

7. POLYMER PROCESSING.

(10)

Introduction, plastics, elastomerics, fibres, compounding processing techniques- calendering, Diecasting, film casting, compressing, moulding, injection moulding. Blow moulding, thermoforming, foaming, reinforcement, fibre spinning.

Ref : 1, Pages 447-454, 456-460, 465 to 475,

REFERENCES : 1. Polymer science by Gowarikar.

2. Text book of polymer science by Billmeyer (3rd Ed.ⁿ)

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PAPER X-B (II) POLYMER CHEMISTRY (PRACTICAL)

- (1) One stage synthesis of polymer :
 - (a) Phenol-Formaldehyde Resin.
 - (b) Urea-Formaldehyde Adhesive.
- (2) (a) Preparation of 6-10 Nylon or Polyamide by interfacial Polymerisation technique.
 (b) Determination of heat of polymerisation of acrylamide by adiabatic solution polymerisation.
- (3) Preparation of polyvinyl alcohol from polyvinyl acetate by polymer modification.
- (4) Preparation of a homopolymer, Plastic sulphur.
 OR
 Preparation of heteropolymer, Boron nitrite.
 OR
 Preparation of cyclic polymer of Dimethyl siloxane.
- (5) Determination of percent conversion of monomer to polymer of Acrylamide in presence of Redox initiator.
- (6) Purification and Identification of a polymer diacetone alcohol by determination of physical constants like B.P., Refractive Index and sp.gravity.
- (7) Determination of molecular weight of high polymer by viscosity measurement of any one of the following :-
 - (i) Cellulose acetate in acetone;
 - (ii) Crap rubber in benzene.
 - (iii) Polyvinyl alcohol in water.
 - (iv) Polystyrene in benzene or Xylene.
 - (v) Polymethyl methacrylate (Perspex) in chloroform.
- (8) End group analysis of any one of the following polymer by chemical method :
 - (i) Carboxyl Terminated Polybutadiene (CTPB)
 - (ii) Hydroxy Terminated Polybutadiene (HTPB)

- (iii) Carboxyl group in polyester.
- (iv) Amino group in polyamide.
- (9) Saponification of a polymer (Polyvinyl acetate)
- (10) Kinetic study of depolymerisation of diacetone alcohol using dilatometer.

REFERENCES :

1. Introductory polymer chemistry by G.S.Mishra Wiley Eastern Limited (1993)
2. Principles of polymer systems by Ferdinand Rodriguez Tata McGraw Hill Company Limited (1994).
3. Text book of polymer science by Fred W. Billmeyer John Wiley and sons (Second Edition, 1971).
4. Polymer science by V.R. Gowariker. Wiley Eastern Limited (1986)
5. Practical Inorganic Chemistry by Dr.G.Marr and Dr. B.W. Reckett. Van Nostrand Reinhold Company, London (1972)
6. Synthetic Inorganic Chemistry by William L.Jolly Prentice + Hall of India (Pvt) Limited.
7. Practical Physical Chemistry by Findley, Revised and edited by Kitchner. Longman Green and Company Limited (8th Edition. 1967)

Notes : Weightage for Theory and Practical parts will be equal. Theory part is to be completed by engaging 2 periods per week. Practical part is to be completed by engaging half of the experiments in first term and remaining in second term. Duration of each experiment will be 4 periods. For calculating workload of practicals 2 periods per week per batch will be considered.

Theory examination will be of 2 hours duration and practicals of 4 hours duration.

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PAPER X-C (OPTIONAL) (BIOCHEMISTRY)

Section : I (First Term)

I. Amino Acids and Proteins : (4)

Amino Acids : Structural features and their classification, use of Acid-Base properties of a.a. in the separation of a.a. by using paper electro-phoresis; Ion - exchange chromatography and amino acid analyzer-peptides-peptide bond formation and characteristic chemical reactions.

II. Proteins :

(12)

Classification of proteins according to its shape and its biological function, simple proteins, conjugated proteins separation of proteins by using methods like Dialysis, gel filtration chromatography, electrophoresis, Ion-exchange chromatography, methods to determine the a.a. sequence of a polypeptide chain, structure of the Insulin molecule definitions of (Primary, Secondary; Tertiary and Quaternary structure of protein).

