

M. Sc. Part II Analytical Chemistry
With Effect From 2009-2010
Structure of the Syllabus

Semester III

Compulsory Courses

- CH-390** : Electro analytical and Current Analytical Methods in Industries.
CH-391 : Environmental and Analysis of Industrial Materials.
CH-392 : Advanced Analytical Techniques

Optional Courses-

- CH-380** : Pharmaceutical Analysis
CH-381 : Medicinal Chemistry

Semester IV

Compulsory Courses

- CH-481** : Bioanalytical and Forensic Science
CH-490 : Analytical Spectroscopy
CH-491 : Polymer Technology

Practical courses-

- CH-387** : Practicals (Inorganic)
CH-487 : Practicals (Physical)
CH-488 : Practicals (Organic) **OR** CH-498: Project

NOTE: One Industrial Visit and report writing is compulsory.

CH-380 Pharmaceutical Analysis (60L)

Section -I

1) a) Sources of Impurities in Pharmaceutical Raw Materials and Finished Products:

(2 L)

Raw materials, Method of manufacture, Contamination-atmospheric, particulate, cross contamination, microbiological, process errors, Packing errors, chemical instability, container contamination (in brief) physical changes, temperature effects. GMP

Ref 1. and Ref 4

b) Stability Studies, Shelf Life Fixation for Formulated Products

(3 L)

2) Test and assay of raw materials and finished products :

a) Biological Assays :

(06L)

Introduction, Precision of biological assays in brief, (estimation of errors is excluded)
Biological assay of insulin, Tetanus antitoxin, Determination of proteolytic activity,
Determination of ABO group and Rh group, Photometric haemoglobinometry, Haemolysins?

b) Chemical Tests and Assays:

(5 L)

Limit test, characteristics of limit tests specificity sensitivity, control of personal errors Loss on drying (NaCl), loss on ignition (ZnO),limit test for lead, arsenic chloride and sulphate,

moisture determination by KFR titration method, assay of steroids, and identification of steroids (IP)

- c) **Analysis of vegetable drugs :** (2 L)
Sampling, foreign organic matter, ash values and water soluble ash (ginger) Acid insoluble ash (Rhubarb), sulphated ash (Aspirin.)
- d) **Microbiological tests and assays:** (7 L)
Microbiological assay of antibiotics, (std. preparations and units of activity, test organisms and inoculum, Apparatus, Method -Cylinder or cup plate method and two level factorial assay (ampicillin from table 4 I.P.) Microbial limit test {preliminary testing, Medium-soyabean casein digest agar medium only}and total microbial count only }Test of sterility-Membrane filtration method , Determination of Thiomersal
- e) **Physical tests and assays** (5 L)
Disintegration tests (tablets, capsules, pessaries and suppositories Dissolution tests- tablets, capsules. *Reference 1 and 2. (Relevant pages.)*)

Section –II

- 3) **Standardization and quality control of different dosage form:** (25 L)
Brief introduction to different dosage forms with the IP requirements Analytical methods for the following- Tablets (aspirin) additives used in tablet manufacture, capsules Rifampicin) Powders (Sodium benzoate), Solutions (saline NaCl) Suspensions(barium sulphate –limit test for impurity) Mouthwashes(Ointments (salicylic acid) and creams Dimethicone by IR) Injections (Mannitol) , ophthalmic preparations (sulphacteamine),Aerosols (salbutamol), Blood products and reporting protocols.
Reference 1 and 2 (Relevant pages)
- 4) **Role of FDA in pharmaceutical industry.** (5 L)
Drug cosmetic act Definitions Drug, Misbranded , Adulterated and Spurious drug, New drug Cosmetics ,Blood bank, Manner of labeling, GMP in brief (Schedule M), FDA. Role of FDA, introduction to new drugs, brief summary of different phases of test and approval for formulation of a drug.
Reference 3
Reference 4 Pages 21,22,23,26, 74, 75,140-144

References:-

- 1) *Practical Pharmaceutical chemistry third edition volume 1. By A.H.Beckett & J.B.Stenlake*
- 2) *Pharmacopiea of India Volume I and II.*
- 3) *Remington 's Pharmaceutical sciences.*
- 4) *Forensic pharmacy by B.S Kuchekar, A.M Khadatore (Nirali Prakashan)*
- 5) *Practical pharmaceutical analysis by Ashitosh Kaur*
- 6) *Analytical problems of drug substances and Exp by Florey*
- 7) *The theory and practice of Ind pharmacy Leon lachmann,Herbert Liebermann and Joseph L.Karnic 3rd edition By Varghese Publication House, Hind Rajasthan Building Dadar Mumbai –14*

