SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CHEMISTRY

1901209-Environmental
Chemistry Lab Manual
(2022-23)

1901209   **APPLIED PHYSICS AND ENVIRONMENTAL**   **LTP C**
                                    CHEMISTRY LABORATORY   **0 0 4 2**
                     (Common to all branches of B.E., / B.Tech., Programmes)

ENVIRONMENTAL CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To determine the dissolved oxygen and chloride content in water.
- To determine calcium and magnesium present in domestic water.
- To estimate iron, sodium and chlorine using various techniques.
- To determine the chemical oxygen demand in industrial effluent.
- To determine the available chlorine in bleaching powder.

List of Experiments

1. Determination of total, temporary & permanent hardness of water by EDTA method
2. Determination of DO content of water sample by Winkler's method
3. Determination of chloride content of water sample by argentometric method
4. Estimation of iron content of the water sample using spectrophotometer
5. Determination of COD value of industrial effluents
6. Estimation of sodium by flame photometry
7. Estimation of available chlorine in bleaching powder

Demo

a. Pollution abatement by adsorption techniques
b. Scintillation Process

OUTCOMES
The student should be able to:

- Appreciate the basic requirements for potable water.
- Understand the need of dissolved oxygen in water.
- Explore the quantity of bleaching powder to be added in water.
- Analyze the ill effects caused by the industrial effluents.
- Explore new research areas in the treatment of waste water.

TEXT BOOK

G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, "Vogel's Textbook of Quantitative Chemical Analysis", John Wiley & Sons Inc, 2014.

CONTENTS

Titration 1 : Standardisation of silver nitrate

Std. NaCl vs $AgNO_3$

Sl. No	Volume of std. NaCl (ml)	Burette reading (ml)		Volume of $AgNO_3$ (V_1 ml)	Concordant value (ml)	Indicator
		Initial	Final			
1.	20	0				K_2CrO_4
2.	20	0				

Calculation of the Strength of silver nitrate

Volume of std. NaCl $\qquad$ (V_2) = 20 ml

Strength of NaCl $\qquad$ (N_2) = 0.01 N

Volume of $AgNO_3$ $\qquad$ (V_1) = _____ ml

Strength of $AgNO_3$ $\qquad$ (N_1) = ?

According to volumetric formula

$$V_1 N_1 = V_2 N_2 \text{ i.e ., } N_1 = V_2 \times \frac{N_2}{V_1}$$

$$N_1 = 20 \text{ ml} \times 0.01 \text{ N}/V_1$$

Strength of $AgNO_3$ (N_1) = _____ N

1. ESTIMATION OF CHLORIDE CONTENT IN WATER BY ARGENTOMETRIC METHOD (MOHR'S METHOD)

Expt. No.		

Date			

AIM

To estimate the amount of chloride ion present in the water sample by Argentometric method (Mohr's method). You are provided with standard NaCl solution of strength 0.01 N and a link solution of $AgNO_3$ (approximately 0.01N).

CHEMICALS REQUIRED

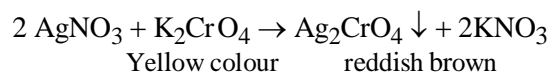Standard NaCl solution, $AgNO_3$ solution, Potassium chromate indicator

PRINCIPLE

Natural water contains chloride ions in the form of NaCl, KCl, $CaCl_2$, $MgCl_2$. The concentration of chloride ions more than 250 ppm is not desirable for drinking purposes.

This determination is based on precipitation titration. When $AgNO_3$ solution is added to the water sample, in presence of K_2CrO_4, the chlorides present in it are precipitated first as AgCl.

$$AgNO_3 + NaCl \text{------>} AgCl \downarrow + NaNO_3$$
$$\text{In water} \qquad \text{White ppt.}$$
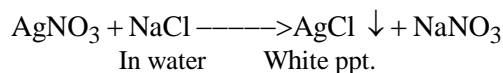
When all the Cl^- ions is removed, $AgNO_3$ added from the burette will react with K_2CrO_4 to give a reddish brown colour due to silver chromate (Ag_2CrO_4). This is the end point.

$$2\,AgNO_3 + K_2CrO_4 \rightarrow Ag_2CrO_4 \downarrow + 2KNO_3$$
$$\text{Yellow colour} \qquad \text{reddish brown}$$

PROCEDURE

Titration 1: Standardisation of $AgNO_3$

The burette is washed well with distilled water and rinsed with small amount of $AgNO_3$ solution. The pipette is washed with distilled water and rinsed with small amount of standard NaCl solution. 20ml of this solution is pipetted out into a clean conical flask. 1ml of 2% K_2CrO_4 indicator solution is added and titrated against $AgNO_3$ solution taken in the burette. The end point is the change of colour from yellow to reddish brown. The titration is repeated for concordant values.

