Shiksha Mandal's

Bajaj College of Science, Wardha

Department of Chemistry

Revised Syllabus of B. Sc. (Semester V to VI)

for Academic Autonomy

(Approved in BOS Meeting 27-September-2022 to be implemented from academic session 2023-24)

Bajaj College of Science, Wardha

Syllabus under Academic Autonomy

SUBJECT CHEMISTRY

B.Sc. III Semester V

UG –CHEM(02)-S5-T: Principles of Inorganic, Organic & Physical Chemistry (60 Hrs)

Course Objectives:-

1. To study and understand important aspects of Organometallic Chemistry, Metal Carbonyls and Inorganic Polymers with special focus on Silicones and Phosphonitrilic halide polymers.
2. To learn fundamental concepts of Bioinorganic Chemistry and get introduced with Hard and Soft Acids and Bases along with magnetic properties.
3. To understand structure, synthesis and reactions of heterocyclic compounds and to get acquainted with the basic knowledge of synthetic dyes, drugs and polymers
4. To study the principles of rotational and infrared absorption spectroscopy and also to learn their applications by analysis of spectral data
5. To understand the fundamental principles behind UV-visible and Raman spectroscopy and to know their applications
6. To study the important aspects of electrochemistry related to EMF, its calculation, determination of electrode potential and applications of EMF measurement.

Contents:-

Unit I (10 Hrs)

A) Organometallic Chemistry

Definition, Nomenclature and Classification of Organometallic compounds. Preparation properties and application of Alkyl and Aryls of Li and Al. A brief account of metal ethylenic complexes (Structure only). Homogeneous Hydrogenation (Wilkinson's Catalyst reaction).

B) Metal carbonyls-Definition, preparation, properties, structure and bonding in mononuclear carbonyls – $Ni(CO)_4$, $Fe(CO)_5$ and $Cr(CO)_6$

C) Inorganic Polymers:

Silicones: Introduction, Nomenclature, preparation, properties and uses, General introduction to Silicon oils, Silicone Elastomers and Silicon Resins

Phosphonitrilic halide polymers: Introduction, Preparation, properties and uses. Structure and bonding in $(NPCl_2)_3$ and $(NPCl_2)_4$

Unit II: (10 Hrs)

A) Bioinorganic Chemistry: Essential and Trace elements in biological processes, Metalloporphyrins with special reference to structure and role of Hemoglobin and Myoglobin in transport of Oxygen. Biological role of Na^+, K^+ and Ca^{2+} metal ions.

B) Hard and Soft Acids and Bases: Classification of Acids and Bases as Hard and Soft. Pearson's HSAB Concept and its applications. Symbiosis.

C) Introduction to magnetic properties: Magnetism and magnetic moment, types of magnetism, diamagnetism, paramagnetism, ferromagnetism, anti-ferromagnetism. Determination of Magnetic Susceptibility by Gouy's Method.

Unit III: (10 Hrs)

A) Heterocyclic Compounds: Introduction, 5-membered heterocyclic ring – pyrrole: Molecular orbital structure, synthesis from acetylene, succinamide and furan, aromaticity, Electrophilic substitution reactions (Orientation)– sulfonation, halogenation, nitration and acylation.
6-membered heterocyclic ring – pyridine: Molecular orbital structure, synthesis from Hantzsch method, acetylene, pentamethylene diamine hydrochloride, aromaticity, Orientation of Electrophilic and nucleophilic substitution reactions (Chichibabin and hydroxylation reaction), Comparison of basicity of pyrrole and pyridine.

B) Synthetic Dyes: Definition and ideal characteristics of dyes, Colour and constitution (Witt theory, electronic concept), Synthesis and uses of Congored, Crystal violet, Phenolphthalein and Alizarin dye.

C) Synthetic Drugs: Definition, preparation, properties and uses of Aspirin, Paracetamol, Chloroquine.

D) Synthetic Polymers: Classifications of synthetic polymers - Addition or chain growth polymers and Condensation polymers. Ziegler-Natta polymerization (without mechanism).

Unit IV: (10 Hrs)

A**) Rotational Spectroscopy:**

Dipole moment and Rotational Spectra. Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number (cm^{-1}) of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Application of rotational spectra for determination of bond length of diatomic molecules.

B) Infrared (IR) absorption spectroscopy: Energy levels of simple harmonic oscillator, Energy level diagram, relative populations of energy levels. Selection rule for pure vibrational spectra (harmonic oscillations), Force constant. Anharmonic oscillator, Morse equation, selection rules, idea of overtones. Degrees of freedom and normal modes of vibration for CO_2, H_2O molecules. Intensity and position of IR bands, measurement of IR spectrum. Fingerprint region, characteristic absorptions of various functional groups and application of IR spectra.

Unit V: (10 Hrs)

A) UV-Visible spectroscopy: Introduction to spectroscopy, electromagnetic spectrum, Absorption spectra, Ultraviolet absorption spectroscopy, Absorption laws (Beer-Lambert law), molar absorptivity, Presentation and analysis of UV spectra, Types of electronic transitions, Effect of conjugation (HOMO-LUMO), concept of chromophores and auxochromes, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. Applications of UV –Visible spectroscopy, analysis of UV–Visible spectra of conjugated dienes and enones.

B) Raman Spectroscopy:

Raman effect, Quantum Theory of Raman Effect, Qualitative treatment of Rotational Raman effect, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion, Applications of rotational spectra, Numericals.

Unit VI: Electrochemistry II (10 Hrs)

(A) Introduction to Electrolytic cell and Electrochemical cell (Galvanic /Voltaic cell), Cell representation of galvanic cell from cell reactions and vice versa, reversible & irreversible cells, Concept of EMF of a cell & Measurement of EMF of a cell, calculation of thermodynamic

quantities of a cell reactions (ΔG, ΔH & ΔS & equilibrium constant), Derivation of Nernst equation for the emf of a cell and hence for a single electrode potential. Numericals.
(B) Types of reversible electrodes : gas electrode, metal-metal ion electrode, amalgam electrode, metal insoluble salt-anion, redox electrodes, Half cell reactions, calculation of cell emf from single electrode potential, reference electrodes, standard electrode potential, liquid-junction potential, salt bridge & its functions, Applications of emf measurements in pH- determination using hydrogen electrode, quinhydrone electrode & glass electrode. Potentiometric titration curves for: (i) strong acid vs. strong base (ii) weak acid vs. strong base (iii) redox titration. Numericals.

Referemce:-

Inorganic Chemistry

- Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- *Principles of Inorganic Chemistry*, Puri, Sharma, Kalia

Organic Chemistry

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- RM Silverstein, G C Bassler and TC Morril, John Wally Spectroscopic identification of organic compound-
- PS Kalsi, Spectroscopy of Organic Molecule- Wiley, Esterna, New Delhi
- Y. R. Sharma, Elementary Organic Spectroscopy
- Tadashi Okuyama and Haward Maskill, Oxford organic chemistry, a mechanistic approach (oxford)
- Hashmat Ali, Reaction mechanism in organic chemistry (S-chand publications)
- Gautam Bramhachari, Organic chemistry through solved problems (Narosa publications)
- Gautam Bramhachari , Organic name reactions, a united approach (Narosa publications)

Physical Chemistry

- P. W. Atkins'and D. Paula, *Physical Chemistry*, 8th Edition, Oxford University Press, 2010
- S.H. Marron and C.F.Pruton. *Principles of Physical Chemistry*,4th edition
- Samuel Glasstone. *Textbook of Physical Chemistry*,
- Ira Levine, *Physical Chemistry*, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
- G.M. Barrow, *Physical Chemistry*, 6th Edition, TMH Publishing Co. Ltd. New Delhi.

- Puri, Sharma, Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co.
- P. L. Sony, O. R. Dharma, *Textbook of Physical Chemistry.*
- B.S. Bahl, G.D.Tuli and Arun Bahl, *Essentials of Physical Chemistry*, S. Chand and Company Ltd.
- C. N Banwell, E. M. McCash, Fundamentals of molecular spectroscopy.
- R. C. Mukherjee, *Modern Approach to Physical Chemistry.*

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- http://nsdl.niscair.res.in
- http://ocw.mit.edu
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://www.mooc-list.com/tags/chemistry

CHEMISTRY LAB: Practical Course (60 Hrs)

Course Objectives:-

1. To prepare the complexes and comment on their VBT structure, magnetic properties and colors
2. To learn to estimate certain compounds
3. To study theoretical principles of specific rotation, Beer-Lambert's law and EMF experimentally.

