NORTH MAHARASHTRA UNIVERSITY, JALGAON

SCHOOL OF CHEMICAL SCIENCES

(Academic Flexibility Since-2009)

SYLLABUS

for

MASTER OF SCIENCE in CHEMISTRY

M.Sc. I

(Semester I and II)

(Choice Based Credit System, 60:40 Pattern)

w. e. f. June 2015

School of Chemical Sciences
North Maharashtra University, Jalgaon – 425 001
M. Sc. I (Semester I and II)
[Polymer Chemistry, Pesticides & Agrochemicals, Industrial Chemistry, Organic Chemistry, Physical Chemistry and Analytical Chemistry]
Common Course Structure for the First Year (60+40 Pattern)
(w.e.f. June 2015)

Semester I

Theory courses*

Course Code		Title	Marks
CH- 101	:	Inorganic Chemistry- I	100
CH- 102	:	Organic Chemistry- I	100
CH- 103	:	Physical Chemistry- I	100

Semester II

Theory courses*

Course Code		Title	Marks
CH- 201	:	Inorganic Chemistry- II	100
CH- 202	:	Organic Chemistry- II	100
CH- 203	:	Physical Chemistry- II	100
CH- 204	:	Basic Concepts in Instrumentation and Analysis	100

Laboratory Courses**

Course Code		Title	Marks
CH- 001	:	Lab. Course in Inorganic Chemistry	100
CH- 002	:	Lab. Course in Organic Chemistry	100
CH- 003	:	Lab. Course in Physical Chemistry	100

* All theory courses of both First and Second Years (Semester I-IV) of all Departments in the School are of 60 hrs each including 10-12 hrs of Tutorials / Home Assignments / Class Room Discussion / Seminars / Internal Tests & Assessment.

** Semester practical examination pattern.

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CH- 101: Inorganic Chemistry- I

Total Marks- 100 **[60 hrs]**

Unit- I **Chemistry of Non-transition elements** **[12 hrs]**

Hydrides-classification, electron deficient, precise and rich hydrides. Study of PH3, SbH3, AsH3, selenides, Tellurides. Synthesis, properties and structures of alkali and alkaline earth metal compounds, Synthesis and reactivity of inorganic polymer of Si and P.

Metal Clusters: Boranes: Classification, synthesis, structure and topology (B_2H_6 to $B_{10}H_{14}$)

Carboranes: Classification, Synthesis and structure

Metalloboranes and metallocarboranes.

Unit- II **Molecular Orbital Theory and its application.** **[12 hrs]**

Linear triatomic molecules – BeH_2, CO_2.Trigonal planar molecule BF_3, Tetrahedral molecule – CH_4, Trigonal pyramidal molecule NH_3, Angular Triatomic molecules H_2O, NO_2.

Symmetry elements and operations, Symmetry planes, reflections, inversion centre, proper / improper axes of rotation, equivalent symmetry elements and atoms, symmetry elements and optical isomerism, symmetry point groups of some molecules H_2O, NH_3, $C_2H_2Cl_2$, (cis& trans) , BF_3, PCl_5, H_2O_2 (trans), XeF_4, H_3BO_3, CO_2, $POCl_3$, C_2H_2 , NO_3^-

Unit- III **Organometallic compounds of transition metals.** **[12 hrs]**

The 18 electron rule, Molecule orbital theory and 18 electron rule, Counting electrons in complexes. Alkyl & aryl complexes, Alkene complexes. Metal π complexes- Metal carbonyl and metal nitrosyls.

Unit- IV **The Ionic solids.** **[12 hrs]**

Classification of ionic structures, radius ratio rules, calculation of some limiting radius ratio values, close packing, Structures of ionic solids.A cautionary word on radius ratios.Lattice energy.The

Born - Haber cycle, Applications of lattice energetics.

Resonance : resonance energy. Concept of formal charge, criteria for resonating structures. Hydrogen bonding concept and structure of water, alcohols, phenols, types, properties

Unit- V Bio-inorganic Chemistry [12 hrs]

Metalloproteins and metalloenzymes, amino acids in metal binding sites. Selective transport and storage of iron (siderophores, iron transport proteins in higher organisms, release of iron transferrin , ferritin, the cellular Fe store), electron transfer (General considerations, Electron transfer cyctochrome, FeS clusters, copper transfer centers), ionophores.