Fibrous protein :- Configuration, conformation, alpha Keratin and its alpha helical structure, beta-keratins and its beta conformation.

Globular Protein :- Myoglobin X-ray analysis and its tertiary structure, Amino sequence which det. the tertiary structure-Forces stabilizing the tertiary structure, Quaternary structure of hemoglobin; collagen.

Ref. 2- Pages 95-104, 108-115, 121-141, 147-156, 169-173, 177-184.

III. Enzymes.

General properties of enzymes and their classification how do enzymes accelerate reactions, Effect of substrate concentration on enzyme catalyzed reactions., Michaelis-Menten Equation. Sucrose density gradient centrifugation; and preparative uses of enzymes-Glucose electrode and

Enzyme linked, Immunosorbent Assay or Elisa : Immobilized enzymes. Effect of temperature and PH. Enzyme Inhibitors- Irreversible, Reversible Inhibitors- Competitive Inhibition; Non competitive Inhibition-uncompetitive Inhibition.

Ref. 2-207 -215, 218, 220-225.

Ref. 3-115 -123, 128-130, 138-144, 147-156.

IV. Carbohydrates :

(8)

Classification-stereoisomerism- Optical isomerism- optical activity. Cynohydrin synthesis-structure of glucose, Structure of monosaccharides, Howorths-projection formula and Boat and chair forms of Pyranose ring, Properties of Monosaccharides-Muta-rotation, Enolization oxidation reduction,. Glycoside formation, Ester formation-aldol condensation, Structure of Disaccharides like Maltose; Cellobiose; Isomaltose, Lactose, Polysaccharides; Storage Polysaccharides Amylose, amylopectin and their structures.

Glycogen, structural Polysaccharides : Cellulose and its structure- Polysaccharides present in the cell wall; Glycoproteins :

Ref. 2 : Pages 277-289.

Ref. 3 : Pages 25-54.

V. Lipids : (6)

Fatty acids, structure of common fatty acids, Nomenclature of Fatty acids, Triacyl glycerols, waxes Phospholipides, sphingolipids, Glycolipids, terpenoids and sterols, Lipoproteins, Functions of lipids, Analysis of Lipids b. Gas liquid chromatography.

Polar lipids, Major components of the cell membrane. Fluid mosaic model of the cell membrane.

Ref. 3 : Pages 265-280.

VI. Vitamins and Coenzymes : (10)

Classification of vitamins, watersoluble and fatx soluble, structure, occurrence and biochemical functions of the following, Thiamine, Riboflavin, Nicotinamide, Nicotinic acid, Vitamin B-6, group, Lipolic acid, Biotin, Folic acid, Vitamin B-12, Panthothenic acid, Ascorbic acid (Vitamin C) Vitamin A, Vitamin D, Vitamin E and Vitamin K (Delete mechanisms.)

Ref. 2 : Pages 249-264.

Ref. 3 : Pages 165-208.

VII. Methods of Separation used in biochemical investigations :

Principle and application : (4)

- (1) Electrophoresis.
- (2) Ion Exchange Chromatography.
- (3) Gel filtration.
- (4) Ultra centrifugation.
- (5) Dialysis and Ultrafiltration.

Refer pages of Aminoacid, proteins, and Enzymes topics from this syllabus.

Ref.2: Pages 108-110, 127 to 129.

Ref.3: Relevant pages.

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SECTION: II

(Second Term)

(I) Metabolism and Biochemical Energetics : (8)

Definition of metabolism, free energy, Determination of ΔG , Energy rich compounds like pyrophosphate compounds; Acylphosphates, Enolic phosphates, Thiol Esters and Guanidium phosphates.

Ref. 3 : Pages 323-336.

(II) Glycolysis :

Carbohydrates as a source of Energy, Glycolysis and

alcoholic Fermentation, Various enzymetic Reactions involved during this process, production of ATP and efficiency of glycolysis.

Ref. 2 : Pages 397-414,

Ref. 3 : Pages 343-358.

(III) Pentose Phosphate Pathway and its Functions : (2)

Ref. 2 : Pages 456-459.

Ref. 3 : Pages 384-391.

(IV) Citric acid cycle : (4)

or Krebs cycle or TCA cycle.

Energetics of Glucose oxidation, oxidation of pyruvate to Acetyl CoA. The citric acid cycle, Important features of the TCA cycle.

