

DAYANAND COLLEGE HISAR

Affiliated to Guru Jambheshwar University of Science & Technology, Hisar
Under DAV College Managing Committee, New Delhi
(Accredited with Grade 'A' by NAAC)



DEPARTMENT OF CHEMISTRY Laboratory Manual



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General Facts about Labs

❖ Infrastructure and Maintenance

Department of Chemistry has four laboratories named as Chem. Lab-1, Chem. Lab-2, Chem. Lab-3 & Chem. Lab-4 which are maintained by Mr. Lalit, Mr. Jagminder, Mr. Sanjay Vasisth and Mr. Satish Kumar respectively for its cleanness and distribution of equipments to the students. We have our own scanner cum printer and Wi-Fi system. The Department has its separate store for Chemical and equipment maintained by Mr. Sanjay Kumar (store keeper) in a proper way.

Purchasing Procedure

Any demand requirement or discrepancy raised by the Lab attendants is brought into the notice of Principal. Application is written after which the order form is filled. Quotation invited is signed by the departmental purchase committee and then the lowest priced items quoted are purchased as per GST rules. All procedure is executed through college “Central Purchase and Maintenance Committee of the college.

❖ General Utilization Procedure

Students are divided into groups for smooth running of practical classes in labs. The related equipments and chemicals are issued to the students as per their schedule. Separate registers for equipment are maintained by Lab attendants on daily basis and issued to different Labs when needed. Models are prepared in our Lab by the students for participating in District and State Level Science Exhibitions.

POSTGRADUATE PRACTICALS

M.Sc. Chemistry 1st & 2nd Semester

Inorganic Chemistry

Practical -I

Course code: ACP-501

240 Hrs (8Hrs /week)

Credits: 8

Exam Time: 8 Hrs (two sessions of 4hrs each)

Marks for Major Test (External): 140

Marks for Internal Exam: 60

Total Marks: 200

I Water Analysis

1. Determination of dissolved oxygen in a water sample.
2. Determination of chemical oxygen demand of a waste water sample.
3. Determination of the amount of bleaching powder required to disinfect a water sample by Horrock's test.
4. Determination of total chlorine residuals.
5. Determination of free and combined chlorine residuals.
6. To determine the minimum dose of a coagulant required to coagulate a given sample by Jar test and to compare the effectiveness of aluminium sulphate and ferric sulphate as coagulants for a given sample at room temperature.
7. Determination of total suspended solids dried at 103-105°C
8. Determination of total dissolved solids dried at 180°C
9. Determination of fixed and volatile solids.
10. Determination of chloride content of a water sample by Mohr's Method.

II Qualitative Analysis

Ten unknown mixtures will be given containing four radicals out of which one must be an insoluble and one may be an acid radical and two metal ions.

- (a) Less common metal ions – Tl, Mo, W, Ti, Zr, Th, V, U (two metal ions in cationic/anionic forms)
- (b) Insoluble – oxides (Al_2O_3 , Cr_2O_3 , SnO_2 , TiO_2 , SiO_2), sulphates (PbSO_4 , BaSO_4), halides (AgCl , AgBr , AgI).
- (c) Acid radicals CO_3^{2-} , HCO_3^- , SO_3^{2-} , SO_4^{2-} , CH_3COO^- , S^{2-} , PO_4^{3-} , NO_3^- , NO_2^- , Cl^- , Br^- , I^- , $\text{C}_2\text{O}_4^{2-}$ etc.

III Preparations

Preparation of the following compounds and their spectroscopic studies.

1. $\text{VO}(\text{acac})_2$
2. $\text{NH}_4[\text{Cr}(\text{NH}_3)_2(\text{CNS})_4]$
3. $\text{Mn}(\text{acac})_3$
4. $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$
5. $\text{Hg}[\text{Co}(\text{NCS})_4]$
6. Potassium trioxalatoferate (III) Trihydrate.
7. Dichlorobis (hydroxylamine) Zinc (II).
8. Pentathioureadicuprous nitrate.
9. Potassium trioxalato cobaltate (III).
10. Carbonato tetra-ammine cobalt (III) nitrate.