CH-381 Medicinal Chemistry
Section-I
Drug Design (30 L)

Part A

Definition of drug, Classification of drug on the basis of therapeutic action, pharmacophoric API (Active pharmaceutical ingredient) chiral drugs, Development of new procedures followed in drug design, Concept of pro-drug and soft-drug, Factor affecting bioactivity, Resonance, Inductive effect, isosterism, bio-isosteris, spatial considerations. (5 L)

Part B:

Theories of drug activity, occupancy-theory, rate theory, induced- fit theory, Quantitative structure- activity relationship, History and development of QSAR, Concept of drug receptors, Elementary treatment of drug receptor interactions. (5 L)

Part C:

Physicochemical parameters lipophilicity, partition- coefficient, electronic ionization constant, steric, Shelton and surface activity, parameters and redox potential. (5 L)

Part D:

Evaluation Methods: Free- Wilson Analysis, Hansch-analysis, relationship between Free-Wilson and Hansch-analysis – LD50 ED50 (mathematical derivation of equation excluded). (5 L)

Part E:

Assay of drugs (6 L)

- 1) Chemical assay- Wet and instrumental methods
- 2) Biological assay
- 3) Immunological assay

Part F:

Pharmacokinetics/ Pharmacodynamics

Drug absorption, disposition, elimination, important pharmacokinetic parameters in defining drug disposition and in therapeutics, uses of pharmacokinetics in drug development process, Novel Drug delivery systems. (4 L)

Section-II (30 L)

- 1) **Antineoplastic Agents:** Introduction, Cancer, chemotherapy, Role of alkylating agents and antimetabolites in treatment of cancer, Mention of carcinolytic antibiotics and mitotic inhibitors of mechlorithamine, cyclophosphamide melphalan, uracil, mustards and 6 – mercapto-purine Recent development in cancer chemotherapy. Hormones and natural products. (6 L)
- 2) **Cardiovascular Drugs:** Introduction cardiovascular diseases. Drug inhibitors of peripheral sympathetic function. Central intervention of cardiovascular output direct acting arteriolar dilators. Synthesis of amyl-nitrate, sorbitrate, diltiazol, quinidine, verapamil, methyldopa atenolol, oxyprenolol. (6 L)

3) Local Antifective Drugs: Introduction and general mode of action, sulphonamides, forazolidione, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, aminosalicilylicacid, isoniazid, ethionamide, ethambutal, econazole, griseofulvin, chloroquin, and primoquin.

(5 L)

4) Psychoactive Drugs: Introduction neurotransmitters, CNS deprents, general anaesthetics mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry of mental diseases, antipsychotic drugs, the neuroleptics, antidepressants, butyrophenones, serendipity and drugs development. Stereochemical aspects of psychotropic drugs, synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuccimide, trimethadione, barbiturates, thiopental sodium, glutethimide.

(9 L)

5) Antibiotics: Cell wall biosynthesis, inhibitors, β - lactamrings antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin 5, ampicilin, amoxicillin, chloramphenicol, cephalosporin, tetracycline, streptomycin.

(4 L)

References:

- 1) *Introduction to medicinal chemistry. A. Gringuage, wiley-VCH.*
- 2) *Wilson and Gisvoldis text books of organic medicinal and pharmaceutical chemistry, Ed Robert F. Dorge.*
- 3) *An introduction to Drug design, S.S. Pandeya and I R Dummeck, New Age International*
- 4) *Burgers medicinal chemistry and drug discovery vol- 1(chapter 9 and 14).*
- 5) *Goodman and Gilmans pharmacological basis of therapeutics, McGraw-Hill.*
- 6) *The organic chemistry of Drug synthesis and Drug action, R.B. silverman, academic press.*
- 7) *Strategic for organic drug synthesis and Design, D. Lednicer, John wiley.*
- 8) *Organic chemistry of Drug synthesis, Lednicer and Meiser, wiley, 5 volume.*
- 9) *Comprehensive medicinal chemistry 5 volume, merck index, 13th volume.*
- 10) *Encyclopedia of analytical chemistry 16 volume, R.A. Meyers.*
- 11) *Encyclopedia of industrial chemical analysis (Wiley-I science)*

CH-390: Electrochemical and current Analytical Methods in Industries.

Section-I

Electrochemical Methods of Analysis (30 L)

1) Voltammetry and polarographic methods of analysis.

