

Department of CHEMISTRY

- a) Enclose copy of curriculum **ENCLOSED**
b) List of the practical experiments in the curriculum actually done by the students and practical demonstrated.

Sl. No.	Name of the experiments [B.Sc.- I Year]
1	Inorganic Mixture Analysis
2	Titration - Acid- base titration, Redox titration, Iodo/Iodi metric titration
3	Surface tension, viscometer, Chemical Kinetics
4	Qualitative analysis, Sublimation, Crystallization, Distillation, Purification
Sl. No.	Name of the experiments [B.Sc.- II Year]
1	Quantitative analysis
2	Instrumentation
3	Chromatography
4	Qualitative analysis
5	Transition temperature
6	Phase equilibrium
7	Thermochemistry
Sl. No.	Name of the experiments [B.Sc.- III Year]
1	Synthesis analysis
2	Gravimetric analysis

3	Laboratory techniques
4	Qualitative analysis
5	Synthesis of organic compounds
6	Electrochemistry
7	Refractometer
8	Polarimeter
9	Colorimeter

c) When was the last exercise for curriculum revision undertaken?

As per the amendments made by affiliating University's Board of Studies.

d) Specialization of the course - **NIL**

e) No. of SoP's created Kits for practicals – **NIL**

PAPER - IV
LABORATORY COURSE

INORGANIC CHEMISTRY

A. Semi-micro qualitative analysis (using H₂S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding interfering, insoluble salts) out of the following:

Cations : NH₄⁺, Pb²⁺, Bi³⁺, Cu²⁺, Cd²⁺, Fe³⁺, Al³⁺, Co²⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, Na⁺
Anions : CO₃²⁻, S²⁻, SO₃²⁻, S₂O₃²⁻, NO₂⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²⁻
(Spot tests may be carried out wherever feasible)

B. Acid-Base Titrations

- Standardization of sodium hydroxide by oxalic acid solution.
- Determination of strength of HCl solution using sodium hydroxide as intermediate.
- Estimation of carbonate and hydroxide present together in mixture.
- Estimation of carbonate and bicarbonate present together in a mixture.
- Estimation of free alkali present in different soaps/detergents

C. Redox Titrations

- Standardization of KMnO₄ by oxalic acid solution.
- Estimation of Fe(II) using standardized KMnO₄ solution.
- Estimation of oxalic acid and sodium oxalate in a given mixture.
- Estimation of Fe(II) with K₂Cr₂O₇ using internal (diphenylamine, anthranilic acid) and external indicator.

D. Iodo / Iodimetric Titrations

- Estimation of Cu(II) and K₂Cr₂O₇ using sodium thiosulphate solution iodimetrically.
- Estimation of (a) arsenite and (b) antimony iodimetrically.
- Estimation of available chlorine in bleaching powder iodometrically.
- Estimation of Copper and Iron in mixture by standard solution of K₂Cr₂O₇ using sodium thiosulphate solution as titrants.

ORGANIC CHEMISTRY

1. Demonstration of laboratory Glasswares and Equipments.
2. Calibration of the thermometer. 80°-82° (Naphthalene), 113.5°-114° (Acetanilide), 132.5°-133° (Urea), 100° (Distilled Water).
3. Purification of organic compounds by crystallization using different solvents.
 - Phthalic acid from hot water (using fluted filter paper and stemless funnel).
 - Acetanilide from boiling water.
 - Naphthalene from ethanol.
 - Benzoic acid from water.

B.Sc.-I

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4. Determination of the melting points of organic compounds.
Naphthalene 80°–82°, Benzoic acid 121.5°–122°, Urea 132.5°–133° Succinic acid 184.5°–185°, Cinnamic acid 132.5°–133°, Salicylic acid 157.5°–158°, Acetanilide 113.5°–114°, m-Dinitrobenzene 90°, p-Dichlorobenzene 52°, Aspirin 135°.
5. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
- Urea – Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1).
6. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method).
- Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzene 80°.
- i. Distillation (Demonstration)
- Simple distillation of ethanol-water mixture using water condenser.
 - Distillation of nitrobenzene and aniline using air condenser.
- ii. Sublimation
- Camphor, Naphthalene, Phthalic acid and Succinic acid.
- iii. Decolorisation and crystallization using charcoal.
- Decolorisation of brown sugar with animal charcoal using gravity filtrations crystallization and decolorisation of impure naphthalene (100 g of naphthalene mixed with 0.3 g of Congo red using 1 g of decolorizing carbon) from ethanol.
7. Qualitative Analysis
- Detection of elements (N, S and halogens) and functional groups (Phenolic, Carboxylic, Carbonyl, Esters, Carbohydrates, Amines, Amides, Nitro and Anilide) in simple organic compounds.