M.Sc. Chemistry 1st & 2nd Semester
Organic Chemistry
Practical -I

Course code: ACP-502

240 Hrs (8Hrs /week)

Credits: 8

Exam Time: 8 Hrs (two sessions of 4hrs Each)

Marks for Major Test (External): 140

Marks for Internal Exam: 60

Total Marks: 200

I Separation and Purification Techniques

Recrystallisation, Distillation: simple, fractional, steam and vacuum distillation, extraction, chromatography: thin-layer and column chromatography and Gas Chromatography.

II Qualitative Analysis

Separation and identification of organic binary solid mixtures having acidic, basic and neutral components using water, NaHCO₃, NaOH, HCl and ether. Preparation of suitable derivatives of isolated compounds.

III Organic Synthesis

Preparation of organic compounds Acetylation: Acetylation of cholesterol. Oxidation: Adipic acid from cyclohexanol.

Aldol condensation: Dibenzal acetone from benzaldehyde. Sandmeyer reaction: *p*-Chlorotoluene from *p*-toluidine.

Other preparations involving different types of organic reactions may be included.

Books Suggested:

1. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
2. Organic Chemistry -A Lab Manual, D.L. Pavia, G.M. Lampman, G.S. Kriz, R.G. Engel, Cengage Learning
3. Practical Organic Chemistry, F.G. Mann, B.C. Saunders, Orient Longman
4. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
5. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
6. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
7. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.

M.Sc. Chemistry
1st & 2nd Semester
Physical Chemistry
Practical -I

Course code: ACP-503

240 Hrs (8Hrs /week)

Credits: 8

Exam Time: 8 Hrs (two sessions of 4hrs each)

Marks for Major Test (External): 140

Marks for Internal Exam: 60

Total Marks: 200

I Refractometry

1. Determine the refractive index of simple organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform.
2. Determine the refractivity and molar refractivity of some organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n -hexane, chloroform.
3. Determine the molar refractivities for CH₂, C, H and Cl.
4. Study the variation of refractive index with concentration for KCl solution and thereafter determine the unknown concentration of given KCl solution.

II Polarimetry

1. a) Study the variation of angle of optical rotation with the concentration of any optically active substance (sucrose or glucose) and thereafter determine the unknown concentration of the same substance in given solution.
b) Determine the specific and molecular rotation of sucrose or glucose at number of concentrations.
2. Study the kinetics of inversion of cane -sugar (sucrose) in presence of an acid.

III Potentiometry

1. Determine the standard electrode potential of Cu and Zn.
2. Determine the strength of a given solution of ferrous ammonium sulphate by potentiometric titration with K₂Cr₂O₇ solution.
3. Study the precipitation titration between KCl and AgNO₃ potentiometrically.
4. Determine the strength of iodide, bromide and chloride in a mixture by potentiometric titration with silver nitrate.

IV Conductometry

1. Determine the strength of strong acid by conductometric titration with strongbase.
2. Determine the strength of weak acid by conductometric titration with strong base.
3. Determine the strength of strong acid and weak acid in a mixture by conductometric titrationwith strong base.
4. Study precipitation titration between KCl and AgNO₃ conductometrically. Determine the strength of given solution of AgNO₃.
5. Determine the basicity of mono-, di- and tri-basic acids conductometrically.

- Determine solubility and solubility product of sparingly soluble salts like PbSO_4 , BaSO_4 .

V pH-metry

- Determine the strength of strong acid by pH-metric titration with strong base.
- Determine the strength of weak acid by pH-metric titration with strong base.
- Determine the dissociation constant of acetic acid using pH-meter.

VI Chemical Kinetics

- Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
- Study saponification of ethyl acetate by sodium hydroxide solution using same initial concentration of both the reactants.
- Study saponification of ethyl acetate by sodium hydroxide solution taking the initial concentration of ester and base to be different.

VII Viscosity

- Determine the viscosity of methyl acetate and ethyl acetate using Ostwald viscometer.
- Study the variation of viscosity with concentration for a glycerol solution using Ostwald viscometer and thereafter determine the concentration of unknown solution of glycerol.
- Determination of molar mass of a polymer.

VIII Distribution Law

- Determine distribution coefficient of ammonia between chloroform and water.
- Determine the formula of the complex formed between copper (II) ion and ammonia using distribution method.