Voltammetry and polarography, electrodes, polarographic principles, Ilkovic Equation, factors affecting on polarographic wave, pulse polarography, differential pulse polarography, square wave polarography, Voltammetric principle, cyclic Voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis by these techniques. **(12 L)**

2) Stripping Voltammetry:

Adsorptive stripping Voltammetry and electrogravimetry. **(4L)**

3) Coulometry:

Instrumentations, coulometric titrations, advantages and limitations. **(6L)**

4) Amperometry:

Principle, Instrumentation, typical applications, amperometric titrations, chrono-amperometry and chrono-potentiometry. **(5L)**

5) Nanoscience:

Synthesis of Nanomaterial by electrochemical deposition method, general applications of nanomaterial. **(3L)**

Section-II

Current Analytical Methods of Analysis in Industries. (30 L)

1) Radioanalytical Methods of Analysis

a) Activation analysis:

Neutron activation analysis, principle, technique, steps involved in neutron activation analysis. Radiochemical and instrumental methods of analysis, important applications of NAA. **(6L)**

b) Isotope dilution analysis:

Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis. **(5L)**

c) Radiometric titration:

Principle, techniques based on complex formation and precipitation, radiometric titration curves for estimation of ions from their mixture. **(3L)**

d) Radio-reagent methods of analysis:

Principle, technique, application and limitation. **(3L)**

- 2) Radiation scattering methods of analysis:**
(Turbidimetry and Nephelometry) principle, instrumentation and typical applications. (3L)
- 3) Thermal methods of analysis:**
Principle, instrumentation of TGA, DTA, DSC and EGA, thermometric titrations, typical applications of each technique. (7L)
- 4) Spectro-electrochemistry:**
Principle, applications, chemically modified electrodes and electrochemical sensors. (3L)

References:

- 1) *Introduction to instrumental analysis* by R.D.Broun, Mc Graw Hill (1987)
- 2) *Instrumental methods of chemical analysis* by H. Willard, L.Merrit, J.A. Dean and F.A. Settle. Sixth edition CBS (1986)
- 3) *Thermal analysis* by W.W. Wendlandt, John Wiley, (1986)
- 4) *Fundamentals of analytical chemistry* by D.A.Skoog, D.M. West and H.J. Holler sixth edition (1992)
- 5) *J. chemical education*, 60,302 to 308 (1983)
- 6) *Cyclic Voltammetry and frontiers of electrochemistry* by N.Noel and K.I. Vasu IBH, New delhi (1990)
- 7) *Source book of Atomic energy* by Glasstone.
- 8) *Principle of Activation Analysis*- P. Kruger, John Wiley and sons, (1971).
- 9) *Nuclear Analytical Chemistry – J. Tolgyessy and S. Verga* vol. 2, university Park press, (1972)
- 10) *Radiochemistry and Nuclear methods – W.D. Ehmann and D.E. Vance*, John Wiley and Sons.

CH-391: Environmental and Analysis of Industrial Materials
Section-I (30L)

1) Analysis of Fertilizers:

Sampling and sample preparation, analysis of nitrogen, phosphorus and potassium. Nitrogen: urea nitrogen, total Kjeldahl nitrogen methods, Ammonia nitrogen. Phosphorus: total phosphorus, available and non-available, alkalimetric ammonium molybdophosphate method. Potassium: potassium by sodium tetraphenyl borate method. **(5 L)**

2) Analysis of ceramics and glass:

Sodium and potassium by flame photometry, analysis of lead and borate glasses, analysis of Cr, Mn, Fe, Co, Ni, and Zn by X-ray. **(4 L)**

3) Analysis of detergents:

General scheme of analysis, sampling, alcohol soluble materials, test for unsulfonated on sulfated materials. **(5 L)**

4) Analysis of cosmetics:

Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate, urea. Analysis of face powder: fats, fatty acid, Ca, Mg, BaSO₄, Ti and Fe. Oxides of Ti, Fe and Al (total). Analysis of hair tonic preparations: 2, 5-diaminotoluene, KBrO₃, resorcinol, salicylic acid. **(4 L)**

5) Analysis of paints and pigments:

Preliminary inspection of sample, Tests on the total coating, Separation of Pigment, Binder and Thinner of Latex Paints, Separation of Pigment, Binder and Thinner of Solvent Type Coatings, Identification of Binder, Identification and Analysis of Pigments, Identification and Analysis of Thinner. **(6 L)**

6) Analysis of Explosives:

General Methods:- Heat of Explosion, Hygroscopicity, Moisture by Karl Fischer Titration, Qualitative tests of explosives, Quantitative Analysis of Explosive Mixtures, Dynamites, Blasting Caps and Electric Detonators, Primers, Liquid Propellants and Solid Propellants. **(6 L)**

Section-II (30L)
Metallurgy and Geochemistry

1) Analysis of Geological materials:

Dolomite, Ilmenite and bauxite. **(5 L)**

2) Analysis of Industrial materials:

a) Steel, b) copper based alloys c) aluminum based alloys. **(5 L)**

3) Industrial Waste Water Analysis:

a) Chemical analysis:

Procedure, preservation of sample, sampling characterization of waste water, analysis of DO, COD, BOD, Arsenic, Mercury, Chromium-hexavalent, Lead cyanide, total suspended solids. **(6 L)**

b) Biological wastewater treatment:

Activated sludge process, trickling, filtration, rotating biological contactors and anaerobic decomposition. **(6 L)**

c) Air pollution:

Suspended particulate matter, aerosol, generation, hazards and control of SO_x, NO_x, CO_x, air monitoring equipments, cyclone separator, electrostatic precipitator, filters and setting chambers. **(4 L)**

d) Sludge analysis and method of disposal.

(2 L)

e) Safety rules and methods in industries.

(2 L)

References:

- 1) *Standard methods of chemical analysis, volume 3, part-B, F.J. Welcher.*
- 2) *Cosmetics by W.D. Poucher (Three volumes)*
- 3) *Insight into speciality inorganic chemicals by D. Thomson, the royal society of chemistry (1995)*
- 4) *Industrial water pollution control by W.W. Ecken and elder, Tata McGraw-Hill (2000)*
- 5) *Applied chemistry, a text book for Engineers and technologists by H.D. Gesser.*
- 6) *Handbook of Industrial chemistry, by Davis Berner.*
- 7) *Air pollution by Rao and Rao*
- 8) *Standard methods of water and waste water analysis by A.K. De.*
- 9) *Standard Methods of Chemical Analysis, Sixth Edition, Volume two-Part B Frank J. Welcher.*
- 10) *Quantitative analysis by vogels.*

CH-392: Advanced Analytical Techniques
Section I (30L)
Basic Electronics and Automation in Chemical Analysis

1) Introduction to components: (15 L)

a) Resistors, conductance, capacitors, inductors, transformers, charging and discharging of condensers, DC circuits, complex DC circuits, simple parallel circuits, current and potential measuring devices, AC circuits, reactance and capacitance, RL circuits, problems based on circuits and components. Ohms law, Kirchoffs law, Faradays law of electrolysis and its applications, problems based on electro deposition. *Ref. 1*

b) Introduction and applications of semiconductors, diodes and its applications, zener diode and its use in voltage regulation. Light emitting diodes, photodiodes, photo resistors, transistors and amplifiers, (only its meaning and applications) introduction to digital computers, binary numbers, decimal numbers and their conversions. *Ref. 1*

2) Role of Computers and Microprocessors in Analytical Chemistry:

Introduction, computers and microprocessors, instrument-computer interfaces. The scope of microprocessor control to various laboratory instruments- liquid chromatography, Atomic absorption spectrophotometer, potentiometer and X-ray spectrometer.

Ref. 7. page No. 491 to 512 (5 L)

3) Automated Analysis:

Automated laboratory analyses, Laboratory apparatus- Continuous flow analyzers, Flow injection analyzers, Discrete-sample analyzers, Centrifugal force analyzers, Process control, process control analyzers, Automatic titrators.

Ref.1. page No.949 to 976 (10 L)

Section-II (30L)

1) Atomic spectroscopy based on flame and electro thermal atomization:

Theory, sources, burners, atomic emission spectra, atomic absorption spectra, effect of temperature on emission, absorption and fluorescence, electro thermal atomizers, radiation sources atomic absorption methods, instrumentation for AAS, spectral interferences, standard addition and internal standard method of analysis, comparison of atomic absorption and emission methods, inductively coupled plasma and direct current plasma emission spectroscopy, atomic and molecular mass spectrometry including ICP-MS and tandem mass spectroscopy, MS-MS principle, instrumentation and analysis of micronutrients like Mo, B, Cu, Zn essential towards the healthy growth of crops, fruits, determination of these micronutrients from soils, plants and fruits. (10 L)

2) Laser Based techniques:

Atomic fluorescence spectroscopy, resonance ionization spectroscopy, laser enhanced ionization, principle, types of transition tunable laser, classification of medium pumping and controlling mechanism, instrumentation, detecting of various gases, liquid and solids, sources, cell, monochromators, detector. (7 L)