Ref. 2 : Pages 435-449,

Ref. 3 : Pages 394-404.

(V) Electron Transport and Oxidation Phosphorylation : (3)

Oxidation of Reduced coenzymes, components involved in Electron transport. The Respiratory chain, oxydative phosphorylation, Mechanism of oxidative phosphorylation and its energetics.

Ref. 2: Pages 487-493.

Ref. 3: Pages 447-464.

(VI) Amino acid Metabolism : (3)

Source of Nitrogen, Assimilation of Ammonia, Transamination, Deamination, Decarboxylation, Metabolic fate of the aminoacids.

Ref. 2 : Pages 532-534.

Ref. 3 : Pages 523-528, 534-538.

(VII) Fatty Acid Metabolism : (4)

Fatty acid metabolism, beta oxidation and its energetics.

Ref.:Pages 418-423.

(VIII) Hormones : (3)

Characteristics of Hormones, Structure, Chemistry and biological functions of the following hormones, Adrenaline, Nor-Adrenaline, Insulin, Thyroid hormones and Sex hormones.

Ref.2 : Pages 723-729, 735-738, 742-744

IX) Urea-ornithine cycle :

Ref.2: Pages 549-555

Ref.3: Pages 540-544

(X) Nucleic Acids : (3)

Components and organization of Nucleic acids, Nucleoside, Nucleotides, structure of DNA and RNA, Nucleic acid

double. Helices, Restriction endonucleases and their uses, classes of Nucleic acids, Nucleoproteins- Chromatin, Ribosomes and Tobacco mosaic Virus.

Ref. 3 : 214-222, 231-240, 245-247, 253-260.

(XI) Arrangement of Gene on Chromosomes : (9)

Pathways to transfer genetic information, Replication, How replication in DNA is semi conservative, Messelson, Stahl experiment to demonstrate that replication in DNA is semi conservative.

Transcription -

Translation -

Genetic Code :

Ref. 2:Pages - 800-803, 807-808, 837-839,843-850, 852-856, 873-874, 896-899.

Ref. 3: Pages 582-598, 600-601, 617-632.

(XII) Structure of Tobacco Mosaic Virus and Bacteriophage

T4 : (1)

Ref. 3 : Pages 258-260,

Ref. 4 : Pages 411-412.

References :

1. Biochemistry By A.L.Lehinger. 2nd Edn 1975.
2. Principle of Biochemistry by A.L.Lehinger,CBS Publishers and Distributors, New Delhi, 1984 Edn.
3. Outlines of Biochemistry, 5th Edn. By E.C.Conn. P.K.Stumpf , G.Bruening, A.H.Doi. John Wiley and Sons New York.
4. Genes by Watson, 3 rd Edn.

For all metabolic pathways give the following.

1. Flowsheet diagram.
2. Explain each reaction giving structures of reactants and products.
3. Mention the type of reaction.
4. Mention the enzymes with its cofactors.
5. Energy change at each step.
6. Over all balance sheet of cycle.

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PAPER X D. (OPTIONAL) (AGRICULTURE AND DAIRY CHEMISTRY)Section I (First Term)Agriculture Chemistry - Theory.

(4)

1. Soil and Soil testing : History and scope of soil science. Soil components, soil organic matter, mineral matter and Soil water. Chemical properties of soils-soils reaction or soil pH, soil solution and electrical conductivity of soil. Acid and alkaline soils, Concept of soil testing, method of soil sampling, preparation of soil samples. Importance of soil testing, Soil fertility and factors affecting it. Evaluation of soil fertility. Interpretation of results of soil tests for fertiliser recommendations.

2. Irrigation water : (3)
Sources and collecting of representative sample of irrigation water, quality of irrigation water, characteristics of irrigation water that determine quality. Interpretation of results of irrigation water testing and recommendation on use of irrigation water. Evaluation of irrigation water salinity, sodicity, Management of different quality water.

3. Manures and Fertilizers : (10)

Manures- Role of organic manures in soil fertility
Farm yard Manure- Factors affecting the composition of FYM, Method of handling FYM, losses during handling and storage of FYM.
Sewage and Sludge- Components of sewage, Sludge, sewage water. Types of Sludges- settled, digested, activated, digested activated Sludges, Carbon/nitrogen ratio.
Sewage irrigation, uses Agro industrial wastes, construction working and use of biogas plants.