IX Adsorption

- Verify the Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid/oxalic acid on activated charcoal.

Books Suggested

- Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
- Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
- Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
- Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
- Experiments in Physical Chemistry, D.P. Shoemaker
- Experiments in Physical Chemistry, D.V. Jahagirdhar.
- Senior Practical Physical Chemistry by B.D. Khosla, V. Garg and A. Gulati.
- Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

SEMESTER-I

CCP- 109 Practical Chemistry

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
 - (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-II

CCP 209 Practical -II

Chemistry Lab-II

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO₃, NH₄Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of *H. Ionicequilibria* pH measurements
 - a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
 - b) Preparation of buffer solutions:
 - (i) Sodium acetate-acetic acid
 - (ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).

SEMESTER-III

CCP-309

PRACTICAL-III

CHEMISTRY LAB-III:(SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY)

Section A: Physical Chemistry

Solutions: Determination of molecular weight of non volatile solute by Rast Method.

Phase equilibria: i. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

ii. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

iii. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance: i. Determination of cell constant

ii. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

iii. Perform the following conductometric titrations:

a. Strong acid vs. strong base

b. Weak acid vs. strong base

Potentiometry: Perform the following potentiometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II. 1. Separation of amino acids by paper/thin layer chromatography.

2. Determination of the concentration of glycine solution by formylation method.

3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a nonreducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.:New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

**SEMESTER-IV
CCP-409**

PRACTICAL-IV

**CHEMISTRY LAB IV: (TRANSITION METAL & COORDINATION CHEMISTRY,
STATES OF MATTER & CHEMICAL KINETICS)**

Section A: Inorganic Chemistry

Semi-micro qualitative analysis (using H₂S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble and interfering salts) out of the following: Cations : NH⁺, Pb²⁺, Bi³⁺, Cu²⁺, Cd²⁺, Fe³⁺, Al³⁺, Co²⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺

Anions : CO₃²⁻, S₂²⁻, SO₃²⁻, NO₂⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²⁻, PO₄³⁻, C₂O₄²⁻,

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate)nickel (II) in a given solution gravimetrically.
2. Estimation of (i) Mg²⁺ or (ii) Zn²⁺ by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Physical Chemistry

- I. Surface tension measurement (use of organic solvents excluded).
 - a. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
 - b. Study of the variation of surface tension of a detergent solution with concentration.
- II. Viscosity measurement (use of organic solvents excluded).
 - a. Determination of the viscosity of a liquid or dilute solution using an Ostwald's viscometer.
 - b. Study of the variation of viscosity of an aqueous solution with concentration of solute.
- III. Chemical Kinetics

Study the kinetics of the following reactions by integrated rate method:

- a. Acid hydrolysis of methyl acetate with hydrochloric acid.
- b. Saponification of ethyl acetate.
- c. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl

acetate

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEMESTER-V

CCP-509(i)

PRACTICAL-V(i)

CHEMISTRY DSC LAB V(i) POLYMER CHEMISTRY

I. Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
 - a. Purification of monomer
 - b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutyronitrile (AIBN)
2. Preparation of nylon 66
 3. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
 - a. Preparation of IPC
 - b. Purification of IPC
 - c. Interfacial polymerization
4. Redox polymerization of acrylamide
5. Precipitation polymerization of acrylonitrile
6. Preparation of urea-formaldehyde resin
7. Preparation of novalac resin/resold resin
8. Microscale emulsion polymerization of poly(methylacrylate).

II. Polymer characterization

1. Determination of molecular weight by viscometry:
 - a. Polyacrylamide-aq. NaNO₂ solution
 - b. (Poly vinyl propylidene (PVP) in water
 2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

III. Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques

3. Preparation of polyacrylamide and its electrophoresis

*at least 7 experiments to be carried out.

Reference Books:

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3rded.Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2nded.Prentice-Hall (2003)
- P. Munk& T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nded.John Wiley & Sons(2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4thed.John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction*3rded.Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed.by Charles E. Carraher, Jr. (2013).