3) Radiochemical Techniques:

Radioimmunoassay, its principle and applications, instrumentation for radiobioassay, clinical application of the radioimmunoassay of insulin, Estrogen and progesterone, receptor techniques of breast cancer. Enzyme- linked immunosorbent assay (ELISA), principles, practical aspects, applications. **(10 L)**

4) Supercritical fluid chromatography (SFC):

Principle, Instrumentation and applications in pharmaceuticals. **(3 L)**

References:

- 1) *Introduction to instrumental analysis* by R.D.Brown, Mc Graw Hill (1987)
- 2) *Instrumental methods of chemical analysis* by H. Willard, L.Meritt, J.A. Dean and F.A. Settle. Sixth edition CBS (1986)
- 3) *Radio-bioassay* by S. Ashkar, volume-I, page 1-35 and 53 to 65 CRC press, Inc. Boca Raton, Florida.
- 4) *Practical clinical biochemistry* by Harold Varley, fourth edition, CBS publication, New Delhi.
- 5) *Immunology* by I Roitt, J. Brostoff, D. Male, Mosby publisher, 5th edition (1998)
- 6) *Instrumental methods of chemical analysis* by Chatwal and Anand.
- 7) *Fundamentals of Analytical Chemistry*, 6th edition, D.A. Skoog, D.M. West and F.J. Holler, Saunders college publishing.
- 8) *Principle and practice of Analytical Chemistry* by F.W. Fifeild and D. Kealey 3rd edition, Blackie and sons Ltd.

CH- 481 Bioanalytical and forensic science
Section-I Bioanalytical (30 L)

1) Body fluids: (10 L)

Composition and detection of abnormal levels of certain constituents leading to diagnosis of diseases. Analysis of physiological fluids- urine, blood and serum physiological and nutritional significance of water soluble and fat soluble vitamins, minerals and analytical techniques for vitamins including microbiological techniques.

2) Human-nutrition: (5 L)

Estimation of enzymes, carbohydrates, essential amino acids, proteins and lipids.

3) Food Analysis: (12 L)

- a) Nutritional value of foods, idea about food processing and food preservations.
- b) Analysis of food such as milk, milk products, tea, coffee and beverages. Flour, starch, honey, jams and edible oils. Analysis of preservatives, coloring matter, micronutrients.

4) Food processing and food preservation: (3 L)

Refining milling, canning, concentration, freezing Drying, pasteurisation sterilization irradiation.
Ref. 8. Pages 446-452

Section-II
Toxicology and Forensic Science (30 L)

a) Toxicology: (20 L)

Isolation, identification and determination of following

- 1) Narcotics- heroin and cocaine.
- 2) Stimulants- caffeine, amphetamines.
- 3) Depressants- Barbiturates, Benzodiazepines.
- 4) Hallucinogens- LSD

b) Forensic Science: (10 L)

1) Medicinal and toilet preparations Act.

Definition alcohol, Medicinal preparation toilet preparation, Denatured spirit bonded manufactory Non bonded manufactory, Narcotic, Opium, exemption from duty Classification of med. and toilet preparations containing alcohol. *Ref. 7. Relevant pages*

2) Narcotics and Psychotropic substances Act.

Def – addict, cannabis (hemp), Coca derivative, coca leaf, Manufacture medicinal cannabis, narcotic drug, opium , opium derivative, opium poppy, poppy straw, psychotropic substance Illicit traffic, Prohibition control regulation offence and penalties. *Ref. 7. (Points 1, 2,3,4,5 and13)*

References:

- 1) *Analytical chemistry of foods by Ceiwyn S. James. Blackie academic and professional- Chapman and Hill publisher, madras 1st edition.*
- 2) *Introduction to food science and technology, food science and technology series by G.F. Stewart and M.A.Amerine, academic press.*

- 3) *Chemical analysis of food by Pearson.*
- 4) *Practical Biochemistry in clinical Medicine- R. L Nath, Academic Publishers 2nd Edn (1990)*
- 5) *Textbook of Forensic pharmacy- B. M. Mithal 9th Edn (1993) National Centre, Calcutta.*
- 6) *V. Malik, Drug and Cosmetics Act.*
- 7) *Forensic pharmacy by B.S Kuchekar, and A.M Khadatre Nirali Prakshan)*
- 8) *Shreves' Chemical Process Industries fifth edition by George Austin McGraw Hill*
- 9) *Practical Pharmaceutical Chemistry by Beckett*

