SOLAPUR UNIVERSITY, SOLAPUR

M. Sc. II- (Sem.-III & IV)

Analytical Chemistry

(Choice Based Credit System-CBCS-True Spirit)

(w.e.f. June, 2017)
SOLAPUR UNIVERSITY, SOLAPUR
M. Sc. II, Sem.-III & IV
ANALYTICAL CHEMISTRY SYLLABUS
(Choice Based Credit System-CBCS-True Spirit)
(w.e.f. June, 2017)

A two-year duration M. Sc. Analytical Chemistry course syllabus has been prepared as per the CBCS semester system. M. Sc. II, SEM-III & SEM-IV Analytical Chemistry syllabus will be implemented from June 2017. The syllabus has been prepared taking into consideration the syllabi of other Universities, SET, NET, UGC guidelines, and the specific inputs of the Expert Committee Members from S.P. Pune University, Pune, Shivaji University Kolhapur and Dr. BAMU, Aurangabad.

General Structure of the Course:

- Course Tenure: Two Academic Years divided into Four semesters
- Each semester: A) Four Theory papers of 70 marks each, for University Assessment and 30 marks each, for College Assessment.
- B) Two Practicals of 70 marks each, for University Assessment and 30 marks each, for College Assessment.
- C) One Tutorial of 25 marks

- The distribution of marks is mentioned below.

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Ratio of marks (Theory: Practical): (73:27)
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Summary:

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L = Lecture  
T = Tutorials  
P = Practical  
4 Credits of Theory = 4 Hours of teaching per week  
2 Credit of Practical = 4 hours per week  
HCT = Hard core theory,  
SCT = Soft core theory,  
HCP = Hard core practical  
SCP = Soft core practical,  
OET = Open elective theory,  
OEP = Open elective practical,  
HCMP = Hard core main project
Nature of Theory Examination Question Paper
Time: 2.5 hours                                                                                                 Maxi Marks 70

Instructions
1. Attempt 05 questions.
2. Section I (question 1) is compulsory
3. Attempt any two questions from section II and any two questions from section III.
4. Answers to all 05 questions (from section I, II, III) should be written in the one
   and the same answer book.
5. All questions carry equal marks.
6. Figures to the right indicate full marks.
7. Use of log tables and calculators is allowed.

Section I
Q 1. Answer the following (14 sub-questions) Marks 14 (1 x 14)
   Multiple choice / fill in the blanks / define the term / True-False, predict the
   product, provide the reagent and conditions etc.
   Sub-questions (i) to (xiv)

Section II
Q 2. a) - - - - - - - - - - - - Marks 07
    b) - - - - - - - - - - - - Marks 07
Q 3. a) - - - - - - - - - - - - Marks 07
    b) - - - - - - - - - - - - Marks 07
Q 4. a) - - - - - - - - - - - - Marks 07
    b) - - - - - - - - - - - - Marks 07

Section III
Q 5. a) - - - - - - - - - - - - Marks 05
    b) - - - - - - - - - - - - Marks 05
    c) - - - - - - - - - - - - Marks 04
Q 6. a) - - - - - - - - - - - - Marks 05
    b) - - - - - - - - - - - - Marks 05
    c) - - - - - - - - - - - - Marks 04
Q 7. Write short notes on (any three) Marks 14
    a) - - - - - - - - - - - -
    b) - - - - - - - - - - - -
    c) - - - - - - - - - - - -
    d) - - - - - - - - - - - -
N.B. In sections II and III, the sub-questions (a, b, and c) in a given question should be from different topics of the syllabus.

At least 25% questions should be problem oriented, where-ever possible, in view to train students for the SET/NET/GATE and other competitive examinations. These questions should test the understanding of candidate rather than the memory. The question paper should cover all the Units included in the syllabus of the respective paper and the weightage of the questions should correspond to the number of lectures allotted to the respective Units / Topics.
### Nature of Practical Examination

M. Sc. Part-II: Distribution of marks (Practicals):-

#### Semester - III

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* Practical Exam will be conducted for 3 days

#### Semester- IV

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* Practical Exam will be conducted for 3 days

### Nature of Question Papers

There shall be seven questions out of which the candidate has to solve five questions. Each question will carry 14 marks. Q. NO.1 (Section I) will be compulsory, objective type and will carry 1 mark per sub-question. Out of Q. No. 2 to 4 (Section II) and Q. No. 5 to 7 (Section III)

