati Prakashan.

(8) Physical chemistry**:** Levine, 6th Edition, McGraw-Hill education, India.

Gujarat University

Syllabus for B. Sc. Semester VI

CHE - 310 (Analytical Chemistry)

UNIT I

(A) Errors and treatment of Analytical data: [08 Marks]

Significant figures, Accuracy and precision, Types of errors and minimization of errors. Ways of expressing accuracy and precision. Rejection of a result, Test of significance (Q-Test, Student t-Test and F-Test) correlation coefficient. Literature of Analytical Chemistry.

(**B**) **Organic reagents used in quantitative Analysis [06 Marks]**

Separation of methods with 8-Hydroxy Quinoline, Cupferron and DMG

UNIT II

(A) Chromatographic methods: [08 Marks]

General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equlibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.

(B) Solvent Extraction Separation: [06 Marks]

Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency.

UNIT III

Electro analytical Techniques:

(A) Polarography: [07 Marks]

Introduction, Principle, electrode, Types of currents, Determination of half wave potential, Ilkovic equation, methods of determining concentration (Standard addition method and Calibration method)

(B) Potentiometry: **[07 Marks]**

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 and use of Calcium ion selective electrode.

UNIT IV

Miscellaneous Titrations:

(**A**) **Acid Base Titrations:** **[07 Marks]**

Titration of poplyprotic acid and mixture of acids, titration of salts, Differential Alkali titration.

(**B**) **Redox titration:** **[04 Marks]**

Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors.

(**C**) **Complexometric titration:** **[03Marks]**

EDTA titration techniques-Direct, Back, Displacement and Indirect Tititration, Masking, Demasking agent, ligand effect and Hydrolysis of EDTA complex, Auxiliary complexing agent- EDTA titration with an auxiliary complexing agent.

Reference Books

(1) Analytical Chemistry**:** Gary D. Christian, 6th Edition; Wiley & Sons

(2) Fundamentals of Analytical Chemistry**:** D. A. Skoog, D. M. West and F. J. Holler, 9th Edition, Cengage Learning.

(3) Instrumental Methods of analysis**:** (CBS) H.H . Willard, L.L. Mirrit, J.A. Dean

(4) Solvent extraction in Analytical Chemistry**:** G.H. Morrison, F. Frieiser, John Wiley & Sons, NY.

(5) Instrumental Methods of Inorganic Analysis**:** A.I. Vogel, ELBS

(6) Chemical Instrumentation**:** A Systematic approach- H.A. Strobel

(7) The principals of ion-selective electrodes and membrane transport**:** W.E.Morf

(8) Principles of Instrumental Analysis**:** Douglas A. Skoog., F. James Holler, Stanley R. Crouch, Cengage Learning; 6th Edition.

(9) Quantitative Chemical Analysis**:** Daniel C. Harris, W H Freeman, New York.

(10) Ion exchange and solvent extraction of metal compounds**:** Y. Macros, A.S.Kertes, Wiley, Interscience.

Gujarat University

Syllabus for B. Sc. Semester VI

CHE – 311 (Subject Elective)

Nanomaterials and Nanotechnology

Unit I

Introduction and preparation **[14 Marks]**

Introduction to Nanomaterials, Optical, magnetic and chemical properties of Nanomaterials, Preparation of Nanoparticles: Chemical Approaches: Chemical reduction; Sonochemical synthesis; Sol-Gel Synthesis; Self assembly. Physical Approaches: Aerosol spray; Gas condensation; Laser vaporization and vapour deposition; Sputtering.

Unit II

Nanostructured materials **[14 marks]**

Quantum dots, wells & wires; Carbon Nanotubes (CNTs): Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs), Graphenes, Fullerenes, Metal/Oxide nanoparticles (NPs), Nanorods, Nanotubes and Nanofibres, Semiconductor quantum dots, Polymer NPs.

Unit III

Characterization techniques for Nanomaterials-I **[07 marks]**

Particle size Analyser (Laser scattering), Optical Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Tunnel Microscopy (STM).

Characterization techniques for Nanomaterials-II **[07 marks]**

X-ray Diffraction (XRD), Auger Emission Spectroscopy, Electron Spectroscopy for Chemical analysis (ESCA)

Unit IV

Application of Nanomaterials: **[14 marks]**

Applications Solar energy conversion and catalysis, Polymers with a special architecture, Liquid crystalline systems, Applications in displays and other devices, Advanced organic materials for data storage, Photonics, Chemical and biosensors, Nanomedicine and Nanobiotechnology.

Reference Books

(1) Introduction to Nanotechnology**:** Charles P. Poole, Jr. and Frank J. Owens; Wiley Student Edition, 2008

(2) Nanostructures and Nanomaterials: Synthesis, Properties and Applications**:** G. Cao, ICP, London, 2004.

(3) Nanobiotechnology, Concepts, Applications and perspectives**:** C. M. Niemeyer and C. A. Mirkin, WILEY-VCH, Verlag GmbH & Co, 2004.

(4) Nanotechnology - Molecularly Designed Materials**:** G. M. Chow and K. E. Gonslaves; (American chemical society)

(5) Optical Properties of semiconductor nanocrystals**:** S. P. Gaponenko, Cambridge University Press, 1980.