SEMESTER-V
CCP-509(ii) PRACTICAL-V(ii)
CHEMISTRY DSC LAB V

Chemistry of Main Group Elements, Theories of Acids and Bases

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodimetric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches
4. Estimation of iodine in iodized salts.
5. Iodimetric estimation of ascorbic acid in fruit juices.
6. Estimation of dissolved oxygen in water samples.
7. Gravimetric estimation of sulphate as barium sulphate.
8. Gravimetric estimation of aluminium as oximato complex
9. Preparation of the following: potash alum, chrome alum, tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).

Recommended Texts:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

SEMESTER-VI
CCP-609(i) PRACTICAL-VI(i)
CHEMISTRY DSC LAB VI
Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR
Spectroscopy

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case.

(Combination of two ions to be given)

- a. Paper chromatographic separation of Fe^{3+} , Al^{3+} and Cr^{3+} or
- b. Paper chromatographic separation of Ni^{2+} , Co^{2+} , Mn^{2+} and Zn^{2+}

2. Preparation of any two of the following complexes and measurement of their conductivity:

- a. tetraamminecarbonatocobalt (III) nitrate
- b. tetraamminecopper (II) sulphate
- c. potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl_2 and LiCl_3 .

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-VI

CCP-609(ii)

Practical-VI(ii)

CHEMISTRY DSE LAB 6B: QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY

UV/Visible spectroscopy

1. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colorimetry

1. Verify Lambert-Beer's law and determine the concentration of CuSO_4 / KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration
2. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
3. Study the kinetics of iodination of propanone in acidic medium.
4. Determine the amount of iron present in a sample using 1,10-phenanthroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).
6. Analyse the given vibration-rotation spectrum of $\text{HCl}(\text{g})$

Reference Books

- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry* 8th Ed.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry* 3rd Ed.; W.H. Freeman & Co.: New York (2003).

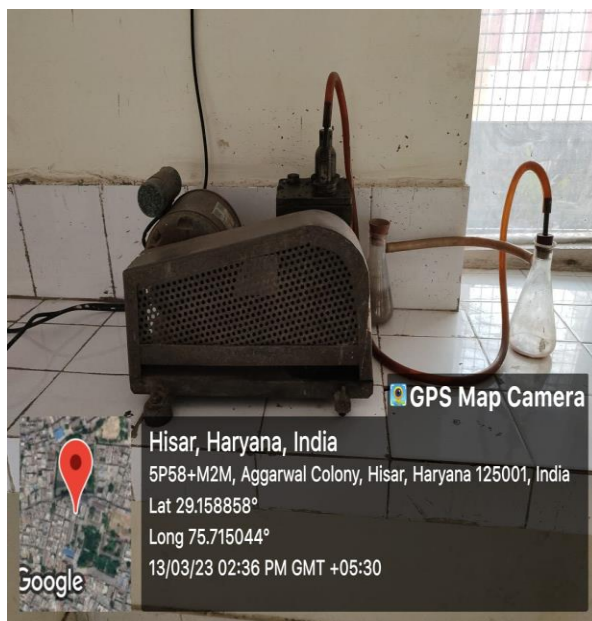
List of Instruments/ Equipments

Sr. No.	Items	Total
1	Atomic Model	7
2	Burner (LPG)	92
3	Balance	20
4	Burette Clamps	165
5	Conductivity Cell	3
6	Copper Plate	20
7	Clamps For Iron Stands	185
8	Counter Balance	2
9	Drying cone	84
10	Electric Oven	3
11	Air Blower	4
12	Distilled Water Plant (Steel)	3
13	Filter Pump	24
14	Foot Blower	1
15	Iron Stand	206
16	Muffle Furnace	1
17	Pastle Motor	10
18	Polythene Bottle	65
19	Ring Iron	50
20	Spatula	242
21	Send Bath	250
22	Stop Clock	4
23	Weight Box	98
24	Water bath	140
25	Zinc plate	20
26	Rotary Shaker	2
27	Digital Electronic Balance	12