#### Notes:
2. It is absolutely essential to have yearly inspection of the Laboratories of the affiliated Colleges [where M. Sc (Chemistry) is being taught] by the 3 member Committee appointed by the Solapur University.
3. Each theory course prescribed for M. Sc. should be covered in 60 periods, each of 60 minutes; engaging 4 lectures per course per week. (Including tutorials)
4. Each practical course will require 6 hr of Laboratory work per week. [i.e. 12 hr for 2 Lab. Courses per week]
5. There shall be 8 students in a batch for M. Sc. Practical Course. (In any case not more than 10 students in a batch).
Semester- III Syllabus

HCT-301
Credit : 04
Contact Hours : 60

Advance Separation Techniques-I

Unit-I 15
**Paper Chromatography**- Definition, theory and principle, techniques, one, two dimensional and circular paper chromatography, mechanism of separation, structure of cellulose and types of paper, methodology-separation of sample, choice of solvents, location of spots and measurement of R value, factors affecting R value, advantages and applications.

**Affinity Chromatography**- Introduction, theory stationary phase, preparation of column, separation of antigens.

**Exclusion Chromatography**- Theory and principle of size exclusion chromatography, experimental techniques for gel filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing-factors governing column efficiency, methodology and applications.

Unit-II 15
**Electrophoresis**- Theory and classification, factors affecting mobility, macromolecular size and charge interactions with supporting electrolyte, pH and concentration discontinuities, Factors affecting electrophoresis phenomena-electrolysis, electrosomosis, temperature and supporting media. Instrumentation, methodology, Preparation of gelstaining and destaining, preparative zone electrophoresis, continuous electrophoresis and Applications.

**Capillary Electrophoresis**- Principle, theory, instrumentation, sample preparation and applications, Capillary electrochromatography and Miscellar electrokinetic capillary chromatography

Unit-III 15
**Membrane-Based Methods**: **Dialysis**- working of techniques, membranes, general consideration of diffusion, Donnan Membrane equilibrium and Applications.

**Electrodialysis**- working of techniques, membranes, Electrodialysis cells and Applications.

**Ultrafiltration**- working of techniques, membranes, non-gelatinous membranes and Applications. Dialysis compared with other membrane-separation methods.

**Other Separation Methods**: **Ultracentrifugation**- Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications.

**Zone refining**- Principle, zone leveling and applications.

Unit-I 15
**Solvent Extraction**- Basic principles, classification of solvent exaction systems, Factors affecting extraction process, Mechanism of extraction, extraction by chelation extraction by solvation, extraction equilibria for chelates, extraction equilibria for solvation, techniques of extraction, separation of metals by extraction, extraction by ion-pair formation, application of solvent extraction in industry, solid-phase extraction (SPE) and uses.
References

HCT-302
Credit : 04
Contact Hours : 60

Instrumental Methods of Chemical Analysis-I

Unit-I

Thermal Methods of Analysis-Introduction, thermo gravimetric analysis (TGA), types of thermo gravimetric analysis, principle, factors affecting the results-heating rate, furnace, instrument control/data. Application-purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination and kinetic parameters of thermal degradation.

Differential Thermal Analysis (DTA)- Theory, variables affecting the DTA curves, Difference between TGA and DTA. General principle, instrumentation, applications. Analysis of physical mixtures and thermal behaviors study. Determination of melting point, boiling point and decomposition point.


Unit-II


Unit-III

Electro Analytical Techniques

1. Ion Selective Electrodes- Terminology, types and construction of selective electrodes glass electrode, solid state and precipitate electrodes, liquid-liquid membrane electrode, enzyme and glass-sensing electrodes, glass electrodes for pH measurement (glass micro electrode) and applications.

2. Voltametry and Stripping voltametry- Principle, instrumentation and applications. Cyclic voltametry. Electrogravimetric analysis- Theory, apparatus, cell process, deposition and separation, electrolytic separation of metals and applications.

3. Coulometric Methods

Introduction, Principle, Coulometric techniques, potentiostatic couloumtry, Coulometric titrations, Coulometric determination, Advantages, Instrumentation for coulometric titration and applications.

Unit-IV

1. High frequency titration principle, instrumentation, advantages and disadvantages of high frequency method. Applications acid-base, complxometric measurement dielectric constant and analysis of mixture.