Inorganic Chemistry

Preparation of following complexes and Comments on its VBT structure, magnetic properties and colors

a) $[Cu(NH_3)_4(H_2O)_2]SO_4$

b) $[Ni(NH_3)_6]Cl_2$

c) Trans $[Co(NH_3)_4Cl_2]Cl$

d) $K_3[Fe(C_2O_4)_3].H_2O$

Organic Chemistry

1. Estimation of Glucose
2. Estimation of Acetamide
3. Estimation of Glycine
4. Estimation of Carboxylic group
5. Saponification value of oil

Physical Chemistry

1. To determine the specific rotation of a given optically active compound.
2. To verify Beer-Lambert law for $KMnO_4$ and determine the concentration of the given solution of $KMnO_4$.
3. To determine the strength of the given strong acid (HCl) potentiometrically using standard alkali solution.
4. To determine the strength of the given weak acid (CH_3COOH) potentiometrically using standard alkali solution.
5. To titrate potentiometrically ferrous ammonium sulphate solution using potassium dichromate solution as titrate and calculate the redox potential of Fe^{2+}/Fe^{3+} system on hydrogen scale.

Reference Books

- Vogel A, IIIrd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
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Bajaj College of Science, Wardha

Syllabus under Academic Autonomy

SUBJECT CHEMISTRY

B.Sc. III Semester VI

UG –CHEM(02)-S5-T: Advanced of Inorganic, Organic & Physical Chemistry (60 Hrs)

Course Objectives:-

1. To understand Metal ligand bonding in Transition Metal Complexes and learn the basics of Electronic spectra of Transition Metal Complexes
2. To learn the fundamentals of colorimetery and spectrophotometery with various separation techniques like chromatography, ion- exchange and solvent extraction
3. To study in detail the fundamental concepts of NMR spectroscopy, to learn to interpret NMR spectra of some organic molecules and solve problems related to structure elucidation
4. To study structures and types of important biological compounds such as Carbohydrates, Amino Acids, Peptides, Proteins, Nucleic Acids, Fats, Oils and Detergents
5. To learn the important terminologies and fundamental principles of quantum chemistry
6. To study the important aspects of photochemistry, dipole moment and nuclear chemistry.

Contents:-

Unit I (10 Hrs)

A) Metal ligand bonding in Transition Metal Complexes:

Limitations of Valency bond theory, Crystal field theory: Splitting of d-orbital in octahedral, tetrahedral, and square planar complexes, Jahn Teller Effect, Factors affecting the Magnitude of 10Dq, Crystal field Stabilisatation Energy of Octahedral and Tetrahedral complexes (Numericals),

Concept of Thermodynamic and Kinetic stability of metal complexes, Stepwise stability and overall stability constant, Determination of composition of Fe (III)-SSA complex by Mole Ratio and Job's Method.

Magnetic Properties of Transition Metal Complexes, Spin only formula and orbital contribution to magnetic moment. Magnetic properties of Octahedral and Tetrahedral complexes with respect to CFT. Numericals on magnetic moments.

B) Electronic spectra of Transition Metal Complexes:

Selection Rules (Laporte and Spin selection Rules). Hole Formalism Principle. Electronic spectrum of $[Ti(H_2O)_6]^{3+}$ and $[Cu(H_2O)_6]^{2+}$ complex ions.

Unit II: (10 Hrs)

A) Colorimetery and Spectrophotometery:

Principles of photometery: Beer-Lamberts Law, derivation and deviation (Numericals). Types of colorimeter and spectrophotometer with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis with reference to estimation of Cu (II) as Cu-ammonia complex.

B) Separation Techniques:

a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography. Numericals.

b) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures. Numericals.
c) Solvent Extraction: Principle and Classification , Factors influencing extraction and application in chemistry. Numericals.

Unit III: (10 Hrs)

Nuclear Magnetic Resonance (NMR) spectroscopy (^{1}H NMR) **:** Introduction, spin active nuclei, ^{1}H or proton magnetic resonance, theory and principle, instrumentation, relaxation phenomenon, nuclear shielding and deshielding, chemical shift, factors affecting chemical shift, equivalent and non equivalent protons, solvents and internal standard-TMS, spin-spin splitting and coupling constant. Intensities of signals, Pascal's triangle, Interpretation of NMR spectra of organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,2 dibromoethane, ethyl acetate, toluene, acetophenone, acetyl acetone. Problem pertaining to the structure elucidation of simple organic molecules by ^{1}H NMR technique.

Unit IV: (10 Hrs)

A) Carbohydrates: Definition, classification and reaction of glucose. Determination of structure of glucose. Epimerisation, mutarotation, conversion of glucose into fructose and vice-versa. Chain lengthening and shortening of aldoses (Wohl's degradation). Introduction to structures of maltose, sucrose, lactose, starch, cellulose, ribose and deoxyribose without involving structure determination.

B) Amino Acids, Peptides, Proteins: Classification, structure and stereochemistry of amino acids. Acids base behavior, isoelectric point and electrophoresis. Structure and nomenclature of peptides and protein. Classification of proteins. Protein denaturation. Structure determination of proteins (primary).

C) Nucleic Acids: Introduction, constituents of nucleic acids, nucleosides and nucleotides, structures of Ribonucleic acid and Deoxyribonucleic acid.

D) Fats, Oils and Detergents: Natural fats, Glycerides, hydrogenation of unsaturated oils, Saponification value. Iodine value. Acid value, Soaps, Synthetic detergents, Alkyl and aryl sulfonates.

Unit V : (10 Hrs)

A) Basics of Quantum mechanics: Introduction to wave functions (Ψ), well behaved and acceptable wave functions. Interpretation of wave function (Ψ) and its square (Ψ^2), Normalized and orthogonal wave functions (only qualitative idea no problems), Introduction to operators, Linear operator, Hermitian operator, Addition, subtraction and multiplication of operators, commutative and non- commutative operators, position, momentum and energy operators. Eigen function and eigen value, eigen value equation. Numericals.

B) Quantum Chemistry:- Schrodinger wave equation, Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Application of Schrodinger wave equation to Particle in a one dimensional box: derivation of energy and normalized wave function. Graphical representation of Ψ and its square (Ψ^2**)**. Applications of particle in a one dimensional box, Numerical problems.

Unit VI: (10 Hrs)

A) Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical process, Beer–Lamberts, laws of photochemistry: Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes (nonradiative and radiative) fluorescence,

phosphorescence, chemiluminesence, quantum yield, determination of quantum yield of reactions, causes for low and high quantum yields. Some examples of photochemical reactions e.g. photochemical decomposition of Hydrogen iodide, photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2

B) Electric Properties: Electrical dipole moment and its unit, Clausius-Mossotti equation (No Derivation), Application of dipole moment to (i) % ionic character (ii) Shape of molecules, (iii) study of geometrical isomers and (iv) Bond moments and Group moments for substituted benzene molecules.

C) Nuclear Chemistry: Important terms in nuclear chemistry:- Isotope, Isobar, Isotone, Mass defect, nuclear binding energy, Average binding energy per nucleon, Numericals. Nuclear reactions: Fission and fusion. Applications of radioisotopes in medicine, agriculture, carbon dating and structure determination.

Referemce:-

Inorganic Chemistry

- Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
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- Gary D. Christian, Analytical Chemistry: (Wiley, India).
- Willard, Merrit, Dean, Settle, Instrumental Methods of Analysis: (CBS Publishers, Delhi)
- Braun, Instrumental Methods of Chemical Analysis: (Tata McGraw-Hill)

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- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
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- Jagdamba Singh and L. D. S. Yadav, Organc Chemistry, Pragati Prakashan
- Pradeep's Organic Chemistry, Volume 3
- RM Silverstein, G C Bassler and TC Morril, John Wally Spectroscopic identification of organic compound-
- PS Kalsi, Spectroscopy of Organic Molecule- Wiley, Esterna, New Delhi
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Physical Chemistry

- Donald A. McQuarrie, Quantum Chemistry

- Ira Levine, Quantum CHemistry
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- H. J. Arnikar, Essentials of Nuclear Chemistry Fourth Edition, New Age International Publishers
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- K. L. Kapoor, Physical Chemistry, Volume 4

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- https://www.mooc-list.com/tags/chemistry

CHEMISTRY LAB: Practical Course (60 Hrs)

Course Objectives:-

1. To determine concentration of inorganic ions in given solutions using colorimeter or spectrophotometer
2. To separate and identify the components from an organic mixture containing two solid components and preparation of suitable derivatives
3. To apply principles of physical chemistry to study various physical properties of compounds.

