

B.Tech. I Year Chemistry
Semester- A & B
CH10652: CHEMISTRY Laboratory

Period/week			Credits			Maximum marks				
T	P	Tu	T	P	Tu	Theory		Practical		Total Marks
						CW	End Sem	SW	End Sem	
-	2	-	-	1	-	-	-	20	30	50

List of Experiments for B.Tech. I year, Chemistry

Laboratory Outcomes (LOs)

This laboratory course will illustrate the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- LO1** Develop abilities to perform various types of qualitative and quantitative analyses .
- LO2** Determine properties of lubricants and oil samples.
- LO3** Analyse water samples for in terms of hardness, chloride content, alkalinity and other dissolved/un-dissolved impurities.
- LO4** Ability to understand, explain and use instrumental techniques for elucidating properties of lubricants oil samples ,chemical materials etc.
- LO5** Follow to good laboratory practices during performance.

Group A

1. Determination of the viscosity of lubrication oil by Redwood Viscometer no.1 (at five different temperatures)
2. Determination of flash point of given oil by Abel's apparatus
3. Determination of percentage of moisture in a coal sample
4. Determination of Steam Emulsification number (SEN) of a given lubricating oil sample
5. Determination of Total Solids in a water sample
6. Determination of flash point of given oil by Pensky Martin's apparatus
7. Determination of the viscosity of lubrication oil by Redwood Viscometer no.2 (at five different temperatures)
8. Determination of Aniline Point of a given oil sample
9. Determination of Drop Point of a given semi-solid lubricant
10. Determination of acid value of an oil sample

11. To study the chemical oscillations (Iodine Clock reaction)
12. Potentiometric estimation of Ferrous Ammonium Sulphate using standard Potassium Dichromate Solution
13. Determination of the partition coefficient of a substance between two immiscible liquids.
14. Synthesis of polymer and nanomaterials
15. Verification of Beer-Lambert's law by visible spectroscopy

Group B

1. Determination of hardness of water sample by EDTA method
2. Determination of carbonates, bicarbonates and total alkalinity of a water sample
3. Determination of percentage purity of iron alloy by internal indicator method
4. Determination of percentage purity of iron alloy by external indicator method
5. Determination of chloride content of water

Text Book

1. A Textbook of Quantitative Inorganic Analysis. AI Vogel, 3rd Edition, Longmans, London.
2. A Textbook On Experiments And Calculations In Engineering Chemistry, SS Dara, S. Chand Publisher

Reference book

1. Vogel's Text Book of Quantitative Analysis, Ed. GH Jeffery, J Bassett, J. Mendham and RC Denny, Longmans, London

Internal Assessment Rubrics'(MM:20)

Sr. No.	Criteria	Marks
1.	Attendance	4
2.	Practical Record Submission	4
3.	Viva Voce	4
4.	Performance in the Lab	4
5.	Lab Ethics and Safety Procedure	4
Total		20
Final Scoring/Assessment		
Poor (1-4), Fair (5-9), Good (10-14), Excellent (15-20)		

Final Practical Exams Rubrics' (MM 30)

Sr. No.	Criteria	Marks
1.	Lab Ethics and Safety Procedure	5
2.	Concept of the Experiment	5
3.	Lab Work/ Experimental	5
4.	Problem Solving Strategy(ies)/Troubleshooting	5
5.	Calculation and Result Accuracy	5
6.	Explanation/Conclusion(s) of the Experiment	5
Total		30

Viva Questions with solutions

1 Engineering Experiment

Experiment – To determine the flash and fire point of a given oil sample by Abel's apparatus

Category- Engineering Experiment

1. Lubricant is used for-

Answer- **A substance which is capable of reducing friction between two surfaces which are sliding over each other**

2. What are the classification of lubricants?

Answer-**Lubricants can be broadly classified, on the basis of their physical state, as follows: (1) Liquid lubricants or lubricating oils; (2) Semi-solid lubricants or greases, and (3) Solid lubricants.**

3. What is flash point?

Answer-**Flash point of oil is defined as the minimum temperature at which it gives off sufficient vapours, which when mixed with air forms an ignitable mixture and gives a momentary flash .**

4. What is fire point?

Answer- **The temperature to which fuel oil must be heated to burn continuously when exposed to an open flame.**

5. What is the basic difference between flash point and fire point?

Answer-**The flash point of a oil is the temperature to which it must be heated to emit sufficient flammable vapor to flash when brought into contact with a flame. The fire point of a oil is the higher temperature at which the oil vapors will continue to burn when ignited.**

6. The flash point of a quality wise good lubricating oil should be.....

Answer-**High**

7. What are the significance of fire and flash point measurement?

Answer- **The flash and fire points are useful in determining a lubricants volatility and fire resistance. The flash point can be used to determine the transportation and storage temperature requirements for lubricants. Lubricant producers can also use the flash point to detect potential product contamination.**

8. Abel's apparatus is a closed or open cup apparatus?

Answer- **Closed cup apparatus**

9. Examples of open cup apparatus. . .

Answer-**Cleveland apparatus**

10. Which type of oil is used in Abels apparatus?

Answer-**It is suitable for oils whose flashes below 70°C.**

11. Pensky Martin's apparatus is a closed or open cup apparatus?

Answer-**Closed cup apparatus**

12. Which type of oil is used in Pensky Martin's apparatus?

Answer- **It is suitable for oils whose flashes above 100°C**

13. What is the basic difference between Abel's and Pensky Martin's apparatus?

Answer- **There are two main differences-**

Apparatus wise- In Abel's apparatus heating medium is water and in pensky martin's apparatus Direct heating process .