2. Ampherometry titration principles of Amperometric titrations, instrumentation, titration procedure, advantages and disadvantages

3. Electrgravimetric titration principle & theory, methods of electrogravimetric analysis, instrumentation, advantages and disadvantages
References
2. Radioactivity applied to chemistry. By Arthur C Wahs and R J Words
7. Radioisotopes Techniques MGH by Overman and Clark
8 Instrumental methods of chemical analysis, by H. Kaur(Pragati Prakashan,)
Applied Analytical Chemistry

Unit-I
Agricultural Analysis-I
Soil Analysis- Soil sampling, field description of soils, physical analysis, determination of major and minor constituents, exchange capacity, soil reaction (pH), chemical analysis as a measure of soil fertility.
Stock feeds analysis - feeding stuffs, qualitative analysis and quantitative analysis.
Plant analysis- Preparation of sample, moisture determination- methods of ashing, methods of plant analysis- starch, sugars, determination of mineral constituents (Fe, Mn, Mo, Si, Ca, Mg, P, S, C and N).

Unit-II
Agricultural Analysis-II
Pesticides and insecticides analysis- Introduction, classification, analysis of DDT, gammexane, zinab, ziram, thiram, thiometon, and chloridane.

Unit-III
Analysis of Minerals, Ores and Alloys
Minerals and ores- Hematite, pyrolusite, gypsum, dolomite, bauxite, and ilmenite ores.
Metal and alloys analysis- Steel, Cu-Ni alloy, solder, bronze, brass, aluminium alloy, Chromium.

Unit-IV
Cosmetics Analysis
Composition of creams and lotions, determination of water, propylene glycol, non-volatile matter and ash content. Determination of borate, sulphate, phosphate, chlorides, titanium and zinc oxide.
Analysis of face powder
Estimation of boric acid, mangnesium, calcium, zinc, iron, aluminium and Barium
Analysis of Deodorants and antiperspirants
Composition, analysis of fats and fatty acids, boric acid, Mg, Ca, Zn, Fe, Ti, Al, phenol, hexachlorophenone, methanamine, sulphonate and urea.
References

3. Encyclopedia of Industrial Methods of Chemical Analysis. By F D Snell (All sensus)
6. Instrumental methods of chemical analysis by Chatwal and Anand.
7. Instrumental methods of chemical analysis by Merit, Dean, Settle
10. Cosmetics By W. D. Poucher
11. Instrumental methods of chemical analysis H. Kaur
Unit-I
Analysis of petroleum and petroleum products  -Introduction, constituents and petroleum fractionation, quality control, requirements, safety and hazardous aspects, Analysis of petroleum products- specific gravity, viscosity, Doctor test, sulphuric acid absorption, aniline point, vapour pressure and colour determination, cloud point, pour point. Determination of water, neutralization value (acid and base numbers), ash content, sulphur and mercapton sulphur. Determination of lead in petroleum.

Unit-II
Analysis of coal and coke -Types, composition, preparation of sample, proximate and ultimate analysis calorific value by bomb Calorimetry.
Analysis of gaseous fuels -composition of fuel gases, collection of gas, analysis of fuel gases (coal gas, producer gas, water gas and flue gas)
Analysis of Explosive- General methods- Heat of explosion, Hygroscopicity, moisture by Karl Fischer titration, Qualitative tests of explosives, Qualitative analysis of explosive mixtures Dynamites. Blasting caps and electric detonators, primers, liquid propellants and solid propellants.

Unit-III
Cement - Loss on ignition, insoluble residue, total silica, sesquioxides, lime , magnesia, ferric oxide, sulphuric anhydride, air and dust pollution from cement plants, atmospheric dispersion of pollutants in cement industry.
Glass and Glass-Ceramics - Introduction, composition, method of analysis-sampling and sampling preparation, composition analysis-preliminary testing, decomposition, chemical method for the individual constituents- Si, B, Pb, Zn, Al, Cl, Ca, Mg, Ti.

Unit-IV
Analysis of Soaps-method of analysis-sampling, separation, identification, determination of soap composition-fatty acids, total anhydrous soap and combined alkali, potassium, water, determination of inorganic fillers and soap builders, determination of other additives.
Analysis of Detergents-types, method of analysis-sampling, separation, identification of components, determination of surfactants and other constituents.
References

2. Treatise on Analytical Chemistry Vol.I & II by L.M.Kolthoff
3. Encyclopedia of Industrial chemical Analysis Vol I to 20 (John Wiley) Riech:
4. Outline of Industrial Chemistry by F.D.Snell :
5. Instrumental Methods of Analysis (CBS) by Willard, Merrit, Dean & Settle :
6. Cosmetics by W D Poucher (Three volumes)
8. Instrumental Methods of Analysis (CBS) by Willard, Merrit, Dean & Settle
10. Quantitative Analysis by Vogel
OET-304A
Credit : 04
Contact Hours : 60

Analytical Spectroscopy

Unit-I

Raman spectroscopy- Introduction, principle, quantum mechanical theory of Raman effect, classical theories of Raman effect, rotational Raman spectra, vibrational Raman spectra, Vibrational-rotational spectra, Instrumentation, Applications of Raman Spectroscopy.