Inorganic Chemistry

1) To estimate copper (II) in commercial copper sulphate sample as ammonia complex using colorimeter or spectrophotometer.
2) To determine composition of Fe- SSA complex by Jobs method.
3) To determine composition of Fe- SSA complex by Mole Ratio method.

Organic Chemistry

Separation of an organic mixture containing two solid components using Aq. $NaHCO_3$ or Aq. NaOH separation, identification of the components and preparation of suitable derivatives (minimum five mixtures)

Physical Chemistry

1) To determine refractive index of given liquid by Abbe's refractometer and to calculate its molar refraction.
2) To construct the phase diagram of three component system (Acetic acid-chloroform-water).
3) To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change data using Born-Harber cycle.
4) To determine the molecular state of Benzoic Acid by distribution method.
5) To study magnetic properties of given complex using Guoy's balance

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
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Bajaj College of Science, Wardha

Department of Chemistry

Revised Syllabus of B. Sc. Chemistry (Semester III and Semester IV) for Academic Autonomy

(Approved in BOS Meeting 8-September-2021 to be implemented from Academic Session 2022-23)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. II Semester III

SUBJECT - CHEMISTRY

UG –CHEM (02)-S3-T: (Elements of Inorganic, Organic & Physical Chemistry) (60 Hrs)

Course Objectives:-

i) To understand the principles and importance of Molecular Orbital theory in chemical bonding.

ii) To study important aspects of compounds like sulfur tetranitride, poly- and interhalogens.

iii) To extend the study of periodic table to transition elements and to gain the knowledge of nonaqueous solvents.

iv) To study important organic compounds like alkyl and aryl halides, organometallic compounds, with respective of their synthesis, properties and reactivities.

v) To gain the knowledge about synthesis, properties and reactivities alcohols, phenols and amines

vi) To study the fundamentals of chemical kinetics and extend the study to the theories of reaction rates.

vii) To understand the important aspects of ionic equilibrium.

viii) To reinforce the basics of phase equilibrium and to understand related concepts.

Course Outcomes:-

By completing this theory course students will-

i) Understand the principles and importance of Molecular Orbital theory in understanding of bonding.

ii) Learn important aspects of compounds like sulfur tetranitride, poly- and interhalogens.

iii) Gain knowledge about important aspects of transition elements and nonaqueous solvents.

iv) Acquire the knowledge about synthesis, properties and reactivities of important organic compounds like alkyl and aryl halides, organometallic compounds, alcohols, phenols and amines.

v) Know the fundamentals of chemical kinetics and reaction dynamics.

vi) Understand the principles of ionic equilibrium.

vii) Gain the knowledge about phase equilibrium and understand various phase diagrams.

Contents:-

Unit I **(10 Hrs)**

A. MO theory

LCAO approximation, wave equation for molecular orbitals. Difference between bonding and anti bonding MO in terms of energy and electron density distribution curves, order of energy levels in MO. Molecular Orbital diagrams for homonuclear diatomic molecules of elements(with Z = 1 to 9) Concepts of nonbonding MO in HF molecule. Coulson's MO diagram of CO and NO diatomic molecule.

B. Preparation, properties and structure of tetrasulphur tetranitride (S_4N_4) and Interhalogen compounds. Polyhalides (Structure of I_3^- and ICl_4^-).

Unit II: **(10 Hrs)**

A. Chemistry of elements of first transition series: Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Colour, Complex formation tendency and catalytic activity.

B. Chemistry of elements of second and third transition series: Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d- analogous (Group Cr-Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior.

C. Non-aqueous solvents:

Classification of solvents and characteristic reactions (acid base, redox & precipitation reactions) in Nonaqueous solvents with reference to i) Liquid Ammonia and ii) Liquid Sulphur dioxide.

Unit III: **(10 Hrs)**

A. Alkyl Halides

Preparation: from alkenes and alcohols. Reactions: Nucleophilic substitution reactions of alkyl halides (alcohol, ester, nitrile & isonitrile formation, Williamson's ether synthesis), mechanism and stereochemistry of nucleophilic substitution reactions (SN_1 and SN_2), factors affecting SN_1 and SN_2 reactions.

B. Aryl Halides

Chlorobenzene: Preparation by aromatic halogenation and Sandmeyer reaction. Aromatic nucleophilic substitution involving Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl and aryl/ Vinyl halides.

C. Organometallic compounds :

Organomagnesium compound: Grignard reagent, formation (from alkyl and aryl bromide) and chemical reactions with carbonyl compounds, esters, alkyne and dry ice.

Organozinc compounds: Formation (from ethyl bromide) and Reformatsky reaction.

Organolithium compounds: Formation of methyl and n-butyl Lithium and its use as base.

Unit IV: **(10 Hrs)**

A. Alcohols: Classification and nomenclature of primary alcohol.

Dihydric alcohols: Nomenclature, methods of formation of ethylene glycol (from ethylene, epoxide, ethylene dibromide and ethylene diamine). Chemical reactions of vicinal glycols: with carbonyl compounds, dehydration, oxidative cleavage with $Pb(OAc)_4$ and HIO_4 and Pinacol–Pinacolone rearrangement (with mechanism).

Trihydric alcohols: Nomenclature and methods of formation (from hydrolysis of fats and oils, propene and acrolein), chemical reactions of glycerol (with PCl_5, HI, oxidation and dehydration).

B. Phenols

Nomenclature, Preparation of phenols from cumene, chlorobenzene (Dows and Raschig process) and diazonium salts. Physical properties and acidic nature of phenol, Resonance stabilization of phenoxide ion, Reactions of phenols, Electrophilic aromatic substitution, acetylation and carboxylation, Claisen rearrangement, Gatterman reaction, Mechanism of i) Fries Rearrangement, ii) Reimer-Tiemann reaction.

C. Amines

Structure and stereochemistry of amines, basicity of amines, preparation of alkyl &aryl amines: reduction of nitro compounds and nitriles, reductive amination of aldehydic and ketonic compounds, Gabriel phthalimide reaction, Hofmann bromamide reaction. Reactions of amines: Preparation and synthetic transformations of aryl diazonium salts (Coupling with β-naphthol and Sandmeyer).

Unit V: Chemical Kinetics **10 Hrs**

A. Concept of reaction rate, factors affecting the rate of a reaction – concentration, temperature, pressure, surface area, light, catalyst. Order and molecularity, Zero order reactions. Mathematical expression for rate constant of first and second order reactions ($a = b$ and $a \neq b$), their characteristics. Pseudo order reactions. mean life of reactions with examples. Methods of determination of order of reaction – integration method, differential method, graphical method, method of half life period and Ostwald's isolation method. Effect of temperature on rate of reaction. Arrhenius equation and its derivation, concepts of activation energy. Numericals.

B. Collision theory of bimolecular reactions (hard sphere model). Transition state theory, expression for rate constant based on equilibrium constant and thermodynamic aspects.

Unit VI: Ionic Equilibria and Phase Equilibrium **10 Hrs**

A. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis - calculation of hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base, weak acid and strong base and Numericals. Buffer solutions – Introduction, Henderson's equations, buffer solution of weak acid and its salt (No derivation), buffer solution of weak base and its salt (No derivation). Numericals.

B. Phase Equilibrium

Phases, components and degrees of freedom of a system, Gibbs Phase Rule no derivation. Phase diagrams of one-component systems (phase diagram of water) and two component systems involving eutectics (phase diagram of lead-silver). **Liquid-Liquid mixtures:** Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law, Partial miscible liquids: phenol-water system, trimethylamine-water, nicotine-water system, lower & upper consolute temperature, Nernst distribution law, limitations and applications (association and dissociation - No derivation).