Titration 2 : Estimation of Chloride

Water sample vs Standard AgNO$_3$

Sl. No	Volume of water sample (ml)	Burette reading (ml)		Volume of AgNO$_3$ (ml)	Concordant value (ml)	Indicator
		Initial	Final			
1.	20	0				K$_2$CrO$_4$
2.	20	0				

Calculation of the normality of water sample (Chloride ion)

Volume of water sample $\quad$ (V$_1$) = 20 ml

Strength of water sample $\quad$ (N$_1$) = ?

Volume of AgNO$_3$ $\quad$ (V$_2$) = _____ml

Strength of AgNO$_3$ $\quad$ (N$_2$) = _____N

According to volumetric formula

$$V_1N_1 = V_2N_2$$

$$N_1 = V_2 \times N_2/20$$

Strength of water sample $\quad$ (N$_1$) = ____N

Calculation of amount of chloride

Amount of chloride present in 1 litre of the given water sample = Eq.wt of chloride ion × Normality of chloride ion

Amount of chloride ion present in 100 ml of the given water sample = 35.46 × Normality of chloride ion × 100/1000gm

Titration 2: Estimation of Chloride ion

The given water sample is made up into 100 ml in a standard flask using distilled water. 20ml of this solution is pipetted out into a clean conical flask and 1ml of 2% K_2CrO_4 indicator solution is added. It is then titrated against standard $AgNO_3$ solution taken in the burette. The end point is the change of colour from yellow to reddish brown. The titration is repeated for concordant values.

RESULT

The amount of chloride ion present in 100 ml of the given water sample = _____ gms.

Titration: 1 Determination of Total Hardness

Sample hard water vs standard EDTA

S. No	Volume of sample hard water (ml)	Burette reading (ml)		Volume of EDTA (ml)	Concordant value (ml)	Indicator
		Initial	Final			
1.	20	0				Eriochrome black –T
2.	20	0				

Volume of hard water sample $(V_1) = 20$ml

Strength of hard water sample $(N_1) = \quad$ N

Volume of EDTA $(V_2) \qquad = ---$ ml

Strength of EDTA $(N_2) \qquad = 0.01$N

According to volumetric formula

$$V_1 N_1 = V_2 N_2$$

$$N_1 = \frac{V_2 \times 0.01}{20}$$

Strength of hard water sample $(N_1) = --- $ N

Total hardness of the hard water sample $= N_1 \times 50 \times 1000$

$$= \qquad \text{ppm}$$

2. ESTIMATION OF HARDNESS OF WATER BY EDTA METHOD

| Expt. No. | |

| Date | | | |

AIM

To estimate the amount of total hardness, permanent hardness and temporary hardness of a given hard water sample by EDTA method. You are provided with a standard solution of calcium of strength 0.01 M.
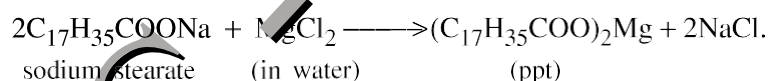
CHEMICALS REQUIRED

EDTA, Eriochrome black-T, water sample, ammoniacal buffer solution.

PRINCIPLE

The amount of calcium and magnesium ions present in a given sample of water is estimated by titration with standard EDTA. The hardness is expressed in terms of calcium carbonate equivalence.