Resonance Raman Spectroscopy: Introduction, technique, difference between normal and resonance Raman spectrum, Resonance Raman effect, Applications of resonance Raman spectroscopy.

Unit-II

Mossbauer spectroscopy- Theory, isomer shift and quadrupole interaction, spectra of iron and tin compounds. Mossbauer spectrophotometer, applications. [Fe₃(CO)₁₂, Prussian blue, oxyheme crethrin, tin halides, hexacyano ferrates, nitroprussides]

Nuclear Quadrupole Resonance Spectroscopy- Introduction, effect of magnetic field on the spectra, relation between electric field gradient and structure applications of NQR.

Unit-III

Photoelectron Spectroscopy- Basic, principle of ESCA instrumentation, scope and limitations of ESCA. Ultraviolet photoelectron spectroscopy, Comparison between ESCA and UPS spectroscopy.

Photo acoustic spectroscopy- Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed system, chemical and surface applications.

Unit-IV

Electron Spin Resonance Spectroscopy


References
3. Molecular Spectroscopy. By G M Barrow
5. Basic Concept in Analytical chemistry, by S.M. Khopkar.
6. Spectroscopy (Atomic and Molecular) by G R Chatwal and S K Anand
7. Instrumental methods of chemical analysis by H. Kaur
Unit Operations of Chemical Engineering

Unit I:
A) Heat Exchangers
Introduction; Shell and Tube Heat Exchanger, Shell side and tube side passes

B) Evaporation
Introduction; Types of evaporators-Jacketed, Horizontal and Vertical tube evaporators, forced Circulation evaporation; Entrainment separators; Effect of various parameters on Evaporation; Multiple effect evaporators and its Economy.

Unit II:
A) Distillation
Introduction; Boiling and Distillation; Vapor liquid equilibria; Azeotropic mixture; Flash/Equilibrium distillation; Steam distillation; Vacuum distillation; Extractive distillation; Batch and Continuous distillation; Equipment and working of Rectifier/Fractionating column-Bubble cap plate, Sieve-plate, Valve plate, Downcomers.

B) Extraction
Introduction; Selection of solvent for Extraction; Extraction with agitation and its Equipments-Mixer Settler, Spray column, packed column, Sieve column, Rotating disc Contactor, pulse column; Extraction with reflux.

C) Leaching
Introduction; solid liquid leaching- Batch plant for extraction of oil from seed, Bollman extractor, Rotocel extractor; continuous leaching Equipments-Dorr Agitator, Dorr thickener, Continuous counter- current extraction.

Unit III:
A) Filtration
Introduction; Principles of cake filtration; Types of filtration-Constant rate, Constant pressure filtration; Filter aids; washing filter cake; Filtration Equipment – centrifugal filtration, Rotary drum filter.

B) Crystallization
Introduction; Supersaturation, Methods of supersaturation, The Miers supersaturation theory and its limitation; Nucleation, Homogeneous Nucleation; crystal growth; Caking of crystal; Crystal hydrates and Solvates; Deliquesence and Hygroscopicity; Efflorescence; crystallization equipment-Agitated tank crystallizer, Swenson -walker crystallizer, vacuum crystallizer, Oslo cooling crystallizer.

Unit IV:
A) Crushing, Grinding, Drying and Mixing

B) Mechanical Separation and Beneficiation
Introduction; Screening sieves- equipment and use, Removal of solid from gases-Cyclone, Hydrocyclone, Dust filters- electrostatic dust precipitators, colloidal particles and their removal- scrubbers.
References
1. F.A. Henglein: Chemical Technology (Pergamon)
2. J.M. Coulson, J.F. Richardson,: Chemical Engineering Vol I, II,III (Pergamon)
3. R.N. Shreve: The Chemical Process industry (MGH)
6. Prakash G. More, Comprehensive Industrial Chemistry, Pragati prakashan, Meerut (Uttar Pradesh)
Semester - IV Syllabus

HCT-401
Credit : 04
Contact Hours : 6
Advanced Analytical Techniques

Unit-I  15
Ion Chromatography
Principle, structure and characteristics of resins, eluent, suppressor columns and detectors used in ion chromatography, analytical applications, environmental speciation by ion chromatography and applications

Unit-II  15
Hyphenated Techniques:
Advanced techniques of analysis: - UV-Visible, IR, 1H-NMR (Recapitulation), 13CNMR, Mass spectrometry (advanced examples), GC-MS, HPLC-MS and their applications.
Kinetic methods of analysis-Rates of chemical reactions, rate laws, first order second order kinetics, psudo first order and second order reactions, enzyme catalysed reactions, steady state conditions, determination of reaction rates-experimental techniques, types of kinetic methods differential and integral, applications.

