

Rs. 5/-*

NORTH MAHARASHTRA UNIVERSITY

JALGAON - 425 001

Syllabus

FOR M.Sc. part I (Agrochemicals)

with effect from July 1997

DEPARTMENT OF AGROCHEMICALS

SCHOOL OF CHEMICAL SCIENCES

**SYLLABUS
FOR
M.Sc.(AGROCHEMICALS) w.e.f. JUNE 1997**

Eligibility : B.Sc. Chemistry as principle subject.

Course Structure for First Year

Semester - I

Sub.Code: Title

ACH 101 : Inorganic Chemistry - I
ACH 102 : Physical Chemistry - I
ACH 103 : Organic Chemistry - I
ACH 104 : Analytical Methods & Use of Computers in Chemistry
ACH 115 : Laboratory Course - I

Semester - II

Sub.Code: Title

ACH 201 : Inorganic Chemistry - II
ACH 202 : Physical Chemistry - II
ACH 203 : Organic Chemistry - II
ACH 204 : Introduction to Agrochemicals
ACH 215 : Laboratory Course - II

Note : The examination of laboratory courses ACH-115 & ACH-215 will be conducted together at the end of the year.

Course Structure for Second Year

Semester - III

Sub.Code: Title

ACH 301 : Pest & Pest Control Practices
ACH 302 : Pesticide Synthesis - I
ACH 303 : Fertilizers
ACH 304 : Pesticide Biochemistry, Toxicology & Residue Analysis
ACH 315 : Laboratory Course - III

Semester - IV

Sub.Code: Title

ACH 401 : Pesticides Formulations
ACH 402 : Pesticides Synthesis - II
ACH 403 : Herbicides & Plant Growth Regulators.
ACH 414 : Project
ACH 415 : Laboratory Course - IV

Note : The examination of laboratory courses ACH-315 & ACH-415 will be conducted together at the end of the year.

Educational Tour : Educational tour aiming at giving practical exposure to students is proposed once in two years

In-plant Training: Students are expected to undergo one month practical training (at their own cost) in relevant industries. The said training is proposed after III / IV semester.

M.Sc. (Agrochemicals)

Semester - I

ACH 101 : Inorganic Chemistry - I

(Marks - 60)

1. Chemistry of non transition elements :- Periodicity & general discussion on properties of non transition elements, special features of individual elements, synthesis, properties & their halides & oxides. Polymorphism of carbon, Phosphorus & sulphur. Synthesis, properties & structures of boranes, carboranes, borazines, silicates, carbides, silicones, phosphazenes sulphur-nitrogen compounds, peroxo compounds of boron, carbon & sulphur, oxyacids of nitrogen phosphorus, sulphur & halogens, interhalogen compounds, pseudohalides and noble gas compounds.
2. Chemistry of lanthanides & actinides - Spectral & magnetic properties, uses of lanthanide compounds.
3. Molecular symmetry & group theory - Molecular symmetry, Representation symmetry operations, definition of groups, basic representation - Derivation of character tables for C_{2V} , C_{3V} & C_{4V} point groups.
4. Solids : Dislocations in solid; Schottky and Frenkel defects. Electrical properties. Insulators and semiconductors, band theory of solids, solid-state reactions.

Recommended Books

1. Modern aspects of Inorganic Chemistry - H.J. Emeleus, A.G. Sharp.
2. Inorganic Chemistry - D.F. Shriver, P.W. Atkins, C.H. Langford.
3. Inorganic Chemistry - I.S. Buttler & S.F. Harrod.
4. Inorganic Chemistry Principles of structure and reactivity - J.E. Huheey (Harper and Row pub. London 1972)
5. Advanced Inorganic Chemistry - F.A. Cotton & G. Wilkinson.
6. Chemical Application of Group Theory - F.A. Cotton.
7. Symmetry in Chemistry - H.H. Jaffe & M. Orchin (Wiley Eastern Pvt. Ltd. New Delhi 1971)
8. Group theory in chemistry & physics - Arora & Narang
9. Solid State Chemistry - C.N.R. Rao
10. Solid State Chemistry - N.B. Hannay
11. Introduction to Solids - L.H. Azaroff (T.M.H.)