References

1) Inorganic Chemistry Principles of Structures and Reactivity, 4th edition; James E. Huheey, Ellen A. Keiter, Richard L. Keiter.
2) Concise Inorganic Chemistry, 5th edition J. D. Lee.
3) Inorganic chemistry, 3rd edition Alan G. Sharpe.
4) Chemical Applications of Group Theory, F.A. Cotton.
5) Inorganic Chemistry, Fourth Edition; Shriver & Atkins Intern.student edition.
6) Principles of Inorganic Chemistry; Late B.R. Puri, L.R. Sharma & K.C. Kalia.
7) Electrons and Chemical bonding By H.B. Gray.
8) Modern Aspects of Inorganic Chemistry, By H. J. Emeleus and A.G. Sharpe; Universal Book Stall, New Delhi – 2
9) Advanced Inorganic Chemistry; Dr. S.K. Agarwala, Dr. Keemtilal, PragatiPrakashan, Meerut.
10) Theoretical Principles of Inorganic Chemistry, G.S. Manku , Tata McGraw-Hill Ed
11) Concepts and Models of Inorganic Chemistry, 2nd edition, B. Douglas, D.H. Mc. Daniel, J.J. Alexander.
12) General &Inorg. Chem. (Part one), R. Sarkar, New Central Book Agency ; Kolkata.
13) Group Theory and its Chemical applications, P.K. Bhattacharya, Himalaya Publishing House.
14) Advance Inorganic Chemistry , Cotton &Wilkinson.
15) Concept and Applications of Group Theory, Dr. KishorArora, Anmol Publication Pvt. Ltd., New Delhi.
16) Modern Inorganic Chemistry by William L.Jolly, 2nd edition, Tata McGraw Hill Co.

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CH-102: Organic Chemistry - I

Total Marks: 100 **[60 hrs]**

Unit-I **[12 L]**

A) IUPAC nomenclature of organic compounds: [**03 L**]

B) Aromaticity: [**04 L**]

Huckel's rule and Concept of Aromaticity, non-aromaticity and antiaromaticity, Annulences and Heteroannulenes, Fullerenes (C60).

C) Reactive intermediates: [5 L]

Formation and stability of Carbocations, Carbanions, Free Radicals, Carbenes, Nitrenes, and Arynes.

Unit-II **[12 L]**

Nucleophilic Substitutions at Saturated Carbon

The Reaction Mechanism: Reactivity at a saturated carbon atom, Available pathways, The SN^1 Mechanism, SN^2 Mechanism. Stereochemistry of Nucleophilic Substitution: The SN^1 reaction and SN^2 reaction. The Variables in Nucleophilic Substitution: The Leaving Group, The Nucleophile, The site of substitution, solvent effects, solvolysis, SN^1 versus SN^2 reaction. The Scope of Nucleophilic Substitution: Halide as the Nucleophile, Competing Reactions, Oxygen and Sulfur as the Nucleophiles, Nitrogen and Phosphorus as the Nucleophile, Neighboring Group Participation.

Unit-III **[12 L]**

Aromatic Electrophilic Substitution

Mechanism and Orientation in Electrophilic Aromatic Substitution: An Addition-Elimination Mechanism, Ortho, Meta and Para Orientation, Relative Rates of Substitution, The Rate Orientation Relation, Orientation in Multiply Substituted Aromatics, A pi-complex intermediate. Quantitative Correlations of Substituents Effects. Electrophilic Aromatic Substitution Reactions– Heteroatoms as the Electrophiles, Carbon as the Electrophile. Nucleophilic Aromatic Substitutions, The elimination-addition mechanism-benzyne. The aryl cation mechanism-diazonium salts, Nucleophilic Substitution via Thallium Derivatives.

Unit-IV **[12 L]**

Elimination Reactions-Alkenes and Alkynes: The Reaction Mechanism: The E1, E2 & E1cB mechanism, mechanistic variables. Elimination versus Substitution: Basicity versus Nucleophilicity, Substrate Structure, Solvent, Temperature. The Direction of Elimination: Formation of the More-Substituted Alkene, Formation of the Less-Substituted Alkene. Stereochemistry: Anti Elimination, Syn elimination, Stereoelectronic Factors. Formation of Alkenes: Dehydrohalogenation, Dehalogenation, Dehydration, Hofmann Elimination, Pyrolytic Elimination, Catalytic Dehydrogenation. Formation of Alkynes.