References:-

Inorganic Chemistry

- Lee, J. D. *Concise Inorganic Chemistry,* ELBS, 1991.
- Cotton, F. A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry,* 3rd ed., Wiley.
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- J. Raja Ram and J. C. Kuriacose, *Kinetics and Mechanism of Chemical Transformations* MacMilllan Indian Ltd., New Delhi (1993)
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- Santosh Kumar Upadhyay, *Chemical Kinetics and Reaction Dynamics,* Springer 2006
- P. W. Atkins'and D. Paula, *Physical Chemistry,* 8th Edition, Oxford University Press, 2010
- S. H. Marron and C. F. Pruton. *Principles of Physical Chemistry,*4th edition
- Samuel Glasstone. *Textbook of Physical Chemistry*,
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- G. M. Barrow, *Physical Chemistry*, 6th Edition, TMH Publishing Co. Ltd. New Delhi.
- Puri, Sharma, Pathania, *Principles of Physical Chemistry,* Vishal Publishing Co., 2020
- Soni P. L., Dharmarha O. P., Dash U. N., *Textbook of Physical Chemistry,* Sultan Chand and Sons, 2016.

- B.S. Bahl, G.D.Tuli and Arun Bahl, *Essentials of Physical Chemistry,* S. Chand and Company Ltd.

e References

- e-PGPathshala (inflibnet.ac.in)
- http://nsdl.niscair.res.in
- http://ocw.mit.edu

UG-CHEM(02)-S3-P: Elements of Practical Chemistry (60 Hrs)

Course Objectives:-

The primary objective of the practical course is to learn to perform experiments those have specific aims with correct techniques.

1. To learn to detect two acidic radicals of different group and two basic radicals of same groups from given mixture of inorganic salts.
2. To prepare an organic compound by following .
3. To study rate and to determine rate constant and activation energy of certain reactions
4. To determine the critical solution temperature of phenol-water system in absence and presence of impurities.
5. To apply pH metry in determination of degree of hydrolysis of a salt, pK_a and dissociation constant of a weak acid

Course Outcomes:-

On completion of the practical course students will-

i) Understand qualitative analysis of inorganic salt mixtures.

ii) Acquire skill in synthetic organic chemistry. This will also help them understand the concepts of atom economy, percent yield which are important for any synthetic process.

iii) Gain an understanding of methods to determine kinetic parameters of reactions like rate of reaction, rate constant, energy of activation.

iv) Learn to determine molecular weights of given compounds from colligative properties.

Contents:-

Inorganic Chemistry

Semi micro Qualitative Analysis

Qualitative analysis of inorganic salt mixture containing two acidic radicals of different group and two basic radicals of same groups. (At least six mixtures to be analyzed)

Organic Chemistry

Preparation:

i) Hydrolysis : Preparation of Benzoic acid from Benzamide

ii) Oxidation: Preparation of Benzoic acid from Benzaldehyde

iii) Nitration: P-nitroacetanilide from Acetanilide

iv) Preparation of azo dye from aniline

Physical Chemistry

1. To determine the specific reaction rate of the hydrolysis of methyl acetate catalyzed by H^+ ions at room temperature.
2. To dertermine the specific reaction rate of hydrolysis of ethyl acetate catalysed by base (saponification)
3. To study the rate of acid catalysed iodination of acetone.
4. To determine the energy of activation of reaction between persulphate iodide
5. To determine the critical solution temperature of two partially miscible liquids (phenol-water systems).
6. To study the distribution of iodine between water and kerosene
7. To determine the degree of hydrolysis of aniline hydrochloride

8. To determine pk_a value of given weak acid by pH-metric titration with strong base.
9. To determine the dissociation constant of oxalic acid by pH-metric titration with strong base

Reference Books

- Svehla G. *Vogel's Qualitative Inorganic Analysis*, Pearson India, 7th Edition, 2002
- Gurdeep Raj, *Advanced Practical Inorganic Chemistry*, Krishna Prakashan Media (P) Ltd, 2013.
- Vogel, A. I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi, 2011.
- Yadav J. B., *Advanced Practical Physical Chemistry*, Krishna Prakashan Media (P) Ltd, 2015.

Bajaj College of Science, Wardha

Syllabus under Academic Autonomy

SUBJECT CHEMISTRY

B.Sc. II Semester IV

UG –CHEM(02)-S4-T: Concise Inorganic, Organic & Physical Chemistry (60 Hrs)

Course Objectives:-

1. To extend the study of periodic table to the position, physical and chemical properties of lanthanides and actinides.
2. To learn basic concepts in statistical analysis of the data.
3. To understand important basic concepts related to coordination compounds.
4. To study important carbonyl compounds like aldehydes and ketones with respect to synthesis, properties and reactivities.
5. To study structure, preparation and chemical properties of carboxylic acids, unsaturated mono- and disubstituted carboxylic acids and their derivatives.
6. To study important topics of surface chemistry i.e. adsorption and catalysis through thermodynamics, adsorption isotherms and theories of catalysis.
7. To understand important concepts related to electrolytic conductance and to study its applications in determination of important electrochemical properties and volumetric titrations.

Course Outcomes:-

By completing this theory course students will-

i) Learn about the position and various physical and chemical properties of lanthanides actinides.

ii) Get acquainted with important basic concepts in statistical analysis of the data.

iii) Gain knowledge about important fundamentals of coordination compounds and their isomerism.

iv) Acquire the knowledge about synthesis, properties and reactivities of important carbonyl compounds like aldehydes and ketones.

v) Learn structure, preparation and chemical properties of carboxylic acids, unsaturated mono- and disubstituted carboxylic acids and their derivatives.

vi) Know the fundamentals of adsorption and its applications in catalysis.

vii) Understand the principles of electrolytic conductance and its applications.

Contents:-

Unit I (10 Hrs)

A) Chemistry of Lanthanides: Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii, Lanthanide contraction and its consequences, Complex forming tendency. Occurrence and separation of lanthanides (ion exchange and solvent extraction).

Chemistry of Actinides: Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii.

B) Errors in Chemical Analysis:

Random and Systematic errors, Explanation of terms: Accuracy and Precision, Uncertainty, Absolute and Relative errors, Mean, Median, Average and Standard deviations, Significant figures, numerical problems, Statistical Test of Data: Q-test, 2.5d and 4d Rules for rejection of data. Numerical problems

Unit II: (10 Hrs)

A) Coordination compounds:

Distinction among simple salts, double salts and coordination compounds. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples, Nomenclature of Coordination compounds. Chelates: Classification and their application, Valence Bond Theory of transition metal complexes.

B) Isomerism in coordination compounds: Structural isomerism and Stereoisomerism in coordination compounds.

Unit III: (10 Hrs)

Aldehydes and ketones:

A) Nomenclature and structure of the carbonyl group, synthesis of aldehydes (from alcohol and acid chloride) and ketones (from alcohol and nitriles). Acidity of alpha hydrogens and formation of enolate, Concept of reactive methylene group, Keto-enol tautomerism in Acetoacetic ester. Oxidation of aldehydes by $KMnO_4$, Tollen's reagent and Fehling solution, Reduction of aldehydes by $LiAlH_4$ and $NaBH_4$.

B) Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Wittig and Mannich reaction (without mechanism), Baeyer-Villiger oxidation of Ketones, Cannizaro reaction (with mechanism), MPV reaction, Clemmensen and Wolf-Kishner reaction.

Unit IV: (10 Hrs)

A) Carboxylic Acids : Nomenclature, structure, physical properties and acidity of carboxylic acids, effect of substituent's on acid strengths, preparation of carboxylic acids (from G.R., cyanides and acetoacetic ester), Chemical Reactions of carboxylic acids: Hell-Volhard-Zelinsky reaction (with mechanism), reduction with $LiAlH_4$, decarboxylation with mechanism.

Unsaturated monocarboxylic acids: (i) Crotonic acid (synthesis from malonic ester and chemical reaction: addition of Br_2 & HX, with NBS) (ii) Cinnamic acid (synthesis by perkin reaction and chemical reaction: oxidation with $KMnO_4$ and reduction with $LiAlH_4$ & Na-Hg)

Dicarboxylic acids: Succinic acid: preparation from malonic & acetoacetic ester. Phthalic acid: synthesis from *o*-xylene. Effect of heat/dehydrating agents on succinic & phthalic acid.

B) Carboxylic acid derivatives: Interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives (acetyl chloride-from acetic acid, ethyl acetate-from ethanol & acetyl chloride, acetamide-from acyl chloride and acetic anhydride-from acetic acid), Chemical reactions (acetyl chloride: Rosenmund reduction & Friedel-Craft reaction, ethyl acetate: hydrolysis & Claisen condensation, acetamide: reduction with LAH & Hoffmann reaction and acetic anhydride: acylation of alcohol and amine).