ACH 102 : Physical Chemistry - I

(Marks - 60)

1. Thermodynamics: First law of thermodynamics, relation between C_p and C_v , enthalpies of physical & chemical changes, temperature dependence of enthalpies, second law of thermodynamics entropy, Gibbs-Helmholtz equation. Third Law of thermodynamics & Calculations of Energy.
2. Chemical Equilibrium: Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation. Equilibrium constant and its temperature-dependence, phase diagram of one and two component system. phase rule.
3. Ideal and Non Ideal Solution: Excess functions; activities, concept of hydration number, activities in electrolytic solution, mean ionic activity coefficient, Debye-Huckel treatment of dilute electrolyte solution.

4. Equilibrium in Electrochemical cells: Cell reaction; Nerst equation, application of cell EMF measurement.
5. Surface phenomena : Surface tension, adsorption solids, electrical phenomena at interfaces including electron kinetics, micelles and reverse micelles; solubilization micro-emulsions, application of photo electron, ESCA and Auger Spectroscopy to the study of surfaces.

Recommended Books

1. Principles of Physical Chemistry - S.H. Maron & C.F. Prutton
4. Fundamentals of Physical Chemistry - S.H. Maron & Lando
2. Physical Chemistry - P.W. Atkins. EL/OS 4th Ed.
3. Physical Chemistry - G.M. Barrow
5. Physical Chemistry - I.N. Levine, McGraw Hill International Edition.

ACH : 103 Organic Chemistry - I

(Marks - 60)

1. Organic reaction mechanism : Definition & types; Energetics, kinetics, labeling & kinetic isotope effects, Hammett equation (Sigma-Rho relationship), non-classical carbonium ions, covalent bond fission - homo- & hetero fissions, intermediates & stability - carbonium ions, carbanions, free radicals, carbenes, nitrenes, arynes.

2. Common organic reactions & mechanisms : Nucleophilic substitution in sat. aliphatic compounds, electrophilic & nucleophilic substitution in aromatic compounds; determination of organic reaction mechanism (kinetic & non-kinetic methods)

Familiar name reactions : Adol, Perking, Stobbe, Dieckmann condensations, Hofmann, Schmidt, Lossen, Curtius, Beckman & Fries rearrangements, Reimer-Tiemann, Reformatsky & Grignard reactions, Diels-Alder reactions, Claisen rearrangement; Friedel-Craft reaction, Wittig reaction & Robinson annulation, Routine functional group transformations & interconversion of simple functionalities. Hydroboration, Oppenauer oxidation, Clemmensen, Wolf-Kishner, Meerwein-Ponndorf-Verley and Birch reductions.

Selective organic name reactions : Favorskii reaction, Stork examine reaction, Michael addition, Mannich reactions, Sharpless asymmetric epoxidation, Ene reaction, Barton reaction, Hofmann-Löffler-Freytag reaction, Shapiro reaction, Baeyer-villiger reaction, Chichibabin reaction.

3. Aromaticity : Huckel's rule & concept of aromaticity, (n) annulenes & heteroannulenes, fullerenes (C₆₀).

4. Stereochemistry : Concept of chirality - Recognition of symmetry elements and chiral structures, R-S nomenclature, diastereoisomerism in acyclic systems, E-Z isomerisms, conformational analysis of simple cyclic (chair & boat cyclohexanes) & acyclic systems. Interconversion of Fischer, Newman and Sawhorse projection.

Stereochemistry & conformational analysis : Newer methods of asymmetric synthesis (including enzymatic & catalytic nexus)

5. Organometallic Compounds : Transition of organometallic Compounds of Palladium, rhodium, Cobalt, iron, Nickel in organic synthesis.

Recommended Books

1. Organic Chemistry by Morrison Boyd
2. Stereochemistry of Carbon Compounds by E.L. Eliel.
3. Some Modern Methods of Organic Synthesis by W. Carruthers.
4. Guide book to mechanism in Organic Chemistry by Peter Sikes.
5. Principles of Organometallic Chemistry by F. Powell
6. Principles of Organometallic Synthesis by R.D. C. Norman
7. Model Synthesis reactions - Herbert O. House
8. Organometallics in Organic Synthesis by Swan & Black.