Unit-V **[12 L]**

Addition Reactions:

Electrophilic Additions to Unsaturated Carbon : The Mechanism of Electrophilic Addition: The AdE2 Mechanism, Structural Effects and Reactivity. Direction and Stereochemistry of Addition: Markovnikov Orientation. Stereochemistry of Addition. Additions to alkenes and alkynes: Halogenation, Hydrohalogenation, Hydration, Hydroboration, Epoxidation-Hydroxylation, Carbene Addition, Hydrogenation, Ozonolysis, Addition of alkenes and alkanes, Alkenes and Alkynes as petrochemical raw material.

Additions to Conjugated Compounds:

Conjugated Dienes: Mechanism of Electrophilic Conjugate Addition, Kinetic and Equilibrium Control. Double bonds Conjugated with Carbonyl Groups: Mechanism of Nucleophilic Conjugate Addition, Conjugate Additions in Synthesis.

References:

1. Organic Chemistry by Stanley H. Pine.
2. Stereochemistry: Conformations and Mechanism by P. S. Kalsi.
3. Advance Organic Chemistry: Reactions, Mechanisms and Structure by Jerry March.
4. Organic Chemistry by Clayden, Greeves, Warren and Wothers.
5. Organic Chemistry by Morrison and Boyd.
6. Stereochemistry of organic compound: D. Nasipuri
7. Stereochemistry of Carbon Compounds by E. L. Eliel.
8. Guidebook to mechanisms in organic chemistry: Peter Sykes

9. Advanced organic chemistry by F. A. Carey and R. J. Sundberg

10. Organic chemistry vol. I and II by I. L. Finar

CH-103: Physical Chemistry I

Total Marks- 100 **[60 hrs]**

Unit I: Atomic Structure and Wave-Mechanics [**12 hrs**]

The classical wave equation, The time independent classical wave equation, The Schrödinger wave equation, Translational energy, Quantization of energy, The free particle, Particles in a box, Tunnel effect, Atomic spectra, Bohr orbits and ionization energies, Schrödinger equation for hydrogen atom, The radial equation (no derivation), The quantum numbers and Radial wave functions.

Unit II: Kinetics-Molecular Theory of Gases **[12 hrs**]

PVT relations for an ideal gas, non-ideal behaviour of gases, Equation of state, Compressibility factor, Virial equation, van der Waals equation, excluded volume and molecular diameter, Maxwell-Boltzmann law for distribution of molecular velocities, Derivation of expressions for average, root mean square and most probable velocities, Experimental verification of distribution law, Molecular collision in gases, collision diameter and collision number in a gas, Kinetic theory of viscosity and diffusion.

Unit III: Thermodynamics **[12 hrs**]

Introduction to three laws of thermodynamics, Entropy and equilibrium, Free energy functions, Maxwell relations, Thermodynamic equation of state, Interpretation of Gibb's function, Phase equilibrium, Derivation of phase rule, PT diagrams for pure components like CO_2, H_2O, SiO_2. The Clapeyron-Clausius equation, Chemical potential and Chemical equilibrium.

Ideal mixtures, Partial molar quantities (Volume/free energy), Henry's and Rault's laws, Gibbs-Duhem relation, Liquid-Vapour free energies, Vapour pressures and solution properties, Non-ideal solutions and excess properties, Activity and activity coefficients and their determination from Freezing point depression and vapour-pressure measurements.

Third law entropies- Calculations of standard entropies from C_p data, Exceptions to third law.

Unit IV: Nuclear Chemistry [**12 hrs**]

Radioactive decay and equilibrium, Nuclear reactions, Q-value, Cross-sections, Types of reactions, Nuclear models, Chemical effects of molecular transformations, Fission and Fusion reactions, Fission products and Fission yields, Radioactive techniques, tracer technique, Neutron activation analysis (NAA), Nuclear detectors (Geiger Muller counter, Ionization and

Proportional).