Unit V: Adsorption and Catalysis (10 Hrs)

(A) Adsorption- General introduction, Thermodynamics of adsorption, Types of adsorption, Factors affecting adsorption of Gases by Solids, Adsorption Isotherms: Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm, B.E.T. Equation (no derivation), Application of B.E.T. equation in the determination of Surface Area of Adsorbent (Numerical), Application of Adsorption.

(B) Catalysis:- Introduction, Homogeneous & Heterogeneous Catalysis, Auto catalysis Examples, Action of Catalytic Promoters & Inhibitors, Activation energy and catalysis, Theories of catalysis i) Intermediate compound formation theory ii) Adsorption theory, Active centre on catalyst surface, Adsorption theory and catalytic activity, Acid – Base catalysis (theoretical aspect only) and its industrial applications.

Unit VI: Electrochemistry I (10 Hrs)

A) Electrical transport: electronic and electrolytic conductors, resistivity, conductance, specific resistivity, specific conductance, molar conductance and equivalent conductance, measurement of conductance of solutions, conductometer, conductivity cell, cell constant, Variation of equivalent & specific conductance with dilution, Arrhenius theory of electrolyte dissociation & its limitation, Debye-Huckel theory (elementary treatment).Relaxation effect, Electrophoretic effect and Onsagar equation. Numericals.

B) Transport number concept, relation between transport number & ionic conductance, factors affecting transport number of ions & its determination by moving boundary method. Kohlrausch's law, application of Kohlrausch's law & conductance measurement for the determination of degree of dissociation & dissociation constant of acids, solubility of sparingly soluble salt, numerical. Conductometric titrations curves in the titration of: (i) strong acid vs. strong base (ii) weak acid vs. strong base (iii) weak acid vs. weak base (iv) mixture of strong and weak acids vs. strong base (v) sodium chloride vs. silver nitrate (vi) barium hydroxide vs. magnesium sulphate. Advantages and limitations. Numericals.

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Inorganic Chemistry

- Lee, J. D. *Concise Inorganic Chemistry,* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Puri, Sharma, Kalia. *Principles of Inorganic Chemistry*.

Organic Chemistry

- Graham Solomon, T. W., Fryhle, C.B. & Dnyder, S.A., *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J. E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013.
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- Hashmat Ali, *Reaction mechanism in organic chemistry* (S. Chand publications)
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- Samuel Glasstone. *Textbook of Physical Chemistry*,
- Ira Levine, *Physical Chemistry*, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
- G.M. Barrow, *Physical Chemistry*, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
- R. C. Mukherjee, *Modern Approach to Physical Chemistry*
- S.H. Marron and C. F. Pruton. *Principles of Physical Chemistry*,4th edition
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- Soni P. L., Dharmarha O. P., Dash U. N., *Textbook of Physical Chemistry*, Sultan Chand and Sons, 2016.
- B.S. Bahl, G.D.Tuli and Arun Bahl, *Essentials of Physical Chemistry*, S. Chand and Company Ltd.

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- http://ocw.mit.edu

UG-CHEM (02)-S4-P: Concise Practical Chemistry (60 Hrs)

Course Objectives:-

The important objective of practical course is to develop skills of observation, recording and analyzing data and present the experimental work in a systematic manner.

1. To estimate an ion from the given solution gravimetrically.
2. To separate binary mixtures of ions by paper chromatography and to determine Rf values
3. To identify the given organic compound
4. To verify the Freundlich and Langmuir adsorption isotherm
5. To apply principles of electrochemistry to perform conductometric titrations, to determine the solubility and solubility product of a sparingly soluble salt and to determine the ionization constant of weak acid.

Course Outcomes:-

On completion of the practical course students will-

i) Understand gravimetric analysis of barium and nickel from given samples.

ii) Acquire skill in qualitative organic analysis to identify given organic compound. This skill is of great help in analysis of various samples while working in government, industrial or forensic laboratories.

iii) Know the methods to determine conductance of electrolytic solutions and use the conductance values for different applications.

iv) Learn to verify Freundlich and Langmuir adsorption isothertms.

Contents:-

Inorganic Chemistry

A) Gravimetric Analysis

i) Estimation of Ba^{2+} as $BaSO_4$,

ii) Estimation Ni^{2+} as Ni-DMG

B) **Chromatographic separation** of binary mixtures (at least Two) containing Cu(II), Co(II) and Ni (II) ions by paper chromatography and determination of Rf values.

Organic Chemistry

Organic qualitative analysis with respect to type, preliminary tests, elements, functional group, physical constants of single organic compound involving following steps:

I. Preliminary examination
II. Detection of elements
III. Detection of functional group
IV. Determination of M.P.
V. Preparation of derivative.
VI. Performance of specific test if any

There should be at least one belonging from each type (**any four**)

a) Benzoic acid, Salicylic acid, Cinnamic acid, Phthalic acid, Succinic acid.
b) β-Naphthol, α-naphthol, Resorcinol.
c) p-Toluidine, α-naphthylamine.

d) Napthalene, Thiourea, Urea, m-Dinitrobenzene, Diphenyl, Glucose, Lactose and Benzamide.

Physical Chemistry

1. To verify the Freundlich adsorption isotherm of acetic acid on charcoal.
2. To verify the Langmuir's adsorption isotherm of acetic acid on charcoal.
3. To determine the strength of the given strong acid conductometrically using standard alkali solution.
4. To determine the strength of the given weak acid conductometrically using standard alkali solution.
5. To determine the strength of strong acid and a week acid in a given mixture conductometrically by titrating it with standard alkali solution.
6. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
7. To determine the ionization constant of weak acid conductometrically.

Reference Books

- Svehla G. *Vogel's Qualitative Inorganic Analysis,* Pearson India, 7th Edition, 2002
- Gurdeep Raj, *Advanced Practical Inorganic Chemistry,* Krishna Prakashan Media (P) Ltd, 2013.
- Vogel, A. I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
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- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi, 2011.
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Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Major / Department Specific Course (DSC)

Semester I course in
Chemistry

Syllabus under Autonomy

(Draft discussed and approved in BOS Meeting 18-April-2023 to be implemented from Academic Session 2023-24)

Shiksha Mandal's

Bajaj College of Science, Wardha

Programme Objectives B. Sc. with Chemistry as Major

- The basic objective of this programme is to impart the theoretical as well as practical knowledge of the subject to the students.
- Also the students should understand the concepts of chemistry in order to interrelate and interact to the other subject like mathematics, physics, biological science etc.
- Students should develop a broad foundation in chemistry that stresses scientific reasoning and analytical problem-solving ability with a molecular perspective.
- Students should get exposures to a wide range of experimental techniques using modern instrumentation.
- Students may acquire the skills in handling scientific instruments, planning and performing laboratory experiments
- An effort to inculcate the skills of observations and drawing logical inferences from the scientific experiments among the students.
- They should be able to analyze the given scientific data critically and systematically and possess the ability to draw the objective conclusions.

Shiksha Mandal's

Bajaj College of Science, Wardha

Programme Learning Outcomes B.Sc. with Chemistry as Major

- After completion of B.Sc. with Chemistry as one of the subjects, students will gain the important fundamental knowledge of the subject.
- Students will develop a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
- They will be able to find the physical, chemical nature the elements identify their role in the daily life.
- The skills of observations and drawing logical inferences from the scientific experiments will be inculcated among the students.
- Students will develop an interdisciplinary approach so as to connect the concepts of chemistry to the other scientific domains.
- The exposures to a wide range of experimental techniques will enable students to extend their knowledge to various opportunities in the government or corporate services particularly in the field of food safety, health inspector, pharmacist, chemist, forensic expert etc.
- Students will acquire the skills in handling scientific instruments, planning and performing laboratory experiments
- They will be able to analyze the given scientific data critically and systematically and possess the ability to draw the objective conclusions.

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. I Semester I

SUBJECT – CHEMISTRY (Major/ DSC)

UCH110T: (Fundamentals of Inorganic and Organic Chemistry)

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce the learners with fundamentals of inorganic and organic chemistry. The journey of science from classical to quantum which boosted the quest for study of atomic structure, the periodic properties and their trends are stressed upon in inorganic chemistry units. Learners will also be introduced with the basic theories in chemical bonding. The very fundamental concepts of organic chemistry are introduced along with stereochemistry. The study has been extended to aliphatic hydrocarbons. The topics studied in this course will be helpful in understanding the concepts introduced in subsequent semesters.