Unit-III  15
Automated Analysis

Unit-IV  15
Super critical fluid chromatography (SFC)-Introduction, properties of super critical fluids, supercritical fluid chromatography-instrumentation and operating variables, comparison to other types of chromatography, applications,
Super critical fluid extraction (SFE)- Introduction, advantages of SFE, instrumentation, supercritical fluid choice, Off-line and On-line extraction and applications.
Particle size determination-introduction, Low-angle laser light scatteringinstrumentation, theoretical models and application. Dynamic light scattering-principles, instrumentation and applications. Photosedimentation- settling velocity and particle size, instrumentation and applications.
References


6. Absorption Spectroscopy of Organic Molecules (Addition Wesley) by V.M. Parikh

7. Instrumental Methods of Analysis (CBS) by Willard, Merrit, Dean & Settle:


10. Applications of NMR Spectroscopy of Organic Chemistry (Pergamon Press) by Jackmann & Sternhill:

11. Nuclear Magnetic Resonance (Mc Graw Hill) by J.D.Roberts:

12. Mass Spectroscopy by K.Benjamin:


15. Basic Concept in Analytical chemistry, by S.M. Khopkar.
Unit-I  
**X-ray methods of Analysis**
Introduction, theory of X-ray generation, comparison with optical spectroscopy, X-ray spectroscopy, X-ray absorption, X-ray diffraction and X-ray fluorescence methods, theory, instrumentation, applications.

**Surface characterization by spectroscopy**-Introduction to the study of solid surfaces, types of surface measurements spectroscopic surface methods, general techniques in surface spectroscopy, sampling of surfaces, surface contamination.

Unit-II  
**Nephlometry and Turbidometry**-Introduction, theory, comparison of spectrophotometry, turbidimetry and nepelometry, instrumentation and applications.

**Refractometry** -Principle, parameters influencing refraction, significance of critical angle during measurements, refractometers, qualitative and quantitative analysis and analytical applications.

**Interferometry**-principles, instrumentation and applications.

Unit-III  
**Fluorimetry and Phosphorimetry**- Introduction, comparison of absorption and fluorescence methods, theory, instrumentation, applications of fluorimetry and phosphorimetry, comparison of fluorimetry and phosphorimetry, comparison of fluorimetry and phosphorimetry with absorption methods, applications of Photoluminescence methods, Chemiluminescence-phenomenon, measurement and applications.

Unit-IV  
A) **Emission Spectroscopy**-Introduction, theory, types of emission spectra, excitation energy requirements, relation of emission spectroscopy to flame photometry, instrumentation-excitation sources, electrodes, sample holder, monochromators, detectors, spectrographs, quantitative and qualitative and specific applications, advantages and disadvantages of emission spectroscopy.

B) **Flame photometry** principle-Instrumentation, interferences in flame photometry. Factors that influences intensity of emitted radiations of flame photometry, limitations of flame photometry and applications.
References

1) Instrumental Methods of Analysis by U. H. Willard L. L. Merrit, J. A. Dean

2) Basic Concept in Analytical chemistry, by S.M. Khopkar.

3) Principles of Instrumental Analysis, Holl Seamlers by D.Sleool and U.West

4) Kinetics in Analytical Chemistry Inter science NY by H.Mark and G.Rachnitz

5) Instrumental Methods of Chemical Analysis, Pragati Prakashan Meerut by H.Kaou,

6) A Text book of Quantitative Analysis by A.I.Vogel

7) Instrumental methods of chemical analysis by H. Kaur
HCT-403

Credit : 04
Contact Hours : 60
Bio-chemical and food analysis

Unit-I 15
Food Analysis
Food flavors, food colour, food preservatives, milk and milk products, floor starches, honey, jam and their major component analysis.
Introduction to natural fats and oils, analysis of oils and fats: softening point, congeg point, titrpoint, cloud point, iodine value, saponification value, acid value by R-M and Polenske value, Elaiden test.

Unit-II 15
Body Fluid Analysis
Composition and detection of abnormal level of certain constituents leading to diagnosis of diseases. Sample collection and preservation of physiological fluids, analytical methods to the constituents of physiological fluids (blood, urine and serum).
Blood-Estimation of glucose, cholesterol, urea, hemoglobin and bilirubin
Urine- urea, uric acid, creatinine, calcium, phosphate, sodium, potassium and chloride.