CH-490 - Analytical Spectroscopy Section I (30L)

1) Introduction:

Electromagnetic radiation, properties, Interaction of radiations with matter, classification of analytical method based on EMR spectrum. (2 L)

2) Instrumentation:

Sources of radiations, monochromators, sample containers, detectors for various types of radiations. (5 L)

3) Electron spectroscopy:

Principle of ESCA. ESCA satellite peaks, chemical shifts, instrumentation, typical analytical applications. (5 L)

4) Ultraviolet photoelectron spectroscopy:

Principle, Instrumentation and analytical applications (2 L)

5) X- ray Methods of Analysis:

Principle, Theory- X-ray spectral lines, X-ray tube. X-ray Absorption, X-ray Diffraction, X-ray Fluorescence- instrumentation, qualitative and quantitative analysis, numerical problems. (10 L)

6) Chemiluminescences:

Introduction, principle, types. Measurement of chemiluminescence, Instrumentation quantitative chemiluminescences. Gas phase chemiluminescence's analysis. Chemiluminescences titrations. Electro-chemiluminescence. (6 L)

Section II (30 L)

7) Nuclear magnetic resonance spectroscopy:

Introduction, theory, Instrumentation, Chemical shifts. Spin-spin Splitting, solvents. Qualitative and quantitative analysis. Non protonic NMR spectra, Multiple resonance, Nuclear overhauser effect, solid samples in NMR, Kinetic studies with NMR, Limitations of NMR spectroscopy, 2-D NMR, Magnetic Imaging. (15 L)

8) Electron Paramagnetic resonance spectroscopy:

Introduction, theory, Instrumentation, Spin-spin coupling, Qualitative and quantitative analysis, multiple resonance, Spin labeling, metallic complexes, other uses of EPR spectroscopy. (12 L)

9) Electron Microscopy:

Introduction, Principles, Instrumentation, Applications. (3 L)

References:

- 1) *Introduction to instrumental analysis* by R. D. Braun, MC. Graw Hill- International edition.
- 2) *Analytical spectroscopy* by Kamallesh Bansal- First edition.
- 3) *Instrumental methods of chemical analysis* by Willard, Dean and Merittee- Sixth edition.
- 4) *Analytical chemistry principles* by John H. Kenedey- Second edition, Saunders college publishing.
- 5) *Electron microscopy in the study of material*, P. J Grundy and G. A Jones, Edward Arnold.
- 6) *Standard methods of chemical analysis- F. J. Welcher, part-B sixth edition (1966)* D. van Nosrtand Company. Inc. 19

CH-491 Polymer Technology Section I (30L)

1) Genesis of Polymers:

Brief history, what are polymers? How are polymers made? Classification of polymers. The role of polymers in society and the environment (2 L)

2) Chemistry of polymerization:

Chain polymerization, step polymerization, copolymerization, miscellaneous polymerization reactions, Polymerization techniques-Bulk, Solution, Suspension, Emulsion polymerization, Melt polycondensation, Solution polycindensation, Interfacial condensation, Salient features of different polymerization techniques. (8 L)

3) Individual polymers:

Preparation and applications of following polymers- Polyethylene, Polystyrene, Polyester, polyformaldehyde, Polycarbonate, Polyurethane, Polyamides, Polyethylene glycol, Polyvinyl acetate, Polyvinyl alcohol, polyvinyl chloride (PVC) Teflon, Polyisoprene, Polybutadine, Phenol- formaldehyde resin, Urea- formaldehyde resin, Epoxy polymers, Silicone polymers, Rayon, Cellophane, Cellulose nitrate, Cellulose acetate. (5 L)

4) Polymer reactions:

Hydrolysis, Acetolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of specific groups such as -OH, - COOH, >C= and other groups, Cyclisation reaction, cross linking reactions, reaction leading to graft and block co-polymers. (3 L)

5) Kinetics and mechanism of condensation reaction:

Chain reaction and co-polymerization reaction, Radiation induced polymerization. Kinetics study and mechanism of polymerization in the liquid and solid phases, effect of radiation on polymers degradation and crosslinking. (8 L)

6) Polymer degradation:

Polymer degradation, Types of degradation – Thermal, mechanical, ultrasonic waves, photo, high energy degradation, oxidative, hydrolytic, biodegradation, environmental implication of polymer degradation. (4 L)

Section II (30L)

6) Analysis and testing of polymers: (10 L)

- a) Chemical analysis of polymers:
X-ray diffraction analysis, thermal analysis, TGA, DTA.
- b) Physical testing of polymers:
Mechanical properties, Fatigue testing, impact testing, tear resistance, hardness, abrasion resistance.
- c) Thermal properties: Softening temperature, flammability.
- d) Optical properties: transmittance, colour, gloss, haze and transparency.
- e) Electrical properties: dielectric constant and loss factor, resistivity, dielectric strength, electronic properties.
- f) Chemical properties: resistance to solvents, vapour permeability, weathering.