Hardness

It is one of the important characteristics of water. Hardness of water is due to the presence of calcium and magnesium salts. Lather is not produced until the cations, Ca^{2+} and Mg^{2+} are completely precipitated out in the form of insoluble salts. For example,

$$2C_{17}H_{35}COONa + CaSO_4 \longrightarrow (C_{17}H_{35}COO)_2Ca + Na_2SO_4$$
sodium stearate   (in water)   (ppt)

$$2C_{17}H_{35}COONa + MgCl_2 \longrightarrow (C_{17}H_{35}COO)_2Mg + 2NaCl.$$
sodium stearate   (in water)   (ppt)

Temporary hardness

It is due to bicarbonates of calcium and magnesium. It can be removed by boiling. The salts are precipitated as carbonates and hydroxides respectively, which can be removed by filtration leaving only permanent hardness producing salts.

Permanent hardness

It is due to the sulphates and chlorides of calcium and magnesium.

Hardness is expressed in terms of $CaCO_3$ equivalence

The reason for choosing $CaCO_3$ as the standard for calculating hardness of water is due to its molecular weight being 100, which makes the calculations easier.

- It is the most insoluble salt, thus can be easily precipitated in water treatment processes.

Titration: 2 Determination of Permanent Hardness

Boiled water sample vs Standardised EDTA

S. No	Volume of boiled hard water Sample (ml)	Burette reading (ml)		Volume of EDTA (ml)	Concordant value (ml)	Indicator
		Initial	Final			
1.	20	0				Eriochrome black –T
2.	20	0				

Volume of boiled hard water sample (V_1) = 20ml

Strength of boiled hard water sample (N_1) =   N

Volume of EDTA (V_2) = ––– ml

Strength of EDTA (N_2) =0.01N

According to volumetric formula

$$V_1N_1 = V_2N_2$$

$$N_1 = \frac{V_2 \times 0.01}{20}$$

Strength of boiled hard water sample (N_1) = ––– N

Permanent hardness of the hard water sample   = N1 x 50 x 1000

   =   ppm

        Temporary hardness   =   Total hardness - Permanent hardness

                        = ...ppm

Determination of hardness

The hardness of water can be determined by complexometric titration. EDTA is used as a complexing agent. The Ca^{2+} and Mg^{2+} present in water are titrated with EDTA using Eriochrome Black T as indicator.

The Chemical structure of EDTA (Ethylene diamine tetra acetic acid) is represented as below:

$$HOOCH_2C\diagdown$$
$$Na^+COO^-H_2C\diagup N-CH_2-CH_2-N \diagup CH_2COO^-Na^+ \diagdown CH_2COOH$$
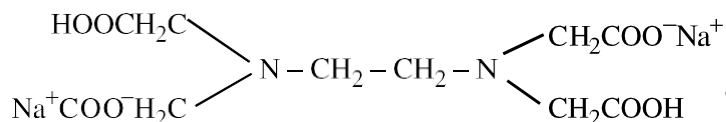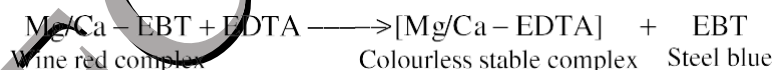
STRUCTURE OF EBT
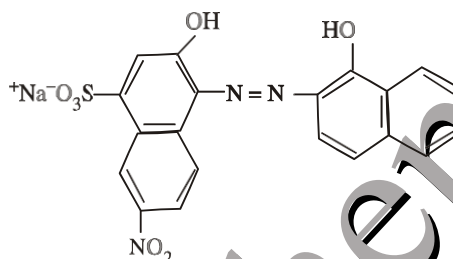
The indicator Eriochrome Black–T (EBT), forms a wine red colored unstable complex with calcium and magnesium ions in hard water at a pH of 8-10.

$$Mg^{2+}/Ca^{2+} + EBT \longrightarrow [Mg/Ca-EBT]$$
(in hard water)   unstable complex (wine red)

As this solution is titrated against EDTA, the Ca^{2+} and Mg^{2+} ions from the indicator complex forms stable metal ion- EDTA complex leaving the indicator free. The free form of indicator is steel blue in colour. The metal–EDTA complex is stable at pH 8-10. This pH range can be maintained by using ammoniacal buffer ($NH_4Cl + NH_4OH$).

$$Mg/Ca-EBT + EDTA \longrightarrow [Mg/Ca-EDTA] \quad + \quad EBT$$
Wine red complex   Colourless stable complex   Steel blue

Thus the amount of EDTA used corresponds to the hardness of water.