PHYSICAL CHEMISTRY

1. Surface tension measurements.
- Determine the surface tension by (i) drop number (ii) drop weight method.
 - Surface tension composition curve for a binary liquid mixture.
2. Viscosity measurement using Ostwald's viscometer.
- Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature.

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- Study of the variation of viscosity of sucrose solution with the concentration of solute.
- Viscosity Composition curve for a binary liquid mixture.

3. Chemical Kinetics

- To determine the specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ions at room temperature.
- To study the effect of acid strength on the hydrolysis of an ester.
- To compare the strengths of HCl & H₂SO₄ by studying the kinetics of hydrolysis of ethyl acetate.

4. Colloids

- To prepare colloidal solution of silver nanoparticles (reduction method) and other metal nanoparticles using capping agents.

Note: Experiments may be added/ deleted subject to availability of time and facilities

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PRACTICAL EXAMINATION

05 Hrs. M.M. 50

Three experiments are to be performed

1. Inorganic Mixture Analysis, four radicals two basic & two acid (excluding insoluble, Interfering & combination of acid radicals) OR Two Titrations (Acid-Bases, Redox and Iodo/Iodimetry)

12 marks

2. Detection of functional group in the given organic compound and determine its MPt/BPt.

8 marks

O R

Crystallization of any one compound as given in the prospectus along with the Determination of mixed MPt.

O R

Decolorisation of brown sugar along with sublimation of camphor/ Naphthlene.

3. Any one physical experiment that can be completed in two hours including calculations.

14 marks

4. Viva

10 marks

5. Sessionals

06 marks

In case of Ex-Students two marks will be added to each of the experiments

REFERENCE TEXT:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Ahluwalia, V. K., Dhingra, S. and Gulati, A. College practical Chemistry, University Press.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
6. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
7. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

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PAPER - IV
LABORATORY COURSE

180 Hrs.

Inorganic Chemistry

Calibration of fractional weights, pipettes and burettes. Preparation of standard solutions, Dilution-0.1 M to 0.01 M. solutions.

Quantitative Analysis

Volumetric Analysis

- (a) Determination of acetic acid in commercial vinegar using NaOH.
- (b) Determination of alkali content-antacid tablet using HCl.
- (c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.
- (d) Estimation of hardness of water by EDTA.
- (e) Estimation of ferrous & ferric by dichromate method.
- (f) Estimation of copper using thiosulphate.

Instrumentation

Colorimetry

- (a) Job's method
- (b) Mole-ratio method
Adulteration-Food Stuffs.
Effluent analysis, water
analysis

Solvent Extraction

Separation and estimation of Mg (H) and Fe (H).

Ion Exchange Method

Separation and estimation of Mg (H) and Zn (H).

Organic Chemistry

Laboratory Techniques

A. Thin layer Chromatography

Determination of R_f values and identification of organic compounds.

- (a) Separation of green leaf pigments (spinach leave may be used)
- (b) Preparation and separation of 2, 4-dinitrophenyl hydrazones of acetone, 2-butanone, hexan-2 and 3-one using toluene and light petroleum (40:60)
- (c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

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B Paper Chromatography : Ascending & Circular.

Determination of R_f values and identification of organic compounds.

- Separation of mixture of phenylalanine and glycine. Alanine and aspartic acid, Leucine and glutamic acid, Spray reagent-ninhydrin.
- Separation of mixture of D, L-alanine, glycine, and L-Leucine using n-butanol : acetic acid : water (4:1:5), Spray reagent-ninhydrin.
- Separation of monosaccharides- a mixture of D-galactose and d-fructose using n-butanol : acetone : water (4:5:1), Spray reagent-aniline hydrogen phthalate.

Qualitative Analysis

Identification of an organic compound through the functional group analysis, determination of M.Pt. and preparation of derivatives. (Aliphatic and Aromatic)

Physical Chemistry

Transition Temperature

Determination of the transition temperature of the given substance by thermometric/ dilatometric method (e.g. $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}/\text{SrBr}_2 \cdot 2\text{H}_2\text{O}$).

PHASE EQUILIBRIUM

- To study the effect of a solute (e.g. NaCl, Succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. Phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
- To construct the phase diagram of two component system (e.g. diphenylamine-benzophenone) by cooling curve method.

THERMO CHEMISTRY

- To determine the solubility of benzoic acid at different temperatures and to determine H of the dissolution process.
- To determine the enthalpy of neutralisation of a weak acid / weak base versus strong base / strong acid and determine the enthalpy of ionisation of the weak acid weak base.
- To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium hydroxide from its enthalpy data using Born Haber cycle.