Unit-III 15
Drug Analysis
Introduction, source of drug, difference between drug and medicine, dangerous drugs, narcotics, classification of drugs, impurities/contaminants in pharmaceutical raw materials/chemical and drug, drug screening using gas chromatography, assay of drugs.
Characterization and analysis of some of the following drug-molecules;
1. Local anesthetics: Procaine Hydrochloride
2. Sedative-Hypnotics: Phenobarbital
3. Antianxiety agents: Diazepam
4. Anticonvulsants: Phenytoin
5. Antipsychotic agents: Chlorpromazine
6. Central intraneural blocking agents: Levodopa
7. Antidepressant agents: Imipramine hydrochloride
8. Central nervous system stimulants: Fenfluramine hydrochloride
9. Opioid Analgesics and Antitussives: Morphine sulphate, Codeine phosphate
10. Diuretic agents: Hydrochlorothiazide
11. Antihistamines- Antiallergic agents: Meyperamine maleate, Cyclizine hydrochloride
12. Nonsteroidal anti-inflammatory drugs: Ibuprofen, Paracetamol
13. Drugs that affect the cardiac functions: Isosorbide dinitrate, Digitoxin
15. Antihypertensive agents: Propanolol hydrochloride
16. Chollnergic agents: Pilocarpine nitrate, Neostigmine bromide
17. Barbiturates: Phenobarbital, Cyclobarbitone calcium
Unit-IV

Clinical Analysis- Biological significance, analysis of assay of enzymes (pepsin, monoamine, oxidase, tyrosinase), vitamins(thiamine, ascorbic acid, Vit. A) and hormones (progesterone, oxytocin, insulin) chemical, instrumental and biological assay wherever applicable.

Forensic Analysis-Special features of forensic analysis, sampling, sample storage, sample dissolution, classification of poisons, lethal dose, significance of LD-50 and LC-50. general discussion of poisons with special reference to mode of action of cyanide, organophosphate and snake venom. Estimation of poisonous materials such as lead, mercury and arsenic in biological samples.

References
1. Hand Book of Sugars (A VI) by S.R. Junk and H.M.Pancoast
2. Perfumery Technology (JC1) by B. Bilat and B.V.Well
3. Treatise on Analytical Chemistry Vol I and Vol II
4. Laboratory Techniques in Food Analysis by I.M.Kolthof, D.Pearson
6. Aids to the Analysis of Food and Drug by Nicholls
7. Standard Methods of Chemical Analysis vol I and II (6th ed) by F.J.Welcher
8. Analysis of Food Products, (Swan Publishers) by S.N.Mahendur :
11. Practical Pharmaceutical Chemistry by Beckett.
13. Forensic Pharmacy by B.S Kuchekar, and A.M Khadatare Nirali Prakshan)
15. P.D.Sethi, Quantitative analysis of drugs in pharmaceutical formulations, Unique publisher, New Delhi.
17.Alka L.Gupta, Analytical chemistry, Pragati prakashan, Merut.
Environmental Chemical Analysis

Unit-I
Air pollution- Suspended particulate matter, aerosol. Generation, hazards and control of SOx, NOx and Cox. Monitoring equipment – cyclone separator, electrostatic precipitator, filters and settling chambers.

Unit-II
Water-
Water resources, origin of waste water, types of water pollutants and their sources.
Chemical analysis of water: Objectives of analysis, parameters of analysis, sample collection and preservation, measurement of colour, turbidity, total solids, alkalinity, hardness, chloride, residual chlorine, sulphates, fluorides, phosphates and different forms of nitrogen in natural and polluted water and heavy metals. Pollution control. Public health significance of Pb, Cd, Hg, As, Cu, Zn and Mn.
Pollution control measures.
General survey of instrumental techniques for the analysis of heavy metal in aquatic system.
Organic loadings-significance and measurement of DO, BOD, COD, TOD and TOC, phenols, pesticides, surfactants, and tannin and lignin as water pollutants and their determination.

Unit-III
Waste water treatment- Terminology in waste water treatment, waste water characteristics, effluent standards.
b) Primary treatment-sedimentation, equalization, neutralization.
c) Secondary treatment-aerated lagoons, tricking filters, activated sludge process, oxidation ditch, oxidation pond and anerobic digestion, sludge treatment and disposal.
d) Tertiary treatment-evaporation, ion-exchange, adsorption, electrodialysis, electrolytic recovery and reverse osmosis.
f) Waste water disposal and re use, industrial waste water and its treatment

Unit-IV
Soil Pollution- Source of soil pollution, soil sediments as a pollutants, treatment and remedial measurements of soil pollution. Soil loss and degradation.
Industrial pollution- Sugar industry, paper and pulp industry, nuclear power plant, polymer drugs, radionuclide analysis, disposal of wastes and their management.
Principles of decomposition -biodegradability, better industrial process.