Unit V: Kinetics of Reactions **[12 hrs]**

Types of reactions and their kinetics: Opposing reactions, Consecutive reactions, Parallel reactions, Chemical relaxation, Reactions in flow system, Chain reactions, Formation of hydrogen bromide, Temperature dependence of reaction rates, Catalysis by enzymes, Michaelis-Menten equation and mechanism.

Collision theory of bimolecular reactions, Transition state theory, Potential energy surfaces-examples of ($D + H_2$) and ($H + H_2$) reactions, Activated complex theory of reaction rate, The entropy of activation, Kinetic and thermodynamic control of a chemical reaction.

Books Recommended:

1. Physical Chemistry, P. W. Atkins, ELBS, 1998
2. Physical Chemistry, G. M. Barrow, International student edition, 2003.
3. Physical Chemistry, G. W. Castellan, AddisionWeslay.
4. Physical Chemistry, W. J. moore, Orient Longman, 1998.
5. Thermodynamics for Chemist, S. Glasstone, D. Van Nostrand, 1965.
6. Essentials of Nuclear Chemistry, H. J. Arnikar, New Age Publication Ltd., 1995.
7. Nuclear and Radiochemistry, Friedlander, Kennedy and Miller, John-Wiley, 1981.
8. Introduction to Nuclear Physics and Chemistry, B. G. Harwey, Prentice Hall, 1963.
9. Sourcebook of Atomic Energy, S. Glasstone, van Nostrand, 1967.
10. Chemical Kinetics, K. J. Laidler, McGraw Hill, 1985.
11. Kinetics and Mechanism, Frost and Pearson.

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CH- 201: Inorganic Chemistry- II

Total Marks-100 **[60 hrs]**

Unit I. Electronic spectra of transition metal complexes **[12 hrs]**

Energy levels in an atom, coupling of orbital angular momenta, coupling of spin angular momenta, spin orbit coupling. Determining the ground state terms – Hund's rule, Hole formulation, Derivation of the terms for a d^2 configuration, calculation of the number of microstates, Electronic spectra of transition metal complexes – Laporte 'orbital' selection rule, spin selection rule, splitting of electronic energy levels and spectroscopic states. Spectra of d^1& d^9 ions, d^2 & d^8 ions, d^5 ions.Spectrochemical and Nephalauxatic series, charge transfer and luminescence spectra, calculations of Dq, B and β parameters.

UnitII. Magnetic properties of complexes **[12 hrs]**

Paramagnetism, 1st and 2nd order Zeeman effect. Quenching of orbital angular momentum by ligand fields. Magnetic properties of A, E & T ground terms in complexes, Spin free - spin paired equilibria.

Unit III. Reaction mechanism in transition metal complexes. **[12 hrs]**

Ligand substitution reaction, The classification of mechanism, The substitution of square planer complexes, the nucleophilicity of entering group, the shape of activated complexes, K1 pathway, Substitution in Octahedral complexes, Rate law and their interpretation, The activation of octahedral complexes, , Base hydrolysis, Stereochemistry, Isomerization reactions

Unit IV. Catalysis **[12 hrs]**

Catalysis, Description of catalyst, Properties of catalyst, Homogeneous catalyst, Catalytic steps, Hydrogenation of alkenes, Hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, Alkene polymerization, Heterogeneous catalysis, Nature of heterogeneous catalyst. Examples of heterogeneous catalysts (hydrogenation, oxidation)

Unit V. The Structure and Reactivity of molecules/ Enviromental aspects **[12 hrs]**

VSEPR Theory, structures of molecules containing lone pair of electrons. Sulphurtetrafluoride, Bromine trifluoride, Dichloroiodate (I) anion, Pentafluorotellurate (IV) anion, Tetrachloroiodate (III) anion, Nitrogen dioxide, nitrite ion and nitryl ion, phosphorus trihalides, carbonyl fluoride, summary of VSEPR Rules, Photochemical reaction, Atomospheric Chemistry.