Course Objectives: -

1. To reinforce the basics of Inorganic Chemistry with special reference to atomic structure.
2. To understand periodic table and periodicity of properties of elements.
3. To understand various covalent bond theories especially VSEPR and Valence Bond Theory and ionic bonding with respect to various physical properties.
4. To understand fundamental concepts in organic chemistry like electronic displacements, bond fissions, classification of reagents, reactive intermediates and types of reactions.
5. To differentiate between various types of stereoisomerism and to understand fundamentals of optical, geometrical and conformational isomerism.
6. To understand the chemistry of alkanes and alkynes with respect to their methods of preparation and chemical reactions.

Course Learning Outcomes: -

On completion of this theory course, students will-

- Know basics of atomic structure of elements.
- Gain knowledge about periodicity which will help them in understanding structure of atom and variations in periodic properties of elements.
- Understand types of bonding and theories related to chemical bonding.
- Learn about ionic solids and polarization theories.
- Realize the basics of organic chemistry.
- Learn the important aspects of stereochemistry.
- Gain knowledge about various aspects of hydrocarbons like alkanes and alkynes.

The topics of this course cover mainly the fundamentals of the subject.

Contents:-

Unit I: Atomic Structure **(10 Hrs)**

Recapitulation of atomic models, Failure of classical mechanics and Foundation of Quantum mechanics: Explanation on the basis of Black body radiation, Photoelectric effect, Hydrogen atom spectra, Bohr's model of Hydrogen atom (No derivation), Planck's quantum theory, de Broglie's hypothesis (Explanation and Derivation). Heisenberg's uncertainty principle (Explanation), Quantum numbers, shapes of s, p, and d orbitals, Aufbau principle, Pauli's exclusion principles and Hund's rule of maximum multiplicity. Electronic Configuration of elements and ions (Z =1 to 30).

Unit II: **Periodic Properties**: **(10 Hrs)**

Atomic and ionic radii, (Covalent radii, van der Waals radii & metallic radii), ionization Potential (Definition, Factors affecting & trends in Periodic table), Electron gain enthalpy and electronegativity (Definition & trends in Periodic table).Pauling's and Mulliken's scale of electronegativity. Effective nuclear charge and Slater's rule with some exercises.

.

Unit III: Chemical Bonding **(10 Hrs)**

A. Covalent Bond: Recapitulation of Bond Theories, Valence shell electron pair repulsion (VSEPR) theory to NH_3, SF_4, ClF_3, and H_2O, Limitations of VSEPR, Valance bond theory,Formation of Hydrogen molecule, directional characteristics of covalent bond, types of covalent bond, overlap criterion and bond strength. Bond energy, bond length, Bond order& Bond angle. Limitations of VBT. Need of concept of hybridization, Hybridization, and its types (sp, sp^2, sp^3, sp^3d, sp^3d^2, sp^3d^3).

B. Ionic bond: Introduction, Lattice energy and its calculation by using Born- Haber cycle. Solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajans rule.

Unit IV: Basics of Organic Chemistry **(10 Hrs)**

A. Bonding of carbon atom in alkanes, alkenes & alkynes. Types of electronic displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation (definition and examples). Bond Fission: Homolytic fission and Heterolytic fission. Nucleophiles and electrophiles (definition and examples).

B. Reactive Intermediates: Carbocation, Carbanion, free radical, carbene and nitrene, (Definition, formation, geometry, stability and one reaction each). Types of organic reactions — addition, substitution, elimination, rearrangement (definition and examples).

Unit V: Stereochemistry **(10 Hrs)**

Concept of isomerism. Types of isomerism with suitable examples

A. **Optical isomerism**-elements of symmetry, molecular chirality, enantiomers, stereogenic centre (lactic acid as example). Optical activity, chiral and achiral molecules with two stereogenic centres (Tartaric acid) diastereo-isomers, mesocompound. Relative and absolute configuration, sequence rules, D & L and R & S system of nomenclature, resolutions of racemic mixture and its types, inversion, retention and racemization, asymmetric synthesis.

B. **Geometrical isomerism:** E & Z system of nomenclature, geometric isomerism in maleic acid and fumaric acid and 2-butene. **Conformational isomerism:** Conformational analysis of ethane and n-butane. Newman's projection and sawhorse formulae. Difference between configuration and conformation.

Unit VI: Aliphatic Hydrocarbons I: (10 Hrs)

A. **Alkanes:** Preparation: Catalytic hydrogenation, Wurtz reaction, from Grignard reagent. Reactions: Free radical Substitution i.e., Halogenation with mechanism.

B. **Cycloalkanes:** Introduction, Baeyer's strain theory. Ring strain in small rings cyclopropane and cyclobutane. Theory of strainless rings. Introduction to conformations of cyclohexane: Boat and Chair, axial and equatorial bonds.

C. **Alkynes:** Nomenclature, Methods of formation of acetylene from - calcium carbide, dehydrohalogenation of dihalides. Chemical reaction - hydroboration, & polymerization. Oxyacetylene flame. Acidity of alkynes.

Reference Books:

Inorganic Chemistry

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- *Principles of Inorganic Chemistry*, Puri, Sharma, Kalia
- *Shriver and Atkins Inorganic Chemistry*. 5th Edition, Oxford University Press

Organic Chemistry

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
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- Delhi (1988).
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- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
- P. S. Kalsi *Organic Stereochemistry,* Narosa Publishing House

UCH110P: Fundamentals of Practical Chemistry

[60 Hrs] **[2 Credits]**

Course Description: -

The purpose of this course is to inculcate basic practical skills among the learners. They will learn to perform experiments of specific aims with correct techniques. The learners will develop skills to observe, record and analyze data. They will be able to interpret the experimental data and to improve analytical skills

Course Objectives:-

1. To understand fundamentals of volumetric analysis and to perform and apply volumetric titrations.
2. To learn to identify extra element and functional group in given organic compound.
3. To learn to purify solid and liquid organic compounds and to study the criteria of their purity.

Course Outcomes:-

On completion of the practical course students will-

- Understand the calibration of apparatus.
- Learn the basics of volumetric analysis with various concentration units. This will help students to gain skills required for solution preparation that can help them to get jobs at quality control units of industries.
- Be able to compare the acid neutralizing capacities of various antacids available in market and also compare the acetic acid content of commercially available vinegars.
- Understand the basics of organic compound analysis enabling them to detect elements and functional groups in given samples. This will equip them to work at forensic labs.
- Gain the skills to purify compounds and test their purity. This skill can be useful while working in variety of laboratories and industries.

Inorganic Chemistry

1. Calibration of pipette.
2. Preparation of standard solution of an acid (oxalic acid) & a base (sodium bicarbonate) by weighing and calculation of concentrations in terms of strength, normality, molarity, molality, formality, % by weight, % by volume , ppm, ppb and mole fraction.
3. Preparation of standard solution of hydrochloric acid by dilution and calculation of concentrations in terms of strength, normality, molarity, molality, formality, % by weight, % by volume , ppm, ppb and mole fraction.
4. Determination of strength of HCl & CH_3COOH using NaOH volumetrically (Discussion of acid-base indicator theories is expected).
5. Determination of acetic acid in commercial vinegar using NaOH.
6. Determination of alkali content in antacid tablet using HCl.

Organic Chemistry

1. Detection of elements (N, S, Cl, Br, I) in organic compounds.
2. Detection of functional groups. (-COOH, Phenolic –OH, -CHO, Aromatic -NH_2, -$CONH_2$).
3. Purification of solid compounds by crystallization (from water)
4. Purification of liquids by distillation.
5. Calibration of thermometer
6. Criteria of Purity: Determination of melting points
7. Criteria of Purity: Determination of boiling points

Reference Books:-

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A. I., Tatchell, A.R., Furnis, B. S., Hannaford, A. J. & Smith, P. W. G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
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- http://ocw.mit.edu

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for B.Sc. Honors with Chemistry as Major

VOCATIONAL SKILL COURSE (VSC)

Course in Chemistry

Syllabus under Autonomy

(Discussed and approved in BOS Meeting 18-April-2023 to be implemented from Academic Session 2023-24)

Shiksha Mandal's
Bajaj College of Science, Wardha
(An Autonomous Institution)

VOCATIONAL SKILL COURSE (VSC)

UCH112P - Systematic Chemistry Laboratory Techniques

[60 hrs] **[Credits 2]**

Course Outcome

1. To introduce the learners about the basic chemistry laboratory facilities.
2. To train the learners about purification of organic compounds.
3. To train them to purify solids and liquids using simple techniques.
4. To develop the laboratory skills of students.