PROCEDURE :

Titration : 1 Estimation of total hardness of sample water

20 ml of the given hard water sample is pipetted out into a clean conical flask. 5ml of ammonical buffer solution and 2 drops of EBT indicator are added. The solution turns wine red in colour. The solution is then titrated against EDTA solution taken in the burette. The change of colour from wine red to steel blue is the end point. The titration is repeated for concordant values. Let the titre value be V ml. This gives the total hardness of the sample water.

Titration : 2 Estimation of permanent Hardness

100 ml of the given sample water is taken in a clean 250 ml beaker and boiled for 10-15 minutes until it is reduced to $1/5^{th}$ of the original volume. It is then cooled and filtered. The filtrate is collected in a 100 ml standard flask and made upto the mark using distilled water. 20 ml of this made up solution is pipetted out into a clean conical flask and the titration is repeated in the same way as in titration 1. Let the titre value be V ml. This gives the permanent hardness of the sample water.

Estimation of temporary hardness

Temporary hardness of the water sample is calculated by subtracting permanent hardness from total hardness.

Temporary hardness = Total Hardness − Permanent hardness.

RESULT

1. The total hardness of the given water sample   = _____ ppm

2. The permanent hardness of the given water sample   = _____ ppm

3. The temporary hardness of the given water sample   = _____ ppm.

Step I : Standardization of sodium thiosulphate

Titration I (Standard dichromate vs Sodium thiosulphate)

Sl.No	Volume of Potassium dichromate (ml)	Burette reading (ml)		Volume of Sodium thiosulphate (ml)	Indicator
		Initial	Final		
1	20	0			Starch
2	20	0			
3	20	0			

Volume of Potassium dichromate (V_1) = 20 ml

Strength of Potassium dichromate (N_1) = 0.0125 N

Volume of Sodium thiosulphate (V_2) = ––– ml

Strength of Sodium thiosulphate (N_2) = ––– N

According to volumetric formula

$$V_1N_1 = V_2N_2$$

$$N_2 = \frac{V_1N_1}{V_2}$$

Strength of Sodium thiosulphate (N_2) = ––– N

3. ESTIMATION OF DISSOLVED OXYGEN OF BOILER FEED WATER

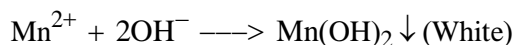| Expt. No.	

Date			

AIM

To determine the dissolved oxygen in the boiler feed water.
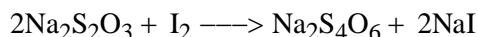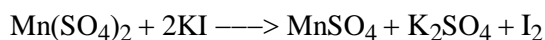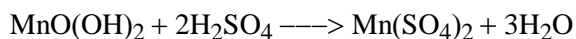
CHEMICALS REQUIRED

$Na_2S_2O_3$ (N/40), $MnSO_4$ solution, KI, starch, conc. H_2SO_4

PRINCIPLE

Oxygen dissolves in water to the extent of 7 - 9 mgs/lit at a temperature range of 25 - 35°C.The estimation of dissolved oxygen in water is useful in studying water pollution. Water sample is collected carefully avoiding aeration/deaeration in ground stoppered flask. Initially manganous sulphate and alkali-iodide reagents are added and the reaction occur as follows

$$Mn^{2+} + 2OH^- \longrightarrow Mn(OH)_2 \downarrow \text{(White)}$$

$$Mn(OH)_2 + \tfrac{1}{2}O_2 \longrightarrow MnO(OH)_2 \downarrow \text{(Yellow brown)}$$

Potassium iodide and the precipitate react with concentrated sulphuric acid liberating iodine and the liberated iodine is titrated against $Na_2S_2O_3$

$$MnO(OH)_2 + 2H_2SO_4 \longrightarrow Mn(SO_4)_2 + 3H_2O$$

$$Mn(SO_4)_2 + 2KI \longrightarrow MnSO_4 + K_2SO_4 + I_2$$

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$

PROCEDURE

Titration I

Standardisation of sodium thiosulphate

The burette is washed and rinsed with sodium thiosulphate solution. Then the burette is filled with the given sodium thiosulphate solution. 20 ml of 0.0125N potassium dichromate solution is pipetted out into a clean conical flask. To this, 5 ml of sulphuric acid and 50 ml of 5% potassium iodide are added. This is titrated against sodium thiosulphate solution. When the solution becomes straw yellow colour, starch indicator is added and then titration is continued.