ACH 104 : Analytical Methods & Use of Computers in Chemistry
(Marks - 60)

Section-I

1. Advance Chromatography Techniques Gas Chromatography - Gas Chromatographs, Detectors, Optimization of Experimental Conditions, Gas-Solid Chromatography, High Performance Liquid Chromatography Methods - Adsorption Chromatography, Liquid-Liquid Partition Chromatography, Ion-Exchange HPLC, Exclusion Chromatography.
2. IR Spectroscopy - Molecular vibrations, Factor influencing vibrational frequencies, instrumentation, IR sources, optical system, detectors process analysis, sampling techniques, interpretation of spectra - Quantitative analysis, ATR & MIR reflectance, FTIR spectroscopy.
3. UV & Visible spectroscopy - Theory of electronic spectroscopy, instrumentation & sampling applications, visual spectroscopy, visual calorimetry, Photometric filter photometry, spectrophotometry, simultaneous spectrophotometry, differential spectrophotometry, photometric titrations.
4. NMR Spectroscopy - Proton NMR spectroscopy, The NMR phenomenon, theory. Chemical shifts and its measurement, factors influencing chemical shifts, sample handling & instrumentation, solvent used in NMR, spin spin coupling, spin spin splitting, Bond multiplicity, applications, derivative curves of values, Hyperfine splitting. Introduction to ^{13}C NMR.
5. Mass Spectrometer - Components of Mass Spectrometers, Resolution, Mass Spectrometers.
6. Interpretation of spectra obtained from various techniques.

Recommended Books

- 1) Instrumental Methods of Chemical Analysis - Willard, Merit, Dean
- 2) Application of Absorption Spectroscopy of Organic Compounds - John R. Dyer, Prentice Hall of India
- 3) Spectroscopy Methods of Organic Chemistry - Williams Fleming
- 4) Organic Spectroscopy - William Kemp
- 5) Mass Spectroscopy - by K.B. Das
- 6) Instrumental Methods of Analysis - Chatwal & Anand
- 7) Basic concepts in Analytical Chemistry - S.M. Khopkar,

Section-II

1. Introduction to Computers :

Hardware components; CPU, Computer memory, I/O devices; information storage, software components; computer programs; stored program concept; operating system; DOS and its use. Algorithm program flowcharts and pseudo-code.

2. Fortran-77 :

Character set. Identifiers. Data types. Arithmetic expressions and operations. Library functions. Input/Output functions. Formatted input and output statements. Control structures (Sequence, relational operations and expressions simple and nested blocks) Loop control (Do WHILE AND REPEAT UNTIL, DO..... CONTINUE and nested loops). Function and subroutine subprograms. Shared variables and constants. One dimensional and multidimensional arrays character data manipulation. File and data manipulation (OPEN, CLOSE, INQUIRE, REWIND, BACKSPACE, ENDFILE)

Programming examples to handle the following numerical methods in chemistry should be done; such as least squared fit, solution of simultaneous equation, polynomial equation, polynomial equation fitting, matrix inversion and diagonalisation and numerical differentiation and integration. Splines and data smoothing. Elements of parallel processing and its use in chemistry.

3. Use of software packages in Chemistry:

a) Spreadsheet Application Least squares fit, kinetics, potentiometric titrations and end point location. Fitting curves and plotting functions.

b) Data-base applications in Chemistry

4. Writing FORTRAN -77 programs for the following problems

1. Finding largest/smallest of the given numbers using array & with out array
2. Arranging given numbers in ascending and descending order using array & with out array
3. Matrix multiplication.
4. Finding GCD of given numbers.
5. Finding molecular weight of given compound.
6. Finding molecular formula from elemental analysis
7. Calculation of pH from given concentration.
8. Conversion of temperature from oF to oC
9. Finding rate constant of reaction from given data
10. Finding out strength of acid/base from titration reading.
11. pH of a weak acid bases titration (with graphics)
12. Potentiometric end point determination (with graphics)

Recommended Books

1. R.N. Reddy & C.A. Ziegler : Fortran-77 (JAICO Book, 1989).
2. P.C. Jurs, T.L. Isenhour & C.L. Wilkens - BASIC programming for Chemists (J.Wiley , 1987).
3. K. Ebert, H. Ederer, T.L. Isenhour - Computer Applications in Chemistry.
4. G.I. Duchi - Spreadsheet Applications for Scientists & Engineers (Addison Wesley 1988).
5. G.Beech - FORTRAN IV in Chemistry - An introduction to Computer assisted methods (J.Wiley & Sons)
6. P.S. Grover - Programming & Computing with Fortran-77/90 (Allied pub.1992).
7. V. Rajaram - Elements of Parallel Processing (Printice Hall 1990).