(6) Nanostructures & Nanomaterials: Synthesis, Properties & Applications**:** G. Cao, Imperial College Press, 2004.

(7) Nano - The essentials**:** T. Pradeep, Tata Mc Graw Hill, New Delhi, 2007.

(8) Nano materials**:** J. Dutta & H. Hofman.

(9) "NANOTECHLOGY-basic science and emerging technologies**:** Mick Wilson, Kamali Kannagara et.al., University of new south wales press ltd,2008.

(10) Nanotechnology**:** Mark Ratner and Daniel Ratner, Pearson Education.

(11) Nanomaterials**:** A.K. Bandyopadhyay; New Age International Publishers.

GUJARAT UNIVERSITY
Syllabus for B. Sc. Chemistry Semester VI
CHE - 312
Practical [I] (Inorganic and Physical Practicals)

[A] Inorganic Quantitative Analysis:

(I) Gravimetric determination of the radicals:

(After removal of interfering radicals in mixed solution)

(a) $BaCl_2$, $FeCl_3$ and HCl (Determination of Ba as $BaSO_4$)

(b) $CuCl_2$, $MnCl_2$ and HCl (Determination of Mn as $Mn_2P_2O_7$)

(c) $CuSO_4$, $FeSO_4(NH_4)_2$ SO_4 and H_2SO_4 (Determination of Fe as Fe_2O_3)

(d) $CuSO_4$, Al_2 $(SO_4)_3$ and H_2SO_4 (Determination of Al as Al_2O_3)

(II) Analysis of Alloy:

(a) Brass (Cu → Volumetrically, Zn → Gravimetrically)

(b) German Silver (Cu → Volumetrically, Ni → Gravimetrically)

[B] Physical: (Kinetics and Instruments)

(1) Kinetics:

Investigate the order of reaction in the following experiments by graphical method .

Exp 1: Reaction between $K_2S_2O_8$ and KI (a =b)

Exp 2: Reaction between $KBrO_3$ and KI ($a \neq b$)

Exp 3: Reaction between H_2O_2 and HI (a = b)

(2) Instruments:

Exp 1: Titration of unknown strength of HCl with standard NaOH solution using pH meter.

Exp 2: Conductometric titration involving precipitation of $BaCl_2$ with K_2CrO_4.

Exp 3 : To determine the concentration of CrO_4^{2-} and Ni^{2+} in solution by colourimetry.

Exp 4 : To determine specific rotation of glucose and hence to find out unknown concentration of glucose in given solution by optical (polarimeteric) measurements.

Reference Books

(1) Vogel's "Textbook of Quantitative Chemical Analysis"**:** Pearson Education Ltd. 6th Edition, 2008.

(2) Vogel's "Qualitative Inorganic Analysis"**:** Pearson Education Ltd. 7th Edition, 2009.

(3) Gurdeep Raj, "Advanced Practical Inorganic Chemistry"**:** Krishna Prakashan, Meerut, 21st Edition, 2009.

(4) J. B. Yadav, "Advanced Practical Physical Chemistry"**:** Krishna Prakashan, Meerut, 29th Edition, 2010.

(5) P. H. Parsania, "Experiments in Physical Chemistry"**:** Neminath Printers Rajkot 1st Edition 2004.

(6) A. M. James and F. E. Prichard, "Practical Physical Chemistry"**:** Longman Group Limited London 3rd Edition Reprinted 1979.

Semester VI

CHE - 312

Practical [II] (Organic and Analytical Practicals)

[A] Organic:

Organic separation and Identification:

Separation of Binary Mixtures and Identification (Minimum 8 Mixtures)
(i) Solid + Solid (4 Mixtures)
(ii) Solid + Liquid (2 Mixtures)
(iii) Liquid + Liquid (2 Mixtures)
One Mixture from each of the following should be given Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral, and Neutral-Neutral. Water soluble compounds are included.
Identification of separated organic compound must be done by physical and chemical tests, sodium fusion test, M.P / B.P., derivatives and crystallization.

[B] Analytical:

Volumetric Analysis:

(1) Estimation of Fe^{3+} by EDTA (Back Titration)
(2) Estimation of Bi^{3+} by EDTA
(3) Estimation of Chloride by silver nitrate (Mohr's Method)
(4) Estimation of Zn^{2+} and Cd^{2+} in a mixture by EDTA
(5) Estimation of Ca^{2+} and Mg^{2+} in a mixture by EDTA
(6) Determination of percentage purity of H_2O_2 solution by Iodometry method.

Reference Books

(1) A. I. Vogel, "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(2) A. I. Vogel, "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(3) Hand book of Organic qualitative analysis by H. T. Clarke.
(4) Practical Organic Chemistry**:** F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS, Longman.
(5) V.K. Ahluwalia, Sunita Dhingra, "Comprehensive Practical Organic Chemistry – Qualitative Analysis"**:** University Press (India) Private Limited, Hyderabad, 1st Indian Edition, 2010.
(6) "Advanced Practical Organic Chemistry"**:** Stanley Thornes Publishers Ltd., J Leonard, B Lygo, G Procter, 1st Indian Edition, 2004.
(7) "Quantitative Analysis"**:** R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt. Ltd., New Delhi, 6th Edition, 2004.