Green Manuring- types of green Manuring, selections of green Manuring, advantages and disadvantages of green Manuring. Role of green Manuring in soil fertility.

Fertilizers- Importance of fertilizers, NPK fertilisers their classification and composition.
Complex and mix fertilizers, physico-chemical properties of NPK fertilizers. Reactions of NPK fertilizers in calcareous and acid soils. Mode of applications of fertilizers. Secondary plant nutrients, Micronutrients, Nitrification and denitrification.

4. Pesticides : (7)

Classifications, Nomenclature, Applications.

Insecticides- definition, Classification based on chemical nature. Elemental composition and mode of action of

synthetic and plant originated compounds. BHC, DDT, Carbaryl, Parathion, Malathion.

Fungicides : Defination, classification, chemical properties, Mode of action of sulphur, copper and mercuric Fungicides, e.g. lime sulphur, Thiram, Bordeaux mixture, Mercuric chloride.

Herbicides- Defination, classification, Chemical properties, mode of action of selective and non-selective herricides. e.g. 2-4 D, 2-4-5-T etc.

Formulation of Chemicals - Compatibility of sprays, hazards, and safty measures, Safe limit of pesticides in food and vegetables.

Reference Books :

1. Hand Book of Manures and Fertilisers. I.C.A.R. Publications.
2. Manures and Fertilizers by Yawalkar.
3. Analytical Agricultural Chemistry. Ey S.L. Chopra and J.S. Kanwar, Kalyani Publishers (Ludhiyana, N. Delhi.)
4. Chemistry of Insecticides and Fungicides. By U.S. Sree Ramulu. Oxford and IBH Publishing house (2 nd Edition.)

Agricultural Chemistry Practicals. (Any 10 experiments to be performed)

A) Analysis of soil :

1. Determination of pH, Electrical conductivity and total carbonate in soil sample by rapid titration method.
2. Determination of org.nic carbon by Walkey and Black method.
3. Determination of lime and gypsum requirments of soil.
4. Determination of available nitrogen from soil by alkaline permangnate method.

B) Analysis of irrigation water.

5. Determinations of calcium and magnesium from irrigations water b EDTA method.
6. Determination of pH, Electrical conductivity, Carbonates, Bicarbonates and chloride from irrigation water.
7. Analysis of chlorine sterilizers (Determination of available chlorine in bleaching powder used for chlorination of water)

C) Analysis of pesticides :

8. Estimation of copper from copper fungicides.
9. Determination of hydrolysable and free chloride from B.H.C. by Volhard's method.

D) Analysis of fertilizers.

10. Determination of total nitrogen from urea by ~~kjeldahl~~ method.
11. Determination of phosphorus from phosphatic fertilizer by gravimetric method.
12. Determination of total potassium content of muriate of potash by perchlorate method.

Reference Books :

1. Analytical Agricultural Chemistry.
By S.L. Chopra and J.S. Kanwar.
Kalyani Publishers (Ludhiana- New Delhi)
2. Laboratory Manual in Agricultural Chemistry By
Dr. D.P. Motiramani and R.D. Wankhede.
Asian Publishers Muzaffarnagar.
3. Practical Manual for Agricultural Chemistry. By A.K.Gupta,
M.L. Varsnani.
Kalyani-Publisher.

DAIRY CHEMISTRY THEORY1. Market Milk (4)

Introduction, Importance of dairy chemistry, definition of milk, secretion of milk.

Composition - Milk constituents, chemical composition of milk of different species such as cow, buffalo, goat and sheep., Chemical composition of milk of some Indian and Foreign breeds, Characteristics of milk of different mammals. factors affecting composition of milk food and nutritive value of milk. Physico chemical properties of milk constituents and milk. Effect of processing on milk constituents. Uses of milk.

2. Method of manufacture, packing and storage of special milks : (4)

Pasteurised milk - flow diagram, receiving milk, preheating, filtration, clarification, cooling and storage of raw milk, standardisation, pasteurisation homogenization, bottling, packing and storage.

Sterilized milk, homogenised milk, flavoured milk, standardised milk and Toned milk.