Course Learning Objective

At the end of this course, the student will be able to:

1. understand theoretical aspects and working principles of chemistry labware and equipment.
2. Synthesize, crystallize, and purify organic compounds
3. Determine melting paint and boiling points.
4. Prepare distilled/ deionized water.

Practical list:

1) Introduction to common laboratory apparatus and equipment's.
2) Purification of organic compounds by crystallization using the following solvents:
    a) Water
    b) Alcohol
    c) Alcohol-Water
3) Preparation of Benzoic acid.
4) Determination of melting point of crystalized organic compound.
5) Effect of impurities on the melting point–mixed melting point of two unknown organic compounds
6) Purification of liquid mixture.
7) Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method).
8) Preparation of distilled/ deionized water.

Mode of evaluation:

Continuous Internal Assessment (No end semester examination)

(Poster presentation / PPT Presentation/ Assignment/ MCQ Test)

Total Mark: 100

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Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

GENERIC ELECTIVE (GE)

(To be opted by Students having major subject other than Chemistry)

Semester I course in Chemistry

Syllabus under Autonomy

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Generic Elective

UCHG111 - Chemistry in Everyday life

[30 Hrs] **[Credits 2]**

Course Description

The course provides the students with the necessary information and practice to explores a range of chemistry-based topics relating to our everyday lives, with an emphasis on the important role of organic chemistry – the study of carbon-containing organic compounds. this course, students will study the important drugs that we use in our daily life. Besides drugs, students also study food additives. Food additives are compounds that we add to our food for a variety of reasons, including preservation and nutritional value. Cleaning agents such as soaps and detergents are also an important part of this course. We use soaps to wash in normal water, but these soaps do not work in hard water.

Course Objectives:

- To understand chemistry in daily life;
- to learn the basis of drug classification;
- to know how different types of drugs work in the body;
- to learn about artificial sweeteners and food preservatives;
- to know about the chemistry of cleaning chemicals.

Course Learning Outcomes:

On completion of this theory course, students will be able to-

- visualise the importance of Chemistry in daily life;
- describe the basis of classification of drugs;
- explore how various types of drugs function in the body;
- know about artificial sweetening agents and food preservatives;

- discuss the chemistry of cleansing agents.

Contents:

Unit: - I Drugs: (10 Hrs)

Drugs and their Classification (On the Basis of Drug Action, On the Basis of Pharmacological Effect, On the Basis of Molecular Targets), Therapeutic Action of Different Classes of Drugs (**Antacids, Antihistamines, Antimicrobials, Neurologically Active Drugs),** Definition, Common Examples, Uses

Unit: - II Food Additives: (10 Hrs)

Preservatives, artificial sweetening agents, the idea of antioxidants Preservatives: role, example (Sodium benzoate). Artificial sweetening agents: roles and examples (aspartame, saccharine, sucralose, alitame and monosodium glutamate)

Unit: - III Cleansing Agents (Soap and Detergents): (10 Hrs)

Introduction & definition, classification and some important examples, structure, synthesis, cleansing action. Saponification value & its determination. Advantages of detergents over soaps.

References:

- Chemistry in daily life, Kirpal Sigh, PHI Learning Pvt. Ltd., 2012 – Science
- Chemistry in Action: The Molecules of Everyday Life Nina Morgan Oxford University Press, 1995

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Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Major / Department Specific Course (DSC)

Semester II course in
Chemistry

Syllabus under Autonomy

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Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. I Semester II

SUBJECT – CHEMISTRY (Major/ DSC)

UCH120T: Concepts of Inorganic and Physical Chemistry

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce the learners with important concepts of inorganic and physical chemistry. The focus is given on extending the study of periodic properties and their trends to the s-. p-, and d- block elements. Learners will also be introduced with the states of matter. The fundamental concepts of chemical thermodynamics are introduced along with thermochemistry.

Course Objectives:-

1. To learn name, symbol, electronic configuration, trends, properties and important applications of s –block elements and to study some of their important compounds.
2. To learn name, symbol, electronic configuration, trends, properties and important applications of p –block elements and to study some of their important compounds.
3. To extend the study of periodic table to the position, physical and chemical properties of first, second and third transition series elements.
4. To understand the behavior of gases, ideal gas as a model system, its extension to real gases and different physical properties of liquids.
5. To study various laws of crystallography and elaborate crystal structures of some compounds
6. To study and understand the tenets of thermodynamics pertaining to First Law of thermodynamics and to correlate between change in enthalpy of various reactions.

Course Outcomes: -

After studying this theory course, students will-

- Learn about the position and various physical and chemical properties of s- and p- b actinides.
- Know the important theories of gaseous state and learn the properties of liquids.
- Know the fundamentals of solid state and structure determination.
- Understand the fundamentals of chemical thermodynamics.

Contents: -

Unit I: s -block elements and Noble Gases (10 Hrs)

A. s-block elements

Comparative study: Electronic configuration, atomic and ionic radii, Ionisation potential, Reducing properties. Diagonal Relationships (Li-Mg).

B. Hydrogen bonding. Classification and effect of Hydrogen bonding on viscosity, solubility, melting point and boiling point. Applications of s-block elements.

C. Chemistry of Noble Gases: Chemical properties of the noble gases, Chemistry of Xenon, Structure, and bonding in xenon fluorides (XeF_2, XeF_4 and XeF_6) and oxyfluorides ($XeOF_2$ and $XeOF_4$).

Unit II: p-block elements (10 Hrs)

A. Comparative study of groups 13 to 17: Atomic and ionic radii, Ionisation potential, electron affinity, electronegativity, redox properties. Diagonal relationship (B-Si).

B. Hydrides: Comparative study with respect to structure of NH_3, PH_3, AsH_3 and SbH_3.

Oxides and Oxyacids of Phosphorous: Structure of P_2O_3, P_2O_5, H_3PO_3 and H_3PO_4 with their Applications.

Peroxyacids of sulphur: Preparation and structure of Caro's and Marshall's acids & Applications

Hydrides of boron: Structure and bonding of diborane , structure of borazine Applications of p- block elements.

C. Preparation, properties and structure of tetrasulphur tetranitride (S_4N_4) and Interhalogen compounds. Polyhalides (Structure of I_3^- and ICl_4^-).

Unit III: (10 Hrs)

Chemistry of elements of first transition series: Characteristic properties of the elementsof first transition series with reference to their: Electronic configuration, Atomic and ionicradii, Ionization potential, Variable oxidation states, Magnetic properties, Colour, Complex formation tendency and catalytic activity.

Chemistry of elements of second and third transition series: Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d- analogous (Group Cr-Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior.

Unit IV: States of Matter (10 Hrs)

A. Gaseous State: Kinetic theory of gases (Postulates), kinetic gas equation (no derivation), deduction of various gas laws from kinetic gas equation (Boyle's, Charles', Graham's, Avogadro's laws). Maxwell's distribution of velocities (graph and qualitative discussion), Effect of temperature on molecular velocities. Different types of molecular velocities - most probable, R.M.S. and average, their expressions and numericals. Concepts of Mean free path, collision diameter and collision number. Explanation of deviation of real gases from ideal behavior, Compressibility factor and Boyle temperature. van der Waal's equation of state,

Critical phenomenon, Andrew's isotherm of a real gas (CO_2) and its comparison with van der Waal's isotherm.

B. Liquid State: Important interactions in liquid state – dipole-dipole, dipole-induced dipole, induced dipole-induced dipole; Properties of liquids i) Surface tension: Explanation, Drop number method of determination, (Numericals) ii) Viscosity: Explanation, coefficient of viscosity, Method of determination by Ostwald viscometer. (Numericals)

Unit V: Solid State (10 Hrs)

Laws of crystallography i) Law of constancy of interfacial angles ii) Law of rationality of indices iii) Law of symmetry, symmetry elements in crystals. Unit cell, space lattice, orientation of lattice place - Miller indices and Numericals. Bravais lattices, crystal systems, X-ray diffraction of crystal, derivation of Braggs' equation. Determination of crystal structure of NaCl, KCI and CsCl by powder method.