Abel's apparatus- It is suitable for oils whose flashes below 70°C.

Pensky martin's- It is suitable for oils whose flashes above 70°C.

Experiment – To determine the Steam Emulsification number of a given lubricating oil sample.

Category – Engineering Experiment

1. What is steam emulsification number?

Answer-

2. What is emulsion and how does it effect quality of lubricating oil?

Answer- **It is the mixture of oil and water under certain condition and it collect dirt, grit particles into oil and causes abrasion in machine parts.**

3. How does quality of lubricating oil change with increasing SEN greater than 1 minute?

Answer- **Good lubricating oil is one which does not form emulsion under lubricating conditions and even if it forms, it should break off very quickly so, quality decreases.**

4. Name of the flask used to generate steam in SEN is.

Answer-**Round bottom flask**

5. Give the name of apparatus parts in SEN.

Answer-

- **Steam generator**
- **Test tube**

- Separating Bath
- Delivery tube
- An emulsifying Bath

Experiment –To determine the Acid Value of a given lubricating oil sample.

Category – Engineering Experiment

1. What is acid no. of oil

Answer-**The acid value is defined as the number of milligrams of Potassium hydroxide required to neutralize the free fatty acids present in one gram of fat.**

2. What is rancidity of lubricating oil?

Answer-

3. Define viscometers and give some examples of different viscometers

Answer- **The instruments used for measuring the viscosity are known as viscometers.**

Different types of viscometers are-

Saybolt Viscometer

Angler's Viscometer

Ostwald Viscometer

Kinematic Viscometer

Redwood Viscometer

4. What are the similarities and dissimilarities between Redwood viscometer 1 and 2

Both the viscometers are identical in principle, shape and mode of testing. The essential differences between the two are-

Parameter	Redwood Viscometer No.1	Redwood Viscometer No.2
Dimensions of orifice (Jet)	Length-10mm, Dia-1.62mm	Length-50mm, Dia-3.8 mm
Kohlrausch flask	Smaller mouth	Wider mouth
Useful for	Low viscous oil having flow time between 30s-2000s e.g. Kerosene oil and mustard oil	Higher viscous oils having flow time greater than 2000s e.g. Fuel oil, mobile oil

5. Name few lubricants with high and low viscosity index.

Answer- **Silicone oil, glycol, vegetable oil, kerosene.**

6. How viscosity index of lubricating oil is can be improved?

Answer- **By adding additives eg. polymers**

7. What does it mean by kinematic viscosity?

Answer- **Kinematic viscosity is a measure of a fluid's internal resistance to flow under gravitational forces. It is determined by measuring the time in seconds, required for a fixed volume of fluid to flow a known distance by gravity through a capillary within a calibrated viscometer at a closely controlled temperature.**

Experiment –Determination of moisture content of coal or coke sample

Category – Engineering Experiment

1. What are the types of coal.

Answer- **Ans. Coal comes in four main types or ranks Peat, lignite or brown coal, bituminous coal of black coal, anthracite.**

2. What is a moisture.

Answer- **Moisture is an important property of coal, as all coals are mined wet. Ground water and other extraneous moisture is known as adventitious moisture and is readily evaporated. Moisture held within the coal itself is known as inherent moisture and analyzed.**

3. Determination of moisture content of coal sample is a ?

Answer- **Proximate Analysis.**

Proximate analysis involving determination of:

Moisture; Volatile matter; Ash content and; Fixed carbon

4. Ultimate analysis involving determination of:

Answer- **Carbon and Hydrogen**

Nitrogen

Sulphur and

Ash content

5. Significance of determination of moisture content of coal sample.

Answer- **Coal with low moisture belongs to a higher rank, possesses higher calorific value and sold / purchased as a superior grade fuel.**

6. Define calorific value.

Answer- **Calorific value of a fuel is the total quantity of heat liberated from the combustion of a unit mass (or unit volume) of the fuel in air or oxygen.**

2 Volumetric analysis

Experiment- Determination of hardness of water by EDTA method.

Category – Volumetric Experiment

1. What is hardness of water?

Answer- **It is the property of water in which hardness is caused by the presence of dissolved salts of Magnesium and Calcium.**

2. How do you differentiate hard water from soft water?

Answer- **It can be easily differentiated by treating with soap. Soft water forms lather easily with soap solution, while hard water doesn't give much lather with soap.**

3. What are the types of hardness? How are they caused?

Answer- **There are two types of hardness of water.**

(a) Temporary hardness caused by the bicarbonates of calcium and magnesium.