3. Preservatives and Adulterants : (3)

a) Preservation of milk- Common methods of preservation of milk- action of heat and uses of chemicals or preservatives.

Preservatives : Definition, importance, some important preservatives and their detection such boric acid, borax formalin, salicylic acid, benzoic acid, and hydrogen peroxide.

b) Adulteration in milk : Modes of adulteration and their detection such as skimming, addition of separated milk or skim milk, Addition of water, starch, and canesugar.

4. Milk proteins, carbohydrates, vitamins and enzymes : (5)

a) Milk proteins : Importance, classification composition nomenclature, separation of milk proteins, nutritive value of milk proteins.

Casein - Preparation/manufacture, properties, uses.
Whey proteins- preparation separation- Lactoalbumin Lactoglobulin, and proteoses- peptones.

b) Carbohydrates : Importance of lactose; classification, properties, nutritive value of lactose, uses of lactose.

c) Vitamins in milk : Importance, properties, nutritive value of vitamins.

Vitamin A- Vitamin B-complex- Vitamin- B₁ (Thiamine)

Vitamin B₂ Riboflavin) Vitamin B₆ (Pyridoxine).

Vitamin B₁₂. Vitamin C & D.

d) Enzymes in milk: Importance, definition, nomenclature, co-enzymes, antienzymes, influence of pH, heat on enzyme, activity.

Important enzymes- Amylase, Catalase, lipase, protease, phosphatase, peroxidase, lactase.

5. Milk products : (8)

a) Cream - Definition, classification, composition, food and nutritive value, physicochemical properties, methods of preparation/ manufacture.

b) Butter : Definition, classification, composition, food and nutritive value, physico-chemical properties.

Manufacturing of butter- Selection of milk/cream, pasteurisation of cream, ripening of cream, churning, salting of butter, washing of butter, packing and storage. Use of butter.

c) Butter Oil : Definition, composition, physicochemical properties, food and nutritive value.

Methods of manufacture : Direct evaporation, decantation, centrifugation followed by vacuum drying, direct from cream by deemulsification and centrifugation, packaging and storage, keeping quality of butter oil. Uses of butter oil.

- d) Cheese : Definition, classification, food and nutritive value Manufacture of cheddar cheese receiving of milk, filtration and clarification, pasteurisation, homogenization, addition of salt, ripening with starter, renneting, cutting of curd, drainage of whey, milling and salting, hooping, dressing pressing and drying. Uses of cheese.
- e) Ice-Cream : Definition, classification, composition, food and nutritive value. Methods of manufacturing- Selection of ingredient, figuring the mix, making the mix, pasteurising the mix, homogenizing the mix, cooling and ageing of mix, freezing of mix, overrun in ice-cream, packaging, hardening and storage of ice-cream. Uses of ice-cream.

Dairy Chemistry Practicals (Any 10 experiments to be performed)

1. Determination of sp. gr. of milk from different sources : Cow, Buffelow milk by using sp. gr. bottle and lactometer.
2. Determination of fat content in samples of cow and buffelo milk.
3. Estimation of fat content in cream butter and ghee.
4. Determination of pH and acidity of cow and beffelo milk.
5. Determination of lactose in milk using Iodimetric method.
6. Determination of casein in milk by pyne's formal titration method and Hence calculate the percentage of protein in milk.
7. Determination of percentage of preservatives like boric acid or formaldehyde in milk sample.
8. Determination percentage of adulterants like water, seperated milk, or extration of some fat in milk sample.
9. Determination of saponification of butter or ghee.
10. Determination of Iodine value of ghee by Whij's method.
11. Estimation of acidity of cream and butter.
12. Determination of acid value of Fats and Oils.

References :