Unit-VI Thermodynamics (10 Hrs)

A. Basic concept of thermodynamics: system, surrounding, types of system (closed, open & isolated), thermodynamic variables, intensive & extensive properties, thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions, Zeroth law of thermodynamics, First law of thermodynamics, concept of heat capacity, heat capacity at constant volume and at constant pressure, their relationship. Calculations of w, q, ΔE & ΔH for reversible expansion of ideal gases under isothermal and adiabatic conditions (Numericals).

B. Thermochemistry: Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralisation, relation between heat of reaction at constant volume and constant pressure. Hess's law of constant heat of summation & its applications (Numericals).

Reference:-

Inorganic Chemistry

- Lee, J.D. *Concise Inorganic Chemistry,* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- *Principles of Inorganic Chemistry*, Puri, Sharma, Kalia
- *Shriver and Atkins Inorganic Chemistry*. 5th Edition, Oxford University Press

Physical Chemistry

- S.H. Marron and C.F.Pruton. *Principles of Physical Chemistry*,4th edition
- Samuel Glasstone. *Textbook of Physical Chemistry*,
- Ira Levine, *Physical Chemistry*, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
- G.M. Barrow, *Physical Chemistry*, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
- Atkins, P. W. & Paula, J. de Atkins *Physical Chemistry* 9th Ed.,Oxford UniversityPress2011.
- Puri, Sharma and Pathania. *Principles of Physical Chemistry*,

- Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa 2004.
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall 2012.
- McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi 2004.
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY 2011
- http://nsdl.niscair.res.in
- http://ocw.mit.edu

UCH120P: Concepts of Practical Chemistry

[60 Hrs] **[2 Credits]**

Course Description: -

The purpose of this course is to impart important practical skills to the learners. They will learn to perform experiments with specific aims using appropriate apparatus. The learners will develop skills to observe, record and analyze data. They will be able to interpret the experimental data and to improve analytical skills. The learners will learn to apply theoretical concepts in experiments and corelate between the theory and practicals.

Course Objectives:-

1. To perform quantitative estimation through the redox and complexometric titrations.
2. Know determination of some important properties of liquids.
3. Learn to determine thermodynamic parameters of a reaction.

Course Learning Outcomes:-

On completion of the practical course students will-

- Understand redox and complexometric titrations including analysis of hardness of water. This enables students to work on water treatment plants etc.
- To learn to determine surface tension, coefficient of viscosity of a liquid and thermodynamic properties like heat capacity of calorimeter and enthalpy of a reaction, solubility and heat of solubility.

Contents:-

Inorganic Chemistry

1. Estimation of Fe(II) by dichromate using internal indicator.
2. Determination of Zn by complexometric titration with EDTA
3. Determination of total, permanent and temporary hardness of water by EDTA
4. Estimation of sodium carbonate content of washing soda

Physical Chemistry

1. To determine co-efficient of viscosity of organic liquids by using Ostwald's viscometer.
2. Determination of surface tension of organic liquids by using stalagmometer.
3. Determination of heat capacity of calorimeter for different volumes.
4. Determination of integral enthalpy of solution of KNO_3
5. Determination of enthalpy of ionization of acetic acid.
6. Study of the solubility of benzoic acid in water and determination of heat of solution.

Reference Books

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.

- Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.
- Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London

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Proposed Syllabus for B.Sc. Honors with Chemistry as Major

SKILL ENHANCEMENT COURSE (SEC)

Course in Chemistry

Syllabus under Autonomy

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Skill Enhancement Course

UCH123P- General Analytical Chemistry

[45 hrs] **[Credits 2]**

Course description:

Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists. It is the introduction to the science of making chemical measurements. Learn the fundamentals of information and sample gathering, measuring, and minimizing experimental error. It deals with the principle and techniques of quantitative analysis, that is how to determine how much of a specific substance is contained in a sample.

Course Objectives

The Course is aimed at

- Studying Introduction to analytical chemistry.
- Knowing fundamentals of information and sample gathering, measuring, and minimizing experimental error.
- Understanding the methods of expressing the concentrations of the solution.
- Gaining knowledge of various classical methods of analysis.

Course Learning Outcomes

At the end of this course, the student will be able to:

- explain the fundamentals of analytical chemistry and steps of a characteristic analysis.
- acquire how to make analysis faster, better, and cheaper.
- compare qualitative and quantitative analyses.
- define the general properties of volumetry.
- express the titrimetric & gravimetric analysis methods.
- employ stoichiometric calculations.

Syllabus: -

1. Preparation of standard solution of an acid, base, salt, oxidizing agent, reducing agent by weighing and dilution. Also calculate concentrations in terms of strength, normality, molarity, molality, formality, % by weight, % by volume, ppm, ppb, and mole fraction.
2. Determination of strength of HCl & CH_3COOH using NaOH volumetrically (Discussion of acid-base indicator theories is expected).

3. Determination of acetic acid in commercial vinegar using NaOH.
4. Determination of alkali content in antacid tablet using HCl.
5. Estimation of chloride in given solution by Mohr's titration
6. Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
7. Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
8. Determination of total, permanent and temporary hardness of water by EDTA
9. Estimation of sodium carbonate content of washing soda

Reference Books:

1. Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2. Vogel's Textbook of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS).
3. Analytical Chemistry: Gary D. Christian (Wiley India).
4. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986).
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons).
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)

Mode of evaluation:

Continuous Internal Assessment (No end semester examination)

(Poster presentation / PPT Presentation/ Assignment/ MCQ Test)

Total Mark: 100

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GENERIC ELECTIVE (GE)

(To be opted by Students having major subject other than Chemistry)

Semester II course in Chemistry

Syllabus under Autonomy

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Generic Elective

UCHG121 Food Adulteration

[30 Hrs] **[Credits 2]**

Course description:

The purpose of this generic elective is to enable non-chemistry student understand the chemistry behind common food adulterants and their detection. The food safety rules and regulation is an important aspect of food industry. The knowledge gained from this course will be helpful for learners to prepare for careers in food industries and food safety laboratories.

Course Objectives:

- To educate students about food adulteration and their types.
- To introduce students with common food adulterants and their methods of detection.
- To make students aware of food safety and standardization acts.

Course Learning Outcomes:

After successful completion of the course, students will be able to:

- Understand the adulteration of common foods and their adverse impact on health.
- Comprehend certain basic skills of detecting adulteration in common foods.
- Apply their knowledge of food safety and regulations.

Contents:

Unit I: Introduction and Types of Adulterants (10 Hrs)

Adulteration – Introduction and definition. Types of Adulterants - Poisonous substances, Foreign matter, cheap substitutes, Spoiled parts. Adulteration through Food Additives –Intentional and incidental. General Impact on Human Health.

Unit II: Adulteration of Common Foods and Methods of Detection (10 Hrs)

Adulteration of Common Foods, Means of Adulteration, Methods of Detection of Adulterants in the following Foods: Milk, Oil, Grain, Sugar, Spices and Condiments, Processed Food, Fruits and Vegetables, Additives and Sweetening agents (at least two methods of detection for each food item).

Unit III: Laws and Procedures on Adulteration (10 Hrs)

Highlights of Food Safety and Standards Act 2006 (FSSA), Food Safety and Standards Authority of India, Rules and Procedures of Local Authorities, Role of Voluntary Agencies - AGMARK, I.S.I. Quality control laboratories of Companies, Private testing laboratories, Quality control laboratories of Consumer co-operatives.

Reference books and Websites:

1. A first course in Food Analysis, A.Y. Sathe, New Age International (P) Ltd., 1999.
2. Food Safety, case studies – R. V. Bhat, NIN, 1992.
3. DART- Detect adulteration with rapid test. FSSAI, Imprinting Trust, assuring safe and nutritious food, Ministry of Health and Family Welfare, Government of India.
4. Rapid detection of food adulterants and contaminants Theory and Practice, S. N. Jh, 2016, Kindle Edition.
5. Domestic Tests for Food Adulterations, H. G. Christian, Forgotten books.
6. A Laboratory Manual of Food Analysis, S. Sehgal, Wiley Publishers.
7. Food Safety and Standards Act, 2006. Bare ACT, November 2020, Commercial law publishers.

Mode of evaluation:

Continuous Internal Assessment (No end semester examination)

(Poster presentation / Project/ Presentation/ Assignment/ quiz)

Total Marks: 50