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Regerence Book -

1. Vogel's qualitative Analysis, revised Svehla, Orient Longman.
2. Standered method of chemical analysis, W.W.Scott, the Technical press.
3. Experimental Organic Chemistry, Vol. I & II, P.R.Singh, D.S. Gupta and K.S.Bajpai, Tata McGraw Hill.
4. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
5. Vogel's Text Book of Practical Organic Chemistry, B.S. Furnis, A.J. Hannaford, V.Rogers, P.W.G. S----ith and A.R. Tatchel, ELBS.
6. Experiments in General Chemistry C.N.R.Rao & U.C. Agrawal.
7. Experiments in Phyeical Chemistry R.C. Das & B.Behra, Tata McGraw Hill.
8. Advanced Practical Phvsical Chemistry, J.B. Yadav, Goel Publishing House.

5 Hrs.**PRACTICAL EXAMINATION****M.M. 50**

Three Experiments are to be Performed.

1. Inorganic - One experiment from synthesis and analysis by preparing the standard solution
be given. 12 marks
 - O R** One Experiment from instrumentation either by colorimetry / solvent extraction/ion exchange method.
 2. (a) Identification of the given organic compound & determine its M.Pt./B.Pt. 6 marks
(b) Determination of R_f value and identification of organic compounds by paper chromatography. 6 marks
 3. Any one physical experiment that can be completed in two hours inciuding calculations. 12 marks
 4. Viva 10 marks
 5. Sessional 04 marks
- In case of Ex-Students one marks will be added to each of the experimets.



Practical Chemistry III

PAPER-IV LABORATORY COURSE

180 Hrs.

Inorganic Chemistry

Synthesis Analysis

- Preparation of Sodium trioxalato ferrate (III), $\text{Na}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ and determination of its composition by permanganometry.
- Preparation of Ni-DMG complex, $[\text{Ni}(\text{DMG})_2]$
- Preparation of copper tetraammine complex, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$.
- Preparation of cis- and trans-bioxalato diaqua chromate (III) ion.

Gravimetric Analysis

Analysis of Cu as CuSCN or CuO , Ni as $\text{Ni}(\text{DMG})_2$, Ba as BaSO_4 and Fe as Fe_2O_3

Organic Chemistry

Laboratory Techniques

A Steam Distillation

Naphthalene from its suspension in water Clove oil from cloves
Separation of ortho and para-nitrophenols.

B Column Chromatography

Separation of fluorescein and methylene blue Separation of
leaf pigments from spinach leaves
Resolution of racemic mixture of (+,-) mandelic acid.

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, NaHCO_3 , NaOH for separation and preparation of suitable derivatives.

Synthesis of Organic Compounds

- Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.
- Aliphatic electrophilic substitution- Preparation of iodoform from ethanol and acetone.
- Aromatic electrophilic substitution-Nitration-
Preparation of m-dinitrobenzene, p-nitroacetanilide
Halogenation- Preparation of p-bromoacetanilide, 2,4,6 tribromophenol
- Diazotization/Coupling- Preparation of methyl orange and methyl red
- Oxidation- Preparation of benzoic acid from toluene
- Reduction- Preparation of aniline from nitrobenzene, m-nitroaniline from m-dinitrobenzene.

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Physical Chemistry

Electrochemistry

- To determine strength of given acid conductometrically using standard alkali solution.
- To determine solubility and solubility product of a sparingly soluble electrolyte conductometrically.
- To study saponification of ethyl acetate conductometrically.
- Determine the ionization constant of a weak acid conductometrically.
- To titrate potentiometrically the given ferrous ammonium sulphate using $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ as titrant and calculate the redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ system on the hydrogen scale.

Refractometry and Polarimetry

- To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
- To determine the specific rotation of a given optically active compound.

Molecular Weight Determination

- Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

To verify Beer-Lambert law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determine the concentration of the given solution of the substance.

REFERENCE BOOKS :

- Vogel's qualitative Analysis, revised, Svehla, Orient Longman
- Standard methods of chemical analysis, W.W. Scott, The Technical Press
- Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, tata McGraw Hill.
- Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern
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8 Hrs.

PRACTICAL EXAMINATION

M.M.50.

Five experiments are to be performed.

1. Inorganic - Two experiments to be performed.
Gravimetric estimation compulsory carrying 08 marks. (Manipulation 3 marks).
Anyone experiment from synthesis and analysis carrying 04 marks.
2. Organic-Two experiments to be performed.
Qualitative analysis of organic mixture containing two solid components.
compulsory carrying 08 marks (03 marks for each compound and two marks for separation).
One experiment from synthesis of organic compound (Single step) carrying 04 marks.
3. Physical-One physical experiment carrying 12 marks.
4. Sessional 04 marks.
5. Viva Voce 10 marks.

In case of Ex-Students one mark each will be added to Gravimetric analysis and Qualitative analysis of organic mixture and two marks in Physical experiment.

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