References

1) Inorganic Chemistry Principles of Structures and Reactivity, 4th edition; James E. Huheey, Ellen A. Keiter, Richard L. Keiter.
2) Concise Inorganic Chemistry, 5th edition J. D. Lee.
3) Inorganic chemistry, 3rd edition Alan G. Sharpe.
4) Chemical Applications of Group Theory, F.A. Cotton.
5) Inorganic Chemistry, Fourth Edition; Shriver & Atkins Intern.student edition.
6) Principles of Inorganic Chemistry; Late B.R. Puri, L.R. Sharma & K.C. Kalia.
7) Electrons and Chemical bonding By H.B. Gray.
8) Modern Aspects of Inorganic Chemistry, By H. J. Emeleus and A.G. Sharpe; Universal Book Stall, New Delhi – 2
9) Advanced Inorganic Chemistry; Dr. S.K. Agarwala, Dr. Keemtilal, PragatiPrakashan, Meerut.
10) Theoretical Principles of Inorganic Chemistry, G.S. Manku , Tata McGraw-Hill Ed
11) Concepts and Models of Inorganic Chemistry, 2nd edition, B. Douglas, D.H. Mc. Daniel, J.J. Alexander.
12) General &Inorg. Chem. (Part one), R. Sarkar, New Central Book Agency ; Kolkata.
13) Group Theory and its Chemical applications, P.K. Bhattacharya, Himalaya Publishing House.
14) Advance Inorganic Chemistry , Cotton &Wilkinson.
15) Concept and Applications of Group Theory, Dr. KishorArora, Anmol Publication Pvt. Ltd., New Delhi.
16) Modern Inorganic Chemistry by William L.Jolly, 2nd edition, Tata McGraw Hill Co.

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CH-202: Organic Chemistry - II

Unit-I: [**12 L**]

Selective Name Reactions:

Aldol, Perkin, Stobbe, Dieckmann Condensation. Reimer-Tiemann, Reformatsky and Grignard reactions. Michael, Mannich, Stork-enamine, Shapiro reaction. Cannizaro reaction, Baylis-Hilman reaction, Darzens reaction, Benzoin condensation, Knovengeal reaction.

Unit-II: [**12 L**]

Rearrangements: Wagner-Meerwein, Pinacol, Wolff, Arndt-Eistert synthesis, Hofmann, Curtius, Schmidt, Lossen, Beckmann, Baeyer-Villiger, Migration from Boron, Favorskii, Benzilic acid, Stevens, Wittig, Claisen and Cope.

Unit-III: [**12 L**]

Reagents in Organic Synthesis:

Gilman's reagent, Lithium dimethyl cuprate, LDA, DCC , 1,3-propane-dithiane, Trimethyl-silyl iodide, Tri-n-butyl-tin-hydride, Woodward and Prevost hydroxylation, DDQ, SeO_2, PTC, Crown ethers, Merrifield resins, Baker's yeast. chromic acid, sodium dichromate, potassium dichromate, Oppenauer oxidation, Jones reagent, Collins reagent, Birch reduction, periodic acid, lead-tetra acetate, Wolf-Kishner reduction, Clemmensen reduction, Meerwein-Pondorf-Verley reduction.

Unit-IV: [1**2 L**]

Stereochemistry:

Recognition of symmetry elements and chiral structures, R-S nomenclature, diastereo isomerism in acyclic and cyclic-systems, E-Z isomerism, conformational analysis of simple cyclic (Chair and Boat Cyclohexanes and acyclic systems, Interconversion of Fischer, Newman and Sawhorse Projections.

Unit-IV: [1**2 L**]

A) U.V. spectroscopy: [3 L]

Woodward-Fisher rules for conjugated dienes and carbonyl compounds, applications of UV.

B) IR Spectroscopy: [3 L]

Characteristics vibrational frequencies of alkanes, alkenes, aromatic compounds, alcohols, phenols, aldehydes, ketones, carboxylic acids, esters, amides, anhydrides, lactones and lactams. Effect of hydrogen bonding and solvent effect on vibrational frequencies

C) 1H NMR Spectroscopy: [6 L]

Chemical shift, factors influencing chemical shift, shielding-deshielding, spin-spin coupling (n+1) rule, Pascals triangle, factors affecting on coupling constant.