Minimum 12 experiments pertaining to the course will be conducted

Inorganic Chemistry

1. Analysis of dolomite w.r.t. - Magnesium/ Calcium
2. Analysis of Cement - Silica/ Calcium/ Magnesium
3. Analysis of alloy - solder alloy - estimation of tin & lead
4. Analysis of plaster of paris - calcium
5. Analysis of pigment - Estimation of potassium (volumetrically)
6. Estimation of uranium in mineral by colorimetry.
7. Estimation of percentage of sodium carbonate in commercial washing soda.
8. Determination of sulphate / chloride by turbidimetry
9. Thermogravimetric studies on calcium oxalate.
10. Thermochemistry -determination of lattice energy of binary salts by heat of dissolution.
11. Synthesis of potassium trioxalato aluminate & estimation of metal ion.

Physical Chemistry

1. Determination of Na, K, Li & Ca by Flame photometry.
2. Determination of % composition of A & B from a given mixture AB by Refractometrically.
3. Determine the molar refraction of Methyl acetate, Ethyl acetate, n-Hexane, Carbon tetra chloride and to calculate atomic refractions of C, H & Cl atoms.
4. Determination of calorific value of given sample by Bomb Calorimeter.
5. Determination of dissolved oxygen present in a waste water sample.
6. Determine magnetic susceptibility by Guoy method.
7. Determination of exact normality of acid from a mixture of acids by pH metry.
8. To verify Ostwald's dilution law.

Organic Chemistry

- a) Mixture Separation - Separation of at least two three component mixture, which involves separation of low boiling compounds water soluble compounds, amines, phenols, acids, neutral compounds, nitrophenols, aminophenol & also compounds containing other elements & functional group.
- b) Two stage preparations of two compounds.
Determination of n_f values of n_D of each compound prepared.

Recommended Books

1. A Textbook of Practical Organic Chemistry, A - I Vogel
2. Practical Organic Chemistry - Raj K. Bansal
3. Systematic Experimental Physical Chemistry - Rajbhoj & Chondhekar, A Lali Publications.
4. Frindley's Practical Physical Chemistry - B.P. Levit , Longman Publications

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Semester - II

ACH 201 : Inorganic Chemistry - II

(Marks - 60)

1. Chemistry of transition elements - Coordination chemistry of transition metal ions, stability constants of complexes their determination, stabilisation of usual oxidation states stereochemistry of coordination compounds, Ligand field theory, splitting of d-orbitals in low symmetry environments, Jahn Teller effect, interpretation of electronic spectra including charge transfer spectra, spectrochemical series, nephelaugetic series, Magnetism - dia-, para-, ferro- & antiferromagnetism, quenching or orbital angular momentum spin orbit coupling. Inorganic reaction mechanism - Substitution reactions trans & electron transfer reactions, photochemical reactions of chromium, ruthenium complexes. Fluxional molecules/iso & heteropoly acids, metal clusters spin cross-over in coordination compounds.
2. Organometallic Chemistry & Catalysis - Structure & bonding Organometallic compounds in organic synthesis & in homogeneous catalytic reactions like-- hydrogenation, Hydroformylation, isomerisation & polymerization Pi-acid metal complexes, activation of small molecules by coordination.
3. Bioinorganic Chemistry - Inorganic elements in biological system, Alkali & Alkaline earth metal ions - role & molecular mechanism of ion transport across membranes, ionophores, chlorophyll in photosynthesis, Biological nitrogen fixation, Metal complexes as oxygen carriers - Haemoglobin, Myoglobin, Hemerythrin, Hemocyanin, Electron Transfer Proteins - Cytochromes, & Ferredoxins.

Recommended Books

1. Inorganic Chemistry - D.E. Shriver, P.W. Atkins, C.H. Langford.
2. Inorganic Chemistry, Principles & Applications - I.S. Buttler & S.F. Harrod.
3. Principles of Organometallic Chemistry - P. Powell
4. Inorganic Chemistry of Biological Processes - M.N. Hughes (2nd Ed., Wiley)
5. Inorganic Chemistry - A.G. Sharpe (ELBS Ed., 1984)
6. Basic Inorganic Chemistry - F.A. Cotton & G. Wilkinson
7. Advanced Inorganic Chemistry - F.A. Cotton & G. Wilkinson
8. Introduction to ligand fields - B.N. Figgis
9. Coordination Compounds - S.F.A. Kettle
10. Coordination Chemistry - F. Basolo & R. Johnson
11. Organotransition Metal Chem. Applications to Organic Synthesis - S.B. Devis.
12. Reaction Mechanism in Inorganic & Organometallic Systems - R.B. Jordan.
13. Magnetochemistry - R.L. Carlin
14. Magnetic Susceptibility - L.N. Mulev

ACH 202 : Physical Chemistry - II

(Marks - 60)

Statistical Thermodynamics :

1. Thermodynamic probability of entropy; Maxwell - Boltzmann distribution of velocities; average, most probable and root-mean-square velocities. Maxwell - Boltzmann, Bose - Einstein and Fermi Dirac Statistics. Partition function; rotational, translational, vibrational and electronic partition functions for

diatomic molecules calculations of thermodynamic functions and equilibrium constant. Theories of specific heat for solids.