1. Outlines of Dairy Technology, Oxford University Press, Sukumar De.
2. Fundamentals of Dairy Chemistry, B.H.Webb, A.H.Johnson, J.A.Alford, CBE Publishers and Distributors.
3. Milk and milk products, C.H.Eckles, H.Macy, W.D.Combs, TATA McGraw Hill publishing Co., Ltd.
4. Chemistry and testing of Dairy products, H.V.Atherton, J.A.Newlander, CBS Publisher and Distributors.
5. Dairy Chemistry and animal nutrition, M.M.Rai. Kalyani Publishers, New Delhi Ludhiana.
6. Principles of Dairy procesing. J.N.Warner, Wiley Eastern Limited.
7. Modern Dairy products. L.M.Lampert, Eurasia Publishers House(Pvt) India.
8. Principles of Dairy Chemistry, R.Jenness and S.Pattern Wiley-Eastern Pvt.Ltd. Publishers.
9. Dairy Chemistry R.N.Sing, The National Book House, Agra.
10. The chemistry of Manufacture of Indian Dairy products, K.S.Rangappa and K.T.Acharya, The Banglore printing and publishing Co., Ltd.
11. Principles of Dairy Science, E.Vanstone, B.M.Dougale, Clever-Hume Press Ltd. London.
12. Practical Dairy Science and Laboratory Methods. A.C.Chaudhari, Scientific Book Agency, Netaji Subhash Road, Calcutta.
13. Handbook of Dairy Science K.C.Mhanta, Kitabistan, Allahabad.
14. Practical Mannual for Agricultural Chemistry(Part II) A.K.Gupta, M.L.Varshaney. Kalyani Publishers, Ludhiana.
15. ISI Handbook of Food analysis Part IX Dairy Products. Indian Standard Institutions, New Delhi.

Notes - Weightage for Theory and Practical parts will be equal. Theory part is to be completed by engaging 2 periods per week. Practical part is to be completed by engaging half of the experiments in first term and remaining half in second term. Duration of each experiment will be 4 periods. For calculating work load of practicals 4 periods per week per batch will be considered.

Theory examination will be of two hours duration and practical of 4 hrs. duration.

PAPER X-E (OPTIONAL) (I) ENVIRONMENTAL CHEMISTRY (THEORY)Section I (First Term)

1. Introduction to environmental Chemistry, Concept and scope of environmental Chemistry, nomenclature, segments, atmosphere, oxygen and ozone Chemistry, Green house effect. (3)
Ref.1 pages 1 to 5, Ref. 2 pages 44 to 51.
2. Water resources, hydrologic cycle, complexation in natural and waste water, eutrophication, Sewage treatment, aquatic environment, water pollutants, trace elements in water, chemical specification, water quality parameters, standard sampling, methodology and analysis. (9)
Ref. 1 pages 33 to 34, 44 to 46, 50 to 54, 164 to 190, 192 to 219.
3. Air pollutants, Air quality standards, sampling monitoring and case study of air pollution. (12)
Ref. 1 pages 95 to 163.

Section II (Second Term)

4. Lithosphere, Composition, Organic and inorganic components in soil, Micro and Macro nutrients, nitrogen pathway, NPK wastes, Reclamation, recycling and reuse of solid waste and organic matter. (4)
Ref. 1. Pages 60 to 64.
Ref. 3. Pages 301 to 302, 332 to 339.
5. Mineral resources, metals and non metals, wood a major renewable resource, fuel and energy resources, world energy resources consumption and conservation. (3)
Ref. 1 Pages 307 to 324.
6. Toxic chemicals in the environment and their impact on enzymes, bio chemical effect of As, Cd, Pb, Hg, CO, SO₂, O₃, nitrogen oxides, cyanide, pesticides, carcinogens and Pan. (8)
Ref. 1 Pages 66 to 91.
7. Instrumental techniques in environmental chemical analysis, Viz, Principles, methods and applications of Atomic absorption spectrophotometry. Gas chromatography, HPLC and flame photometry. (9)
Ref. 4 (Relevant Pages)

Reference Books :-

- Ref. 1. A.K.De, "Environmental Chemistry," 2nd Edn. Wiley Eastern Ltd. India.
- Ref. 2. O.D.Tyagi and M.Mehra, "A Text Book of Environmental Chemistry," Anmol Publication, New Delhi.
- Ref. 3. J.W.Moore and E.A. Moore, "Environmental Chemistry", Academic Press, London.
- Ref. 4. A.I.Vogel's Text Book of Quantitative Inorganic Analysis, IVth Edn. Revised by Bassett, Denny, Medhan & Jaffery. ELBS.

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PAPER X+E (II) ENVIRONMENTAL CHEMISTRY (PRACTICALS)

Each student should perform minimum of 10 experiments.