Joint Problems based on UV, IR & NMR

References:

1. Organic Chemistry by Stanley H. Pine.
2. Stereochemistry: Conformations and Mechanism by P. S. Kalsi.
3. Advance Organic Chemistry: Reactions, Mechanisms and Structure by Jerry March.
4. Organic Chemistry by Clayden, Greeves, Warren &Wothers.
5. Organic Chemistry by Morrison and Boyd.
6. Modern Methods of Organic Synthesis by W. Carruthers, Iain Coldham.
7. Spectroscopy of Organic compounds by P. S. Kalsi
8. Spectroscopic Identification of Organic compounds by R.M.Silverstein, G.C.Bassler and T. C. Morrill.
9. Stereochemistry of Carbon Compounds by E. L. Eliel.
10. Stereochemistry of Organic compounds by D. Nasipuri.
11. Pavia spectroscopy of Organic compounds – Pavia
12. Fundamentals of molecular spectroscopy – C. N. Banwell, and E. M. McCash

CH-203: Physical Chemistry -II

Total Marks-100 **[60 hrs]**

Unit I: Photochemistry **[12 hrs]**

Electronic transitions:Frank-Condon principle, selection rules, photodissociation, Predissociation, photoreduction, photooxidation, photodimerization, photochemistry in atmosphere and Green house effect.

Life time of electronically excited state, electronic transition and intensity of absorption bands, Construction of Jablonski diagram, Photophysical pathways of excited molecular systems, Fluorescence and phosphorescence, Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, Fluorescence quenching.

Unit II: Electrochemistry **[12 hrs]**

Electrochemical cells with and without transference, Determination of activity coefficient of an electrolyte by emf method, Acid and alkaline storage battries.

Electrochemistry of solutions: Debye-Hückel and Onsager treatment for activity coefficients and equivalent conductance of an electrolyte, Ion-pair formation and Bjerrum model, Experimental verification of Debye- Hückel model, Structure of electrified interfaces, Guoy-Chapman and Stern models.

Unit III: Colloids and Macromolecules **[12 hrs]**

Small particles/Large molecules, Mass range and Average mass, Surface tension, capillarity, Surface tension of solutions, surfactants and micelles, Critical micelle concentration, structure of surface films, Colloidal sols-particle size distribution, Methods of determination of molecular weights, Osmometry, Solution viscosity, methods based open diffusion coefficient and light scattering.

Mechanism of polymerization, Degree of polymerization, Kinetics of free radical and Condensation polymerization.

Unit IV: Microwave Spectroscopy **[12 hrs]**

Rotation of molecule, Rotational spectra of Diatomic molecule, polyatomic molecule, Technique and Instrumentation, Calculation of moment of inertia of simple molecules, Doppler shift, Stark effect and calculation of dipole moment. Microwave heating.

Unit V: Infra-Red Spectroscopy [12 hrs]

Vibrating Diatomic Molecule, Simple Harmonic Oscillator, Anharmonic Oscillator, Diatomic Vibrating Rotator, Breakdown of Born-Oppenheimer Approximation, Vibration of Polyatomic Molecules, Skeletal vibrations, and finger printing, Group frequencies, Calculations of bond length and force constant of simple molecules.

Books for References:

1. Physical Chemistry, P. W. Atkins, Oxford University Press, 2002
2. Physical Chemistry, G. M. Barrow, Tata-McGraw Hill, 2003.
3. Physical Chemistry, G. K. Vemulapalli, Prantice-Hall of India, 1997.
4. Physical Chemistry, W. J. Moore, Prantice-Hall of India, 1984.
5. Modern Electrochemistry, Vol I and II, J. O. M. Bockris and A. K. N. Reddi, Plenum, 1998.
6. Polymer Chemistry, F. W. Billmeyer Jr., John-Wiley and sons 1971.
7. Polymer Chemistry of Macromolecules, D. D. Deshpande, Vishal Publications, 1984.
8. Fundamentals of Molecular Spectroscopy, C. N. Banwell, E. M. MacCash, fourth Edition, McGraw Hill.
9. Magnetic Susceptibility- L. N. Mulay.
10. Molecular Structure and Molecular Spectra by G. Herzberg, Van Nostrand.
11. Molecular Spectroscopy by G. M. Barrow.