2. Reaction Kinetics: Methods of determining rate laws, mechanisms of photochemical, chain and oscillatory reactions, collision theory of reaction rates, Steric factor, treatment of unimolecular reactions, Theory of absolute reaction rates, comparison of results with Arrhenius and Arrhenius equations. Ionic reactions; salt effect. Homogeneous catalysis and Michaelis - Menten Kinetics, heterogeneous catalysis.

3. Fast Reactions : Study of kinetics by stop-flow technique, relaxation method, flash photolysis and magnetic resonance method.

4. Nuclear Chemistry : Radioactive decay and equilibrium. Nuclear reaction; G value, cross-sections, types of reactions. Chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Radioactive techniques, tracer techniques, neutron activation analysis, counting techniques, such as G.M., ionization and proportional counters.

Recommended Books

1. Physical Chemistry - P.W. Atkins, Oxford University Press ELBS Edition London.
2. Essential of Nuclear Chemistry - H.J. Arnikar, Wiley Eastern
3. Basic Chemical Kinetics - G.L. Agrawal, Tata McGraw Hill Publishing Company, New Delhi.
4. Kinetics & Mechanism - A.A. Frost and R.G. Pearson John Wiley & Sons.
5. Chemical Kinetics - Laidler, Tata McGraw Hill Publishing Company, New Delhi.
6. Statistical Thermodynamics - M.C. Gupta, Wiley Eastern.

ACH 203 : Organic Chemistry -II

(Marks - 60)

1. Heterocyclic chemistry : Synthesis and reactivity of Furan, Thiophene, Pyrrole, Pyridine, Quinoline, Isoquinoline and Indole, Skraup synthesis, Fisher Indole synthesis.
2. Pericyclic reactions: Selection rules and stereo chemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, Sommelet, Hauser, Cope and Claisen rearrangement.
3. Reagent in organic synthesis : Use of the following reagents in organic synthesis and functional group transformations, complex metal hydrides, Gilman's reagent, Lithium dimethyl cuprate, Lithium diisopropylamide, Dicyclohexyl carbodiimide, 1-3 dithiane, Trimethylsilyliodide, Tri-n-butyl-tinhydride, Woodward and Prevost hydroxylation, Osmium tetroxide, DDQ, Selenium dioxide, Phase transfer catalyst, Crown ethers and Merrifield resins, Peterson's synthesis, Wilkinson's catalyst, Baker yeast
4. Chemistry of natural products, Familiarity with methods of structural elucidation and biosynthesis of alkaloids, terpenoids, steroids, carbohydrates and proteins.
5. Bioorganic chemistry : Elementary structure and function of biopolymers such as proteins and nucleic acid.
6. Photochemistry : Cis trans isomerization, Paterno-Buchi reaction, Norrish type I & II reactions, photoreduction of ketones di-pimethane rearrangement, photochemistry of arenes.

10. Plant growth regulators - Definition, uses, examples and Chemistry IAA and NAA.

A brief Chemistry of 2,4-D, 2,4,5-T.

9. Herbicides - Definition, Classification, Examples. Physical and Chemical Control of Weeds.

8. Fungicides - Definition, Classification examples of each type. Characteristics of good fungicides. A brief Chemistry of inorganic copper, sulphur and mercury compounds.

7. Pesticidal Formulations - necessity and types.

Site of action. A brief Chemistry of Lead Arsenate, Cryolite, BHC, DDT, Thimet, Metasystox, P-dichlorobenzene, Hydrogen Cyanide, Nicotine.

6. Classification of insecticide according to mode of action, fruit borer.

5. Major insect pest of Agricultural Importance - Life cycle, Marks of identification, Nature of damage and control measures for Pests of Sorghum, Red Cotton Bug, Mango Stem Borer, Ber

4. Pesticide Toxicity - LD50 & LC50 values, Acute, Chronic, Oral, Dermal, Inhalation toxicity, Pesticide Hazards, Mode of entry, Antidotes, Tips of safety.