28	Deionizer Water treatment plant	1
29	Separating Funnel (Polythene)	13
30	Tripod Stands	348
31	Refrigerator	2
32	pH Meter	8
33	Colorimeter	8
34	Avo Source	1
35	Magnetic Stirrer	2
36	Heating Mental	6
37	Conductivity Meter	15
38	Hot Plate	6
39	Stabilizer For Gas Plant	1
40	Melting Point app.	15
41	Water Bath Electric	1
42	Potentiometer	6
43	Telephone Set	1
44	Vacuum Pump	4
45	Centrifugal Machine	3
46	Abbe's Refractometer	6
47	TLC Applicator	1
48	Lab Scale	4
49	Computer and UPS	1
50	Spectrophotometer	2
51	Cork Boring Machine	1
52	Interactive Bord With Projecter	1
53	PG Gas Cylinder	12
54	R.O. (Water Purifier	1
55	Laptop	1
56	Aluminium Box 24x 36"	2
57	Printer	2



Conductivity Meter



Vaccum Pump



Distillation Assembly



Hot Plate



Spectrophotometer



Centrifugal Machine



Potentiometer



Colorimeter



Melting Point Apparatus



Abbe's Refractometer



Digital Balance



Distillation Unit



Chemicals



Saparating Funnel

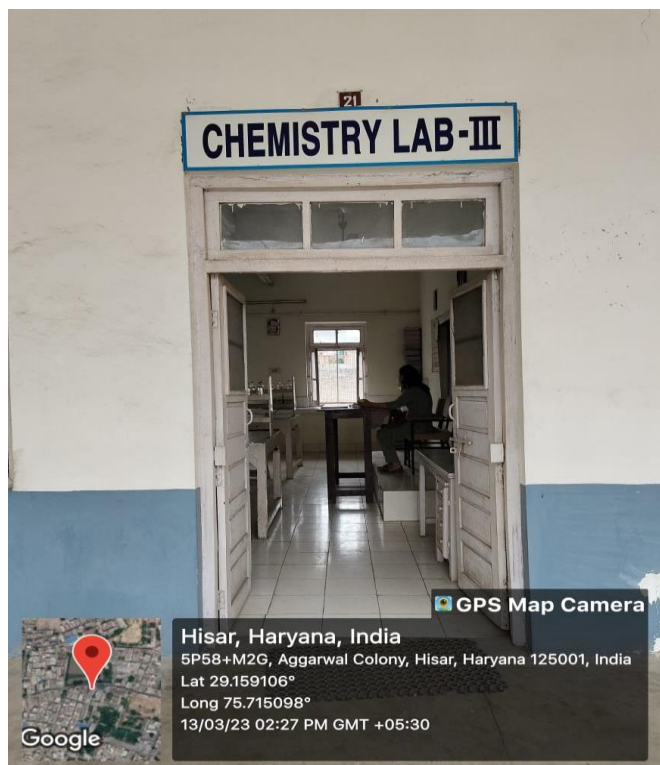
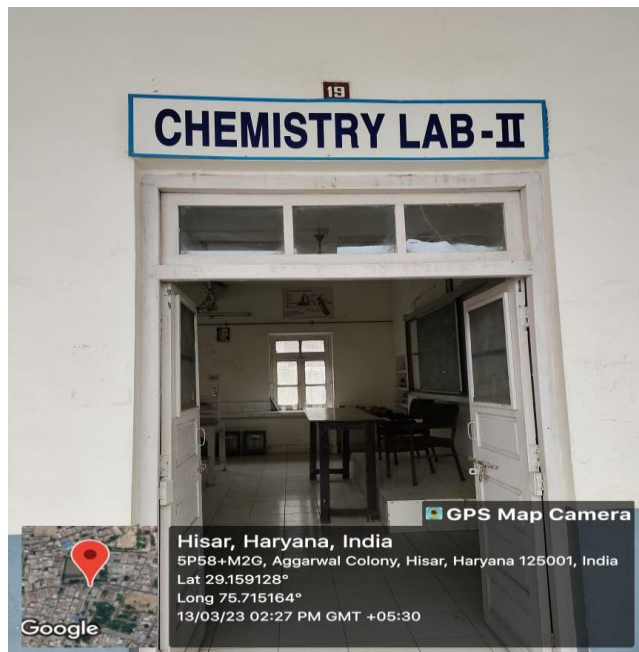


Reagents



Store Rooms

CHEMISTRY LABORATORIES



HEAD OFFICE & STAFF ROOMS