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CH-204: Basic Concepts in Instrumentation and Analysis

Total Marks-100 **[60 hrs]**

Unit 1. Statistical Analysis: **[12 hrs]**

Error, Precision, Average and Mean deviation, Q-test, Student T test, Varian ratio

Unit 2. Basic Analytical Terms: **[12 hrs]**

Volumetric and Gravimetric analysis, Titration, Types of titration viz. acid-base, redox, iodometric, iodimetric and complexometric titrations, Types of indicators, Selection of indicator, Aquametry (Karl-Fisher titration)

Unit 3. A) Chromatographic Analysis: Principle, brief Theory and Applications of [12 hrs]

Column Chromatography, HPLC, TLC, HPTLC, GC, GCMS, LCMS, Electrophoresis

B) Spectroscopy: Principles, Instrumentation and Applications of

UV- Visible Spectroscopy, IR Spectroscopy, Atomic (absorption and emission) Spectroscopy, NMR (^{1}H and ^{13}C) Spectrometry, Mass Spectrometry.

Unit 4. A) Principles, brief Theory and Applications of **[12 hrs]**

X- Ray Fluorescence, X- Ray Diffraction and Neutron Diffraction Spectrometry

B) Thermal Analysis: Principle, Theory and Applications of

Differential Thermal Analysis, Thermogravimetric Analysis, Differential Scanning Calorimetry

Unit 5. A) Principles, Techniques and Applications of **[12 hrs]**

Conductometry, pH and Potentiometry, Polarography, Fluorometry, Flame photometry, Turbidimetry.

B) Morphological Analysis: Principle, brief Theory and Applications of

Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy

References:

1. Instrumental Methods of Analysis- Willard Merrit and Settle.
2. Instrumental Methods and Chemical Analysis- G. R. Chattwal and S. Anand
3. Essential of Nuclear Chemistry- H. J. Arnikar.
4. Vogel's Textbook of Practical Organic Chemistry – Furniss B. S., Hannaford A. J., Smith P. W. G. and Tatchell A. R., 5th edn., Pearson education Ltd., New Delhi, 2004.
5. A Txtbook on Experiments and Calculations in Engineering Chemistry- Dara S. S., S. Chand & Company Ltd., New Delhi, 2003.
6. Advanced Practical Organic Chemistry- Vishnoi N. K., Vikas Publishing House Private Ltd., New Delhi, 2005.
7. Laboratory Manual of Organic Chemistry- Bansal R. K., New Age International 7 Publishers, New Delhi, 2009.
8. Application of Absorption Spectroscopy of Organic Compounds- J. R. Dyer –

Prentice Hall
9. Spectroscopic Methods in Organic Chemistry – D .H. Williams ad I FlemmingMcgraw Hill, 4th Ed., (1989)
10. Organic Spectroscopy- P. S. Kalsi
11. Instrumental Methods of Analysis – Chattawal and Anand

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CH-001: Laboratory Course in Inorganic Chemistry.

[Total Marks-100]

1. Analysis of ore (Any one)

i) Pyrolusite ore - Estimation of silica gravimetrically and Manganese volumetrically.

ii) Chromite ore – Estimation of Iron gravimetrically and Chromium volumetrically

2. Analysis of Alloy

Solder alloy – Estimation of Tin gravimetrically and Lead volumetrically

3. Instrumental method of Analysis

A) Photometric Analysis - To study complex formation between Fe (III) and salicylic acid and find the formula and stability constant of the complex.

B) Simultaneous determination of Cr^{+2} and Cu^{+2}

C) To determine the strength of given mixture of carbonate and bicarbonate in the given mixture by pH metric method

D) Potentiometric determination of stability constant.

E) To determine the amount of copper present in given solution by iodometric method potentiometrically.

4. Preparation and purity determination (Any two)

i) Potassium trioxalato chromate (III). ii) Tris (acetylacetanato) Iron (III). iii) Bis (ethylene diamine) copper (II) sulphate.

5. Drug Analysis: Determination of iron from given drug sample.

6. Characterization of soil and water.

7. Column Chromatography: Ion exchange capacity of resine by Co and Ni.

8. Table work

i. Data Analysis, error analysis, least squares method,. Plot of Born Maeyer to determine 1:1 type molecule (internuclear separation). Characterization of metal ligand bonding using IR spectroscopy.

ii. Visualizing frontier MO's

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CH-002: Laboratory Course in Organic Chemistry

[Total Marks-100]

1. Techniques: (At least Two Practical of Each Technique)

Crystallization, Sublimation, Distillation, Steam Distillation, Vacuum Distillation, Column Chromatography, Thin Layer Chromatography.

2. Preparation of Derivatives: (Each Derivative of two Compounds)

Oxime, 2, 4-DNP, Acetyl, Benzoyl, Semicarbazone, Anilide, Amide, Aryloxyacetic acid.