The end point is disappearance of blue colour and appearance of light green colour. The titration is repeated to get concordant values.

Step II : Estimation of dissolved oxygen

Titration II (Water sample vs Sodium thiosulphate)

Sl.No	Volume of Water sample (ml)	Burette reading (ml)		Volume of Sodium thiosulphate (ml)	Indicator
		Initial	Final		
1	100	0			Starch
2	100	0			
3	100	0			

Volume of Sodium thiosulphate (V_1) =

Strength of Sodium thiosulphate (N_1) =

Volume of water sample (V_2) = 100 ml

Strength of water sample (N_2) = ——— N

According to volumetric formula

$$V_1N_1 = V_2N_2$$

$$N_2 = \frac{V_1N_1}{V_2}$$

Amount of dissolved oxygen in one litre of tap water =

Normality $\times$ Eq.wt.of O_2 $\times$ 1000 mg.

$$= \text{———} N \times 8 \times 1000$$

$$= \text{———} mg/lit$$

Titration II

Estimation of dissolved oxygen

100-150ml of the water sample is taken in the iodine flask, 2ml of manganese sulphate and 2 ml of alkali-iodide are added. The stopper is replaced and the flask is inverted and shaken several times for thorough mixing of the reagents. The flask is left aside for sometime. When half of the precipitate settles down, the stopper is removed and 2 ml of concentrated sulphuric acid is added.

The stopper is replaced and the flask is inverted several times for complete dissolution of the precipitate. 100 ml of the brown coloured solution is pipetted out and titrated against standardized sodium thiosulphate solution. Starch indicator is added when the solution becomes light yellow. The titration is continued until the blue colour disappears. From the titre value, the strength of dissolved oxygen and hence the amount of dissolved oxygen in the water sample is calculated.

RESULT

Amount of dissolved oxygen in water sample = ------------ mg/lit

Titration I: Standardization of sodium thiosulphate

Standard dichromate vs Sodium thiosulphate

Sl.No.	Volume of Potassium dichromate (ml)	Burette readings (ml)		Volume of sodium thiosulphate (ml)	Concordant Value (ml)
		Initial	Final		
1	20	0			
2	20	0			

Volume of Potassium dichromate (V_1) = 20 ml

Strength of Potassium dichromate (N_1) = 0.01 N

Volume of Sodium thiosulphate (V_2) = —— ml

Strength of Sodium thiosulphate (N_2) = —— N

According to volumetric formula, $V_1N_1 = V_2N_2$

$$N_2 = \frac{V_1N_1}{V_2}$$

Strength of Sodium thiosulphate (N_2) = —— N

4. ESTIMATION OF AVAILABLE CHLORINE IN BLEACHING POWDER

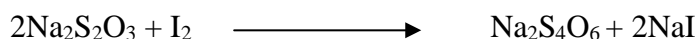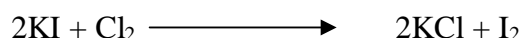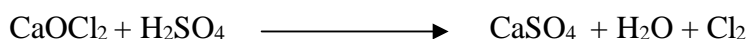| Expt. No	

Date			

AIM:

To determine the Percentage of Available chlorine in the given sample of bleaching powder solution Iodometrically.
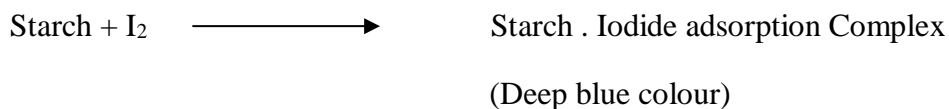
CHEMICALS REQUIRED:

N/10 Hypo ($Na_2S_2O_3.6\ H_2O$), bleaching powder sample solution, Solid KI, dilute H_2SO_4.