3. Methods of pest control - Objective & Discussion of Natural [Climatic, Topographic, Natural Enemies] and Applied Mechanical /Physical, Cultural, Biological, Legal and Chemical] control, Genetic,Regulatory & Integrated Pest Control.

2. Introduction and classification of pests. A brief discussion of each type.

1) Definition and general classification of agrochemicals, according to the target species. Examples and structures of each type.

ACH : 204 Introduction to Agrochemicals (Marks - 60)

1. Organic Chemistry by Morrison Boyd
2. Some Modern Methods of Organic Synthesis by W. Carruthers.
3. Spectroscopic methods in Organic Synthesis by Williams.
4. Fleming
5. Spectroscopic identification of Organic Compounds by G.R. Silverstein.
6. Absorption Spectroscopy of Organic Molecules by Parikh.
7. Mass Spectroscopy by K.S. Das & James.
8. Principles of Modern Heterocyclic Chemistry by Raquette.
9. Conservation of Orbital Symmetry by R.B. Woodward & R. Hoffmann.
10. Modern Molecular Photochemistry by Nicholas J. Turro.

Recommended Books

7. Spectroscopy : Applications of UV-VIS, IR, NMR, and Mass Spectroscopy for structural elucidation of compounds.

Recommended Books

1. Insect pest management -David Dent
2. Insect pest and their control - J.W.Evans.
3. Agricultural insect pest of the tropics and their control
D.S.Hill
4. Agricultural pests - Biology and control measures - B.M.
Deoray and T.B. Nikam.
5. Chemistry of Insecticides and Fungicides - U.S. Shree Ramulu
6. Fungicides in Plant Disease Control - Y.L. Nene, P.N.
Thapliyal.
7. Fundamentals of Plant Pest Control - D.A. Roberts
8. Chemistry of Herbicides - U.S. Shree Ramulu.
9. All about weeded control - S. Subramanian.
10. Molecular & cell Biochemistry Cell Biology - Smith & Wood.
11. Principals & procedures of Plant Protection - Chattopadhyay

ACH 215 : Laboratory Course - II

(Marks - 60)

Minimum 12 experiments pertaining to the course will be conducted

Inorganic Chemistry

1. Analysis of Ilmenite ore - estimation of silica, iron, titanium.
2. Analysis of Bauxite ore - estimation of silica, aluminium, Iron.
3. Analysis of steel - estimation of iron, nickel & chromium.
4. Analysis of pigment - estimation of chromium
5. Preparation of trioxalato ferrate(III) trihydrate
6. Preparation of Zinc ferrite
7. Preparation of trans bis ethylene diamine cobalt chloride
8. Kinetics of aequation of trans bis ethylene diamine cobalt chloride
9. Kinetics of aequation of tris(1,10-phenanthroline) iron (II) in acid solution by spectrophotometry.
10. Magnetochemistry - Determination of magnetic susceptibility of given complexes.
11. Colorimetric analysis of mixtures of Co(II) & Ni(II)
12. Determination of number of water molecules from the given hydrated compounds.
13. Determination of stability constant of metal complexes by Bjerrum's (potentiometric) method or spectrophotometric method.
14. Determination of metal, ligand ratio by Jobb's method.
15. Analysis of IR spectrum of transition metal complexes [Bis acetyl acetonato copper (II)].

Physical Chemistry

1. Determination of Flash and Fire Point of the given lubricating oil.
2. Determination of capacity of ion exchange resin.
3. Determination of chemical oxygen demand of given waste water sample.
4. Determination of Biochemical oxygen demand of waste water sample.
5. Determination of moisture content by karl fischer titration.
6. Determination of turbidity of waste water by using Nephelometry.

7. Analysis of flue gas by orsat gas analyser.
8. To determine radius of a molecule by viscometry.
9. To determine formal redox potential of Fe ions.
10. To determine basicity & pKa value of an organic acid potentiometrically.

Organic Chemistry

- A) Estimation of number of functional groups in -
 - a) amines
 - b) acetylsters
 - c) aldehydes
 - d) carboxylic acids
- B) Use of synthetic reagents in organic synthesis
 - a) Sodium borohydride
 - b) N-Bromo succinamide
 - c) Unhydrous Aluminium Chloride
 - d) Poly phosphoric acid

Recommended Books

1. Practical Organic Chemistry - F.G.Mann, B.C.Saunders
2. Textbook of Practical Organic Chemistry A - I Vogel
3. Practical Organic Chemistry - Raj K. Bansal.

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