7) Measurement of molecular weight and size: (8 L)

End group analysis, colligative properties measurements, solution viscosity and molecular size.

8) Polymer processing techniques: (8 L)

Plastics, elastomers and fibers, compounding, processing techniques- calendaring, die-casting, film casting, compression moulding, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing, hand lay-up technique, filament winding technique, spray-up technique, fiber spinning, melt spinning, dry spinning, uniaxial orientation, post treatment of fibers.

9) The sol-gel process and ceramics: (4 L)

The basic chemistry of sol-gel process, gelation, aging and structure development, sol-gel and aqueous chemistry of metal oxide, optical material.

References:

- 1) *Textbook of polymer science 3rd edition by F.W.Billmeyer (1994).*
- 2) *Principles of polymer systems by F. Rodrigue, Tata Mc Graw Hill, New Delhi.*
- 3) *Principles of polymer systems by P.J.Flory, Cornell University press, New York.*
- 4) *Polymer chemistry-an introduction Seymour-Carraher-Marcel Dekker. Inc. New York.*
- 5) *Polymer Science by V.R. Gowarikar, N.B. Vishvanathane, New Age International Ltd. publisher (1998)*
- 6) *Polymer Science by Vasant Gowarikar, Wiley Eastern New York (1998).*
- 7) *Principle of polymer science, Bahadur and sastri, Narosa publishing house.*

CH-387 Practical course – I (Inorganic)

Perform any eighteen experiments of following:

1. Analysis of Dolomite with respect to a) Calcium b) Magnesium c) SiO_2 .
2. Analysis of bauxite ore with respect to a) mixed oxide b) Iron c) aluminum.
3. Analysis of Bronze with respect to a) Copper b) Tin.
4. Estimation of COD from waste water.
5. Analysis waste water with respect to a) alkalinity b) T.D.S. c) sulphate d) dissolved chlorine.
6. Estimation of Nitrogen from given fertilizer by Kjeldahl method.
7. Estimation of Phosphorus from given fertilizer by volumetry / colorimetry.
8. Estimation of Potassium from given fertilizer by gravimetry / Flame photometry.
9. Estimation of calcium in the sample of dairy whitener by flame photometry.
10. Estimation of sodium in the sample of dairy whitener by flame photometry.
11. Analysis of Borax by conductometry.
12. Volumetric determination of sugar by copper reduction (volumetric).
13. Determination of iron in syndets by colorimetric.
14. Analysis of pigments with respect to Zn and Cr.
15. Determination of alcohol from beverages spectrophotometrically using dichromate.
16. Determination of alcohol in beverages by gas chromatographic technique.
17. To study the oxidation of Ferrocene and reduction of $\text{K}_3[\text{Fe}(\text{CN})_6]$ by Cyclic Voltammetry.
18. Separation and molecular weight determination of protein by gel electrophoresis.
19. Thermo gravimetric analysis: composition of CaCO_3 and MgCO_3 in mixture.
20. To estimate the amount of paracetamol and dichlofenac sodium in caftol tablets (USP) by HPLC technique.
21. Limit test for Chloride / sulphate / lead / Iron.
22. Dissolution test of tablets.

CH-487 Practical Course II (Physical)

CH-487 Practical Course II (Physical)

Perform any eighteen experiments of following:

1. To determine amount of each para nitro-phenol and meta nitro-phenol from the given mixture by spectrophotometric titration using standard solution of NaOH. ($\lambda_{\max}=280\text{nm}$)
2. To determine the amount of each copper and bismuth or copper and iron (III) from the given mixture at 745nm by spectrophotometric titration using standard solution of EDTA.
3. To record ultraviolet adsorption spectrum of acetone in n-hexane and identify the various transition by Spectrophotometry.
4. Estimation of aspirin, paracetamol and caffeine from APC tablet by UV-Visible spectrophotometry.
5. Determination of relative strength of acetic acid, chloroacetic acid and trichloroacetic acid through measuring their K_a -value by conductivity measurement method.
6. Determination of the pK_a value of chloro-acetic acid and tri-chloro acetic acid by potentiometry / pH-metry using standard solution of NaOH.
7. Determination of concentration of each sulphuric acid, acetic acid and copper sulphate from their mixture by conductometric titration with standard NaOH.
8. Determination of strength of acetic acid from the commercial vinegar sample by potentiometric titration and its confirmation by conductometric / pH-metric titration using standard solution of NaOH.
9. Determination of strength of commercial phosphoric acid by potentiometric / pH-metric titration up to three equivalence point using standard solution of NaOH.
10. Estimation of various transition elements like Zn/Ni/Co/Cd/Al from various commercial samples by complexometric titration on potentiometry by using mercury electrode system.
11. Flame photometric estimation of each Na, K, Li and Ca from the given sample mixture by calibration curve method.
12. Flame photometric estimation of Na/ K/ Li/ Ca from their given sample by working curve method and its confirmation by standard addition method.
13. Flame photometric estimation of Na and K / Ca and K/ Na and Li from their binary mixture by standard addition method.
14. Estimation of Na and K / Ca and K from the binary mixture by internal standard method using lithium as internal standard on flame photometry.
15. Determination of amount of Zinc from the given sample solution by Nephelometric / Turbid metric titration using standard solution of $K_4[Fe(CN)_6]$ in 0.4M HCl.
16. Determination of amount of sulphate from the given sample solution by Nephelometric / Turbid metric titration using standard solution of $Ba(NO_3)_2$ or $Pb(NO_3)_2$.
17. Determination of amount of chloride from the given sample solution by Nephelometric/ Turbid metric titration using standard solution of $AgNO_3$.
18. Photofluorimetric determination of Quinine / Riboflavin / aluminum from unknown sample by working curve method and its confirmation by standard addition method.
19. Estimation of Zn and Cd from the unknown solution by polarographic technique.
20. Estimation of Zn and Cd from their mixture by polarographic technique.
21. Estimation of Ca and Mg from the mixture of their oxalate by recording their TGA curve.
22. Recording a TGA curve for a mixture of $CuSO_4$ and NaCl, find out the percentage of each constituent in the mixture.
23. Estimation of As, Pb, Se, Cr, Zn, Cu, Al, Ni, Fe and some important transition elements from the commercial samples by Atomic absorption spectrometry with working curve and standard addition method.
24. Determination of moisture content in food sample by Karl fisher reagents.

CH-488 Practical Course III (Organic)

Perform any eighteen experiments of following:

1. Determination of glucose from blood serum (enzyme method)
2. Determination of cholesterol and HDL Cholesterol in blood serum by kit method / colorimetry.
3. Estimation of Urea from blood sample (kit method).
4. Estimation of Tannin from tea.
5. Estimation of HMF from Honey.
6. Estimation of Salbutamol sulphate from Asthma inhaler.
7. Estimation of blood-glucose by Folin-Wu-method.
8. Isolation of caffeine from tea.
9. Estimation of aspirin/ paracetamol /caffeine from APC tablet.
10. Assay of Thiamine.
11. Assay of Local anesthetics. (I P)
12. Assay of soaps and detergents.
13. Assay of sulphur drugs.
14. Assay of polymers and plastics.
15. Estimation of Ketone bodies.
16. Estimation of creatine / creatinine in urine.
17. Estimation of total carbohydrates by Anthrone method.
18. Quantitative analysis of mixture by Gas Chromatography a) Chloroform and carbon tetrachloride b) methanol and ethanol.
19. Preparation of sulphanilamide from acetanilide (Organic Vogel).
20. Preparation of Methyl Salicylate and assay its purity (Organic Vogel)
21. Isolation of lycopene from tomato or β – Carotene from Carrots (Ikan).
22. Preparation, purification and assay of aspirin.
23. Isolation of casein from milk.
24. Estimation of Vitamin-C by 2,6 dichloro-indophenol method.

Reference books:

1. *Organic Laboratory technique a micro scale approach* by Donald L. Pavia, Gary M. Lampman, George S. Kriz, Randall G. Engel second edition.
2. *Practical clinical Biochemistry*, Harold Varley (4th Edition), CBS publishers and Distributors. New Delhi -110002.
3. *R. Ikan; natural products.*
4. *Peach and Tracy; Methods of Plant analysis Vol- VII.*
5. *Pavia and others; Organic Laboratory Techniques, (Second Edition, 1995), Sanders Series (Harcourt Brace*

Note: All organic compounds used as drugs prepared here will be purified and assayed for purity by standard IP/BP/VSP methods.