PRINCIPLE:

The amount of chlorine liberated by the action of dilute acids on bleaching powder is termed as available chlorine and expressed as percentage weight of bleaching powder. The bleaching powder is a mixture of ($CaOCl_2.4H_2O$)($CaCl_2\ Ca(OH).H_2O$) and some free $Ca(OH)_2$. When dilute H_2SO_4 reacts with bleaching powder then free chlorine is liberated. The liberated chlorine reacts with potassium iodide to give free iodine. This liberated free iodine is then titrated against N/10 Hypo solution, using freshly prepared starch solution.

$$CaOCl_2 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + Cl_2$$

$$2KI + Cl_2 \longrightarrow 2KCl + I_2$$

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$

Sodium Tetra Thionate

$$Starch + I_2 \longrightarrow Starch\ .\ Iodide\ adsorption\ Complex$$

(Deep blue colour)

PROCEDURE:

Titration 1:

Standardization of sodium thiosulphate

The burette is washed and rinsed with sodium thiosulphate solution. Then the burette is filled with the given sodium thiosulphate solution. 20 ml of 0.0125N potassium dichromate solution is pipetted out into a clean conical flask. To this, 5 ml of sulphuric acid and 50 ml of 5% potassium

Titration 2: Estimation of available chlorine

Bleaching powder vs Sodium thiosulphate

Sl.No.	Volume of Bleaching Powder sample taken (ml)	Burette readings (ml)		Volume of sodium thiosulphate (ml)	Concordant Value (ml)
		Initial	Final		
1	20	0			
2	20	0			

Volume of Sodium thiosulphate (V_1) = ml

Strength of Sodium thiosulphate (N_1) = N

Volume of Bleaching Powder solution (V_2) = 20 ml

Strength of Bleaching Powder solution (N_2) = ―― N

According to volumetric formula, $V_1N_1 = V_2N_2$

$$N_2 = \frac{V_1N_1}{V_2}$$

Strength of Bleaching Powder solution (N_2) = ―― N

Amount of Chlorine per Litre of solution = Normality x Equivalent weight

= N_2 x35.5 g/lit

Percentage of Available Chlorine = N_2 x 35.5x $\frac{500}{1000}$ x $\frac{100}{W}$

=…………………%

iodide are added. This is titrated against sodium thiosulphate solution. When the solution becomes straw yellow colour, starch indicator is added and then titration is continued.

The end point is disappearance of blue colour and appearance of light green colour. The titration is repeated to get concordant values.

Titration 2:

Estimation of available chlorine

Fill the burette with Hypo solution. Pipette out 20 ml of bleaching power solution into 250 ml conical flask. Add 2 ml of KI and 10 ml of dilute H_2SO_4. Cover the mouth of conical flask with lid and keep it for 2 minutes. Solution becomes brown. The liberated Iodine against Hypo solution till a light yellow colour persists. Add 1 to 2 ml of starch solution. Solutions turns to blue colour. Continue adding Hypo solution till blue colour disappears. This the end point. Repeat the experiment until the concordant readings are obtained.

RESULT:

The percentage of available chlorine in the given sample of bleaching powder is ………………….%

Tabulation :

Sl.No.	Volume of water sample (ml)	Burette readings (ml)		Volume of Ferrous Ammonium Sulphate (ml)	Concordant Value (ml)
		Initial	**Final**		

Calculation:

Quantity of Fe $(NH_4)_2(SO_4)_2$ added for blank (A) =

Quantity of Fe $(NH_4)_2(SO_4)_2$ added for sample (B) =

Dilution Factor = $\dfrac{\text{Volume of dilute sample}}{\text{Volume of waste water sample added}}$

$= \dfrac{40}{10}$

$= 4$

Chemical Oxygen Demand (COD) = $\dfrac{(A-B) \times N \times 8 \times 1000 \times \text{Dilution Factor}}{\text{Volume of Sample}}$

COD = ………………...

5. DETERMINATION OF COD VALUE OF INDUSTRIAL EFFLUENTS

Expt. No	

Date			

AIM:

To determine the chemical oxygen demand (COD) exerted by the given waste water sample.

APPARATUS REQUIRED:

Reflux Apparatus, Burette, Hot plate/ Heating mantel.