3. Preparations: Single Stage (Any 12)

i) Cyclohexanone to Adipic acid
ii) Benzophenone to Benzhydral
iii) Anthracene to Anthraquinone
iv) Chlorobenzene to 2,4-Dinitrochlorobenzene
v) 2,4-Dinitrochlorobenzene to 2,4-Dinitrophenol
vi) Acetoacetic ester to 1-Phenyl-3-methyl-5 pyrazolone
vii) Benzaldehyde to Cinnamic acid
viii) 4-Chlorobenzaldehyde to 4-Chlorobenzoic acid + 4-Chlorobenzyl alcohol
ix) Benzene to β-Benzoyl propionic acid
x) Benzaldehyde to Dibenzylidene acetone
xi) p-Aminobenzoic acid to p-Chlorobenzoic acid
xii) N,N-Dimethylaniline to 4-Formyl-N, N-dimethyl aniline
xiii) Benzophenone to Benzpinacol
xiv) p-Nitrotoluene to p-Nitrobenzoic acid
xv) Anisole to 2,4-Dinitroanisole
xvi) Phthalic anhydride to phthalimide
xvii) Phthalimide to Anthranilic acid
xviii) Acetanilide to p-Bromoacetanide
xix) p-Bromoacetanide to p-Bromoaniline
xx) m-Dinitrobenzene to m-Nitroaniline

4. Use of Computer - Chem Draw-Sketch, ISI – Draw: (Max. 24 Hours for each batch)

Draw the structure of simple aliphatic, aromatic, heterocyclic organic compounds with substituents. Get the correct IUPAC name.

5. **Interpretation of UV, FT-IR &^{1}H-NMR spectrum of above synthesized compounds.** (10 Compounds)

References:

Vogel's, Practical Organic chemistry.

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CH-003: Laboratory Course in Physical Chemistry

[Total Marks-100]

Students are expected to perform atleast 15 experiments of 3-4 hours duration each.

Experiments are based on Potentiometry, Calorimetry, Phase rule, Conductometry, Kinetics, Nuclear chemistry, Colorometry (spectrophotometry), Refractive index, Adsorption, Densiometry and Viscosity.

1. Determination of molecular weight of high polymer by viscometry.
2. Determination of sparingly soluble salts solubility in water by conductometrically.
3. Determination of hydrolysis constant of sodium acetate conductometrically (or NH_4Cl).
4. To determine the equivalent conductance of weak electrolyte at infinite dilution using Kohlrausch law.
5. To test the validity of Beer-Lambart's law and hence the unknown concentration in a solution.
6. To determine dissociation constant of an indicator (phenolphthalein) coluromitrically.
7. Determination of molecular radius of molecule (organic liquids) using refractometer.
8. Determination of partial molar volume of ethanol and of water in aqueous solutions at room temperature.
9. Study of the kinetics of zero order reaction.
10. Study of the kinetics between $K_2S_2O_8$ and KI using differential method.
11. To determine the integral heat of solution of a salt using Dewar's Flask as calorimeter.
12. Determination of heat of transition./OR Determination of transition temperature of sodium sulphatedecahydrate by thermometric method.
13. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuirs adsorption isotherms.
14. Construction of phase diagram for three component system.
15. Determination of pH values of various mixtures of sodium acetate and acetic acid in aqueous solutions and hence dissociation constant of an acid.
16. Study of redox potential of Fe^{2+} - Fe^{3+} system potentiometrically.

17. Study of dissociation constant of monobasic acid potentiometrically (or dibasic acid).
18. Determination of molecular weight of organic compounds using Freezing-point technique.

Reference Books:

1. Findlays Practical Chemistry, Revised by J. A. Kitcher.
2. Text Book of Quantitative Inorganic Analysis, by A. I. Vogel.
3. Experimental Physical Chemistry, by R. C. Das and Behera.
4. Advanced Practical Physical Chemistry, by J. B. Yadav, Goel Publishing.
5. Experimental Physical Chemistry, by F. Daniels and J. Williams.
6. Advanced Physical Chemistry Experiments, by Shoemaker and Gerland.
7. Instrumental Methods of Analysis, by Willard, Merrit Dean and Settle

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