**References**

1) Environmental Chemistry, Environmental Pollution Analysis by S.M.Khopkar,

2) Environmental Chemistry, New Age International Publisher by A.K.De

3) Industrial Chemistry by B.K.Sharma


6) Instrumental Methods of Chemical Analysis by Chatwal and Anand.

7) Water and Waste Water Analysis; (NEERI) Ramteke,

8) Industrial Chemistry by B.K.Sharma.

9) Pollution Control in Process Industries by S.P.Mahajan.


Unit-I 15

a) Sources of Impurities in Pharmaceutical Raw Materials and Finished Products:
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. General
manufacturing processes.
b) Stability Studies, Shelf Life Fixation for Formulated Products

Unit-II 15

Test and assay of raw materials and finished products :
a) Biological Assays
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:
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 of moisture by KFR titration method and assay of
steroids. steroids (IP)
c) Analysis of vegetable drugs :
Sampling, foreign organic matter, ash values and water soluble ash (ginger) Acid
insoluble ash, sulphated ash.
d) Microbiological tests and assays
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,
Mediumsoyabean casein digest agar medium only)and total microbial count only }Test of
sterility-Membrane filtration method , Determination of Thiomersal
e) Physical tests and assays
Disintegration tests for (tablets, capsules, pessaries and suppositories Dissolution testtablets
and capsules.

Unit-III 15

Standardization and quality control of different dosage form
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.
Unit-IV

Role of FDA in pharmaceutical industry.
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.

References:-


2) Pharmacoepia of India Volume I and II.

3) Remington's Pharmaceutical sciences.

4) Forensic pharmacy by B.S Kuchekar, A.M Khadatare (Nirali Prakashan)

5) Practical pharmaceutical analysis by Ashitosh Kaur

6) Analytical problems of drug substances and Exp by Florey

1) Estimation of COD from waste water.

2) Analysis of waste water with respect to (a) alkalinity (b) T.D.S. (c) Sulphate (d) dissolved chlorine.

3) Estimation of nitrogen from given fertilizer by Kjeldahl method.

4) Estimation of phosphorus from given fertilizer by volumetry/colourimetry.

5) Estimation of potassium from given fertilizer by gravimetry / Flame photometry.

6) Estimation of calcium in the sample of dairy whitener by flame photometry.

7) Estimation of sodium in the sample of dairy whitener by flame photometry.

8) Analysis of borax by conductometry.

9) Determination of iron in syndets by colorimetric method.

10) Determination of alcohol from beverages spectrophotometrically using dichromate.

11) Dissolution test of tablets.

12) Determination of amount of Zinc from the given sample solution by
Nephelometric/Turbidimetric titration using standard solution of Ba (NO₃)₂ or Pb (NO₃)₂.

13) Determination of amount of chloride from the given sample solution by
Nephelometric/Turbidimetric titration using standard solution of AgNO₃.

14) Determination of dissociation constant of weak acid pH-metrically.

15) Chromatographic separation of sugars, amino acids by paper, TLC and ion exchange method (both quantitative and qualitative method) separation of organic compounds by column chromatography.

16) Estimation of Al in steel Rhudrescence method.

17) Analysis of felspar ore.

18) Analysis of some common pesticides insecticides, plastics and detergents.

19) Assay of sulpha drugs.

20) Chemical analysis of chilli-powder.

21) Any other relevant expt. may be added
1) To determine the amount of each para nitro-phenol and meta nitro-phenol from the given mixture by spectrophotometric titration using standard solution of NaOH (max-280 nm)

2) To determine the amount of each copper and bismuth or copper and iron (III) from the given mixture at 745 nm by spectrophotometric titration using solution of EDTA.

3) Determination of relative strength of acetic acid, chloroacetic acid and trichloroacetic acid through measuring their Ka-value by conductivity measurement method.

4) Determination of the pkₐ value of chloroacetic acid and trichloroacetic acid by potentiometry / pH. metry using standard solution of NaOH.

5) 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.

6) Flame photometric estimation of each Na, K, Li and Ca from the given sample mixture by calibration curve method.

7) Estimation of Zn and Cd from unknown solution by polarographic technique.

8) Determination of moisture content in food sample by Karl Fisher reagents.