PRINCIPLE:

The organic matter present in sample gets oxidized completely by $K_2Cr_2O_7$ in the presence of H_2SO_4 to produce CO_2 and H_2O. The excess of $K_2Cr_2O_7$ remaining after the reaction is titrated with $Fe(NH_4)_2(SO_4)_2$. The dichromate consumed gives the oxygen required for the oxidation of organic matter.

REAGENTS:

1. Standard Potassium Dichromate 0.2N
2. Sulphuric Acid with reagent (Conc. $Ag_2SO_4^+ H_2SO_4$)
3. Std. Ferrous Ammonium Sulphate (0.1N)
4. Ferroin Indicator
5. Mercuric Sulphate
6. Silver Sulphate

PROCEDURE:

1. Take 10 ml of samle.
2. 5 ml of more conc. Dichromate solution are placed in a flask together with glass beads.
3. Add slowly 15 ml of H_2SO_4 containing Ag_2SO_4 and mix thoroughly.
4. Add pinch of mercurous sulphate ($HgSO_4$) and silver sulphate (Ag_2SO_4)
5. Connect the flask to condenser. Mix the contents thoroughly before heating. Improper mixing may result in bumping and the sample may be blown out.
6. Reflux for a minimum period of 2 hours. Cool and wash down the condenser with distilled water.
7. Dilute the sample to make up to 40 ml with distilled and cool.
8. Add 2-3 drops of Ferroin indicator. Mix thoroughly and titrate it against 0.1 N $Fe(NH_4)_2(SO_4)_2$. Sharp colour change from blue- green to wine red indicate the end point.
9. Reflux the blank solution in the same manner using distilled water instead of sample.

RESULT: The COD for the given water sample is…………………..
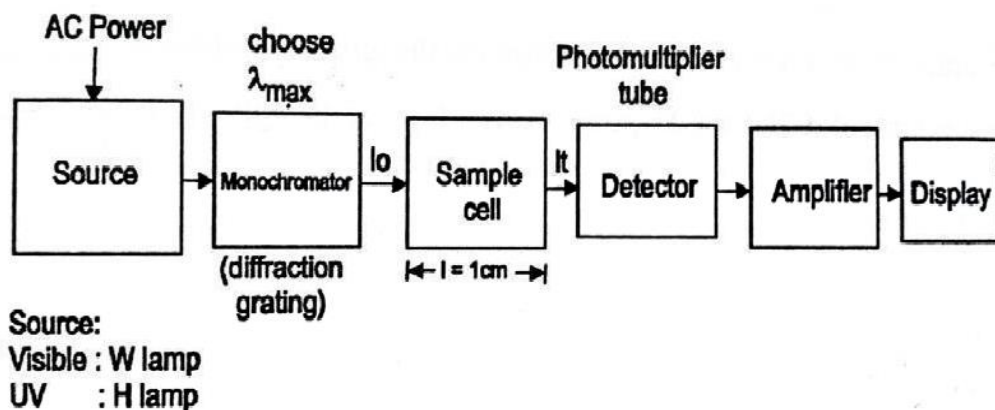
UV - Vis Spectrophotometer - Block diagram
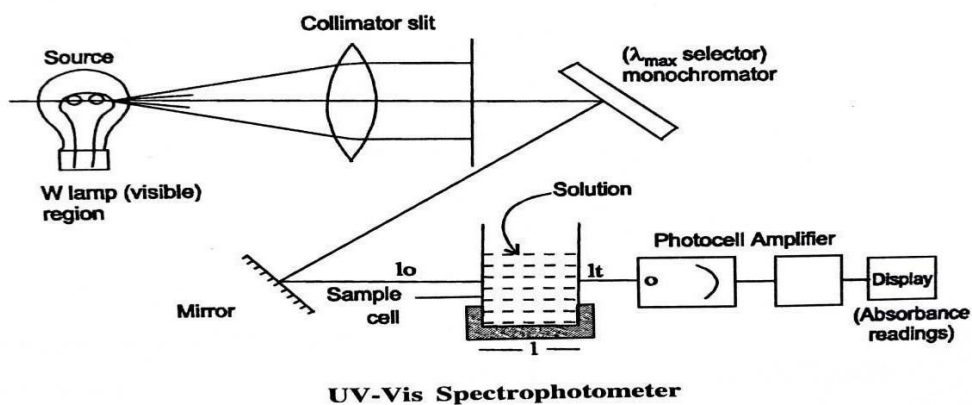
UV-Vis Spectrophotometer