A. Water Chemistry :- (At least 7 expts.)

1. Total - N by Kjeldahl method in water/waste water.
2. $\text{NO}_3^- \text{N}$ in water/ waste water by colourimetry method.
3. Estimation of phosphate in water sample by spectrophotometry.
4. Detection of Fe in water/waste water by spectrophotometer.
5. Detection of Cr in water/waste water by spectrophotometer.
6. Estimation of F (Fluoride) in water sample by SPDNS method.
7. Na and K in water by flame photometer.
8. Hardness of water and waste water by EDTA method.
9. Estimation of C.O.D. in waste water/industrial water.
10. Determination B.O.D. in waste/industrial water.
11. Oil and Grease estimation in water.

B. Soil Chemistry :- (At least 3 expts.)

12. Detection of O.M. (Organic Matter) in soil/sludge sample by Walky and Black method.
13. Exchangeable Na and K in soil by Flame photometry.
14. Exchangeable Ca and Mg in soil by EDTA method.
15. Estimation of $\text{NH}_4^- \text{N}$ in sludge/soil sample by colorimetry or titration method.
16. Available phosphorus in soil sample by colourimetry.

Reference Books :-

1. R.K. Trivedy and P.K.Goel "Chemical and Biological methods for water Pollution studies,". Environmental publications, Karad.
2. W.Fresenius, K.E.Quentin, and W.Schneider (Eds),"A Practical Guide to physico-chemical, Chemical and Microbiological water Examination and Quality assurance, springer verlag, Newyork.

Notes :

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Theory examination will be of 2 hours duration and practicals of 4 hours duration.

PRACTICAL COURSE NO. 1

PHYSICAL CHEMISTRY PRACTICALS.

Group A (Instrumental)

Each student should perform a minimum of 10 experiments. As far as possible a least experiment should be from each technique.

I) Potentiometry :

1. Determination of Ecal and hence the unknown pH of five buffer solutions using quinhydrone electrode.
2. Estimation of the amount of KCl/NaCl by titration with AgNO₃.
3. Determination of strength of HCl by titrating with NaOH.
4. Determination of the activity coefficient of Ag⁺ using concentration cell with salt bridge.
5. Determination of formal redox potential of Fe⁺⁺ / Fe⁺⁺⁺ system.

II) Conductometry :

1. Estimation of the amount of lead nitrate/KCl by titration with sodium sulphate/silver nitrate.
2. Determination of relative strength of chloroacetic acid and acetic acid.

III) Refractometry :

1. Determination of molar refraction of four pure liquids by measuring their refractive indices, and densities by pycnometer/specific gravity bottle.
2. Determination of unknown composition of a mixture of two liquids by measuring the refractive indices and

densities of the pure liquids and their mixtures of known compositions.

IV) pH_metry.

1. Determination of degree of hydrolysis of aniline-hydrochloride by preparing the solutions of different concentrations and measuring their pH.
2. Determination pKa of a weak monobasic acid by titrating it with a strong base.

V) Radiochemistry :

1. Determination of plateau voltage and the resolving time of G.M. counter.
2. Determination of E max of beta particles.

VI) Colorimetry :

1. Determination of max, verification of Beer's law and determination of unknown concentration of copper sulphate solution by preparing solutions of different known concentrations and measuring their absorbance and transmittance.
2. Estimation of Fe(II) by titrating with potassium permanganate solution.

Group B (Non-instrumental)

Each student should perform a minimum of 10 experiments.

1. Determination of critical solution temperature of phenol water system.
2. Determination of molecular weight of liquid by steam distillation.
3. Determination of molecular mass of high polymer by viscosity measurement (Polyvinyl alcohol/Polystyrene).
4. To study the kinetics of decomposition of hydrogen peroxide by measuring the volume of oxygen.
5. To study the kinetics of the reaction between potassium persulphate and KI with unequal initial concentration.
6. To study the kinetics of hydrolysis of methyl acetate catalysed by HCl.
7. To study the kinetics of inversion of cane sugar catalysed by HCl polarimetrically.
8. Determination of equilibrium constant of $KI + I_2 \rightleftharpoons KI_3$ by distribution method.
9. Determination of energy of activation of the reaction between bromic and hydrobromic acids with equal initial concentrations.
10. To study the kinetics of saponification of ethyl acetate by NaOH. (Titration method)

- 11. Determination of radius of glycerol/sucrose molecules from viscosity measurements.
- 12. Determination of the bimolecular rate constants of the oxidation of iodide ion by hydrogen peroxide in aqueous solutions at room temperature.