9) Flame photometric estimation of Na/k/Li/Ca from their given sample by working curve method and its confirmation by standard addition method.

10) Estimation of Na and K / Ca and K from the binary mixture by internal standard method using lithium as internal standard on flame photometry.

11) Determination of concentration of sulphuric acid, acetic acid and copper sulphate from their mixture by conductometric titration with std. NaOH.

12) Estimation of various transition elements like Zn/Ni/Co/Cd/Al from various commercial samples by complexometric titrations on potentiometer by using mercury electrode.

13) Determination of dissociation constant of Cu-ammonia complex potentiometrically.

14) Determination of an indicator constant and isobestic point of an indicator spectrophotometrically.

15) Simultaneous estimation of Cl and I by potentiometrically.

16) Estimation of bicarbonate and carbonate by potentiometrically.

17) Estimation of purity of a given azo dye by colorometry.

18) Analysis of iodized table salt.

19) Analysis of malathion by colorometry.

20) Determination of concentration of given solution by standard addition method.

21) Any other relevant expt. may be added.
1. Separation of multicomponent mixtures using column chromatography
   a. Organic compounds
   b. Carbohydrates
   c. Pigments
   d. Amino acids
1) Estimation of Tannin from Tea.
2) Isolation of caffeine from tea.
3) Assay of soaps and detergent.
4) Preparation of sulphanilide from acetonilide, (Organic Vogel)
5) Preparation of methyl Salicylate and assay its purity (O.V)
6) Preparation, purification and assay of aspirin.
7) Isolation of casein from milk.
8) Estimation of the purity of a given azo dye by colourimetry.
9) Analysis of milk.
10) Determination of sap value and Iodine value of an oil.
12) Identification of organic compounds by their IR spectra.
13) Determination of amount of vit-B2 in the medicinal tablet fluorometrically.
14) Estimation of N-methyl and C-methyl groups.
15) Estimation of sodium benzoate/sodium metabisulphite, boric acid and salicylic acid in food.
16) Determination of Latent heat of fusion of naphthalene.
17) Estimation of glycine from given unknown solution
18) Preparation of methyl salicylate and assay its purity. (Vogel)
20) Determination of glucose from blood serum.
21) Estimation of urea from blood sample (kit method)
22) Any other relevant expt. may be added
A) List of Experiments
1) To calculate standard deviation of results obtained from redox titration of Fe$^{+2}$ against standard K2Cr2)7 solution
2) Determination of amount of zinc from given sample solution by Nephelometric / Turbidimetric titration using standard solution of K4(Fe (CN)6) in 0.4 M HCL
3) Determination of amount of sulphate from the given sample solution by Nephelometric / Turbidimetric titration using standard solution of Ba (NO3)2 or Pb (NO3)2
4) Analysis of soda ash.
5) Determination of moisture content in food sample by Karl Fisher reagent.
6) Spectrophotometric determination of manganese in steel.
7) Colorimetric and spectrophotometric determination of managanese in steel.
8) Solvent extraction separation of iron from marncrike using diethyl ether and their determination titrimetrically.
9) Analysis of chrome steel alloy for chromium and nickel content.
10) Agricultural analysis of soil sample, animal feeds, soil micronutrients, milk powder for Ca, Fe and P content.
11) Simultaneous spectrophotometric determination of (Cr and Mn )and (Ti and V)
12) Analysis of Illiminate ore.
13) Estimation of Fe by ceric sulphate and potassium dichromate titration potentiometrically.
14) Determination of concentration of Fe ions in ferric salicylate complex spectrophotometrically.
15) Estimation of amount of copper (II) with EDTA spectrophotometrically.
16) Analysis of vitamin A in food products.
17) Determination of Al/Mg by using 8-hydroxyquionoline as complexing agent by spectrophotometric method.
18) Analysis of pigments with respect to Zn and Cr.
19) Assay of polymer and plastic.
20) Isolation of lycopene from tomo to or β-carrotene from carrots.
21) Preparation, purification and assay of aspirin.
22) Estimation of phosphoric acid from given sample of Cola drink by molybdenum blue method.
23) Any other relevant expt. may be added
Project work or Industrial in plant training

In the final semester, students have to carry out project either at college laboratory or University laboratory or in any recognized R & D laboratory (Public /, Private / Government) or Industry or Institute of national repute across the country under the guidance of a scientist or a post-graduate faculty member. Every student has to submit his / her work in the form of a dissertation; which will be evaluated by the Examiners.

OR

Student can take industrial in-plant training in any chemical industry and after completion of training he/ she can submit the report. which will be evaluated by the examiner.