V. DETERMINATION OF IRON IN WATER SAMPLE BY SPECTROPHOTOMETRY (USING THIO CYANATE)

Expt. No			Date			

AIM:

To estimate the amount of Fe^{3+} ion or Fe^{2+} ion present in the given aqueous solution by spectrophotometry. You are provided with a standard solution of ferrous ammonium sulphate containing 0.0838g in 1000ml.

MATERIAL REQUIRED:

Spectrophotometer, ferrous ammonium sulphate, nitric acid, potassium or ammonium thiocyanate, glass wares.

PRINCIPLE:

When a light passed through a solution, a portion of the light is absorbed. The portion of absorbed light depends on the concentration of the solution,

According to Lamberts Beer Law, if I_o and I_t are the intensities of the incident and transmitted light.

$$Log\ I_o/I_t = \varepsilon cl = A$$

ε, l are constants. A = absorbance, c= concentration

Thus by finding out the change in intensity of colour of the light absorbed by a solution, its concentration can be calculated.

In order to get a visible colour, Fe^{2+} ion is oxidized to Fe^{3+} by nitric acid and treated with potassium thiocyanate to get deep red colour.

$$Fe^{3+} + 6KSCN \longrightarrow (Fe\ (SCN)_6)^{3+}$$
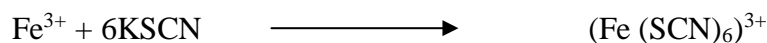
(red colouredthiocyanato complex of iron which absorbs in the visible region of 480 – 500 nm)

### PROCEDURE:

A standard solution may be prepared by dissolving 0.0838 g of pure ferrous ammonium sulphate in distilled water with 1 ml of con. HNO_3 and making upto 1000 ml (containing 1 ppm of iron / ml). 2,4,6 and 8 ppm iron solutions are prepared by pipetting out 2,4,6 and 8 ml solution in to a measuring cylinder,

Absorbance of Solution at 480 – 500 nm

S.No.	Concentration of Solution (mg/l)	Absorbance(nm)
1		
2		
3		
4		
5		

Graph
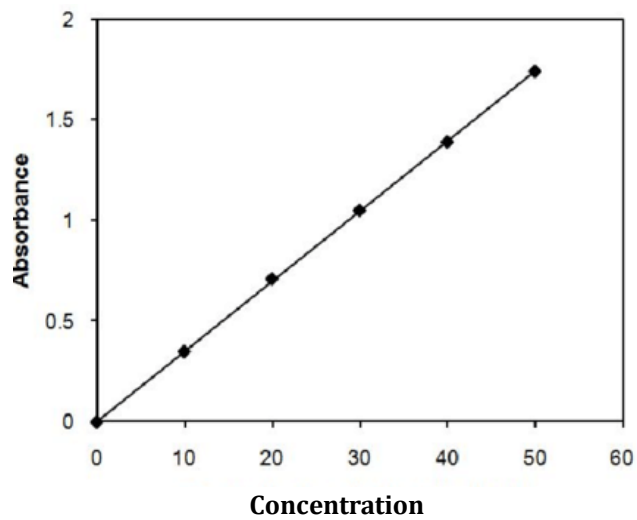
1ml of 1:1 HNO$_3$ and 1 ml of 10% thiocyanate and remaining distilled water are added to make the total volume of 10 ml.

The spectrophotometer is adjusted for λ = 480nm. The transmittance (I/I$_o$) of the blank solution taken in the cell is adjusted for 100% absorbance. Solutions of various known concentrations are taken one after the other and the respectiveabsorbances are measured. Lastly, the unknown solution is taken in the cell after carrying out the same treatment with nitric acid and thiocyanate.

Absorbance is measured. A graph is drawn connecting absorbance with concentration. A straight line is expected. From the graph and the absorbance of the unknown solution its concentration can be found out.

RESULT:

Amount of iron present in the given sample of water is = ----------------- ppm.