In the examination, each student will have to perform one experiment from Group A and one from Group B.

References.

1. Advanced practical Physical Chemistry by B. Yadav. (Goel Publishing House Meerut)
2. Experimental Physical Chemistry by Virje Das and B. Behara. (Tata Mc-Graw Hill, Edition)
3. Experiments in Physical Chemistry J.M. Wilson, R.J. Newcombe, A.R. Denaro, Rickett. (Pergamon Publications.)
4. Findlay's practical physical chemistry Revised by J.E. Kitchener or B.P. Levitt.

PRACTICAL COURSE NO. 2

Inorganic Chemistry Practicals.

1. Inorganic Qualitative Analysis :- (At least 8 mixtures)
 - a) Separation of Binary mixture including insoluble phosphates and borates.
2. Gravimetric Estimations :- (Any Two)
 - a) Iron as Fe_2O_3 .
 - b) Zinc as $Zn_2P_2O_7$.
 - c) Barium as $BaSO_4$ Homogeneous precipitation method.
3. Volumetric Estimations :- (Any Two)
 - a) Magnesium by using E.D.
 - b) Manganese by Volhard's method.
 - c) Iron using dichromate (External indicator).
4. Colourimetric Estimations. (Any Two)
 - a) Titanium by using H_2O_2 .
 - b) Cobalt by using R-Nitroso salt.
 - c) Chromium by using diphenyl carbazide.
5. Paper Chromatography :- (Any Two)

Separation and identification of a binary mixture by paper chromatography.

(Mn²⁺, Fe²⁺, Co²⁺, Ni²⁺, Cu²⁺, Zn²⁺.)

6. Inorganic Preparations :- (Any Two)
 - a) Potassium Trioxalato aluminate (III)
 - b) Reinecke's salt.
 - c) Tris-(en) Nickel (II) thiosulphate.
7. Analysis of Brass sample cu/zn (Estimate any one volumetrically)
8. Separation Sodium Chloride and Naphthalene from the mixture by solvent extraction and estimation of chloride by Mohr's method.

REFERENCES -

1. A text book of Inorganic Quantitative Analysis.
By A.I. Vogel.
2. Practical Inorganic Chemistry 1972
By G.Marr and S.Rockett.
3. A text book of macro and semi micro qualitative analysis
By A.I. Vogel.

PRACTICAL COURSE NO.3

Organic Chemistry Practicals.

- A) Qualitative analysis of Binary mixtures
(Minimum 8 mixtures)

- i) Solid - Solid 4 mixtures.
- ii) Liquid - Liquid 2 mixtures.
- iii) Liquid - Solid 2 mixtures.

At least one mixture from each of the following type.

Acid-Base, Acid-Phenol, Acid neutral, Phenol-Base Phenol - neutral Base - neutral, neutral-neutral - neutral, neutral-neutral - (Solid-Solid mixture should not be included for neutral-neutral type)

- B) Preparations of Derivatives

At least one derivative of each of the following type should be prepared.

Acetyl, Benzoyl, 2,4 DNP, and semicarbazone.

- C) Estimations of (Any One)

- a) amide by hydrolysis.
- b) ester by hydrolysis.

- D) Determinations of

- a) n_D^{20} and n_D^{25} value of an oil.
- b) Molecular wt. of monobasic/dibasic acid by volumetric method.

E) Single stage preparation (Any Four)

- i) Hydroquinone to quinone.
- ii) Acetanilide to p-bromoacetanilide.
- iii) p-nitroaniline to p-dinitrobenzene.
- iv) Acetanilide to p-nitroacetanilide.
- v) Aniline to Sudan-I.
- vi) p-nitrotoluene to p-nitrobenzoic acid.
- vii) p-aminophenol to p-acetamol.

F) Technique of TLC for the separation of binary mixture.
(Any One)

- i) o-nitroaniline and p-nitroaniline.
- ii) o-nitrophenol and p-nitrophenol.

References :

1. Practical Organic Chemistry by A.I.Vogel.
2. Laboratory manual of organic chemistry
by Raj. K.Bansal. 2nd Edn. (1990)
(Wiley Eastern Ltd.)

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