(b) Permanent hardness caused due to the chlorides and sulfates of magnesium and calcium.

4. How hardness of water is expressed?

Answer- **Hardness of water is generally expressed in ppm (parts per million) of CaCO_3 .**

5. What does EDTA stands for?

Answer- **Ethylene diamine tetra acetic acid.**

6. Why disodium salt of EDTA is used instead of EDTA in determining the total hardness of water?

Answer- **EDTA is sparingly soluble in water, therefore disodium salt of EDTA which is readily soluble in water. Hence It is used in determination of total hardness of water.**

7. What are buffers?

Answer- **These are the solutions in which resists the changes in pH when small amounts of acid or alkali is added to it.**

8. Give an example for acidic buffer and basic buffer.

Answer- **Acidic buffer: $\text{CH}_3\text{COOH}-\text{CH}_3\text{COONa}$ buffer**

Basic buffer: $\text{NH}_3-\text{NH}_4\text{Cl}$ buffer

9. Name the indicator used in determination of total hardness of water.

Answer- **Eriochrome Black-T (EBT)**

10. Give an example for metal ion indicator.

Answer- **Eriochrome Black-T (EBT)**

11. What are the ill effects of hard water?

Answer- **The main ill effects are skin irritation, cardiovascular disease, heart disease and high blood pressure etc. Especially in adults and children, there is an increased risk of reproductive failure and growth retardation was observed.**

12. Account for the colour change when indicator is added to hard water and at the end point.

Answer- **Wine red to clear blue formation due to the formation of weak metal ion indicator complex. At the end, it turns blue colour due to the release of free indicator. Since the weak wine-red complex is attacked and broken by the strong chelating agent EDTA.**

13. What is standard solution?

Answer- **Standard solutions are solutions that contain a known and accurate amount (i.e. concentration) of a substance or element.**

14. Define Normality and Molarity?

Answer- **Normality is defined as the number of equivalent mass of the solute dissolved in 1 litre/1000cm³/dm³**

Normality = (Mass X 1000) / (Eq. Mass X Volume)

Molarity is defined as the number of molecular mass of the solute dissolved in 1 litre/1000cm³/ dm³

Molarity = (Mass X 1000) / (Mol. Mass X Volume)

15. What is total hardness of water?

Answer- **Total hardness is the sum of temporary hardness (due to bicarbonates of calcium and Magnesium) and permanent hardness (due to chlorides, sulphates etc., of Calcium and Magnesium).**

16. How temporary and permanent hardness can be removed?

Answer- **Temporary hardness can be removed by simple physical process like boiling Permanent hardness can be removed only by chemical methods like soda-lime process, ion exchange process and Clark's method.**

17. Name the deposition formed when hard water is boiled?

Answer- **Scale and sludge formation take place (Boiler Problems)**

18. Why pH gets altered in the experiment?

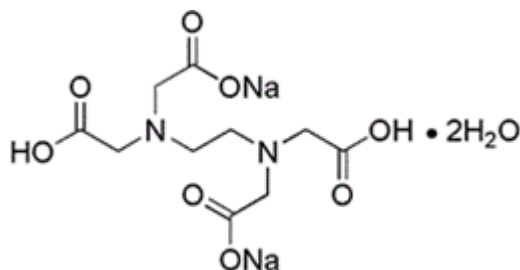
Answer- **The reaction involves the liberation of H⁺ ions and the indicator is sensitive to the concentration of H⁺ ions of the solution and this will directly affect the variation in the pH during the experiment.**

19. Why and how pH is maintained in the experiment?

Answer- **The reaction involves the liberation of H⁺ ions and the indicator is sensitive to the concentration of H⁺ ions of the solution and this will directly**

affect the variation in the pH during the experiment. However, a constant pH around 10 has to be maintained for completion of reaction. For this purpose, ammonia-ammonium chloride buffer is used.

20. Write the Chemical structure of disodium salt of EDTA.



Experiment-Determination of % purity of iron alloy by internal indicator method.

Category – Volumetric Experiment

1. Define normality?

Answer- **The number of gram or mole equivalents of solute present in one litre of a solution.**

2. What is Molarity?

Answer- **Molarity of a given solution is defined as the total number of moles of solute per litre of solution.**

3. What is the principle of volumetric analysis?

Answer- **In volumetric analysis, the concentration of a solution is determined by allowing a known volume of this to react quantitatively with another solution of known concentration.**

4. Define titration?

Answer- **The process of adding one solution from the burette to another in the titration flask in order to complete the chemical reaction involved, is known as titration.**

5. What is indicator?

Answer- **Indicator is a chemical substance which changes colour at the end point.**

6. The end point of titration is—.

Answer- **the stage during titration at which the reaction is just complete.**

7. Define internal indicator.

Answer- These are those indicators which takes part in the reaction(titration) and after completion of titration it changes the color of the solution indicating the sharp end point. An example of internal indicator is Diphenyl Amine, which is used in the titration of Mohr's salt and Potassium Permanganate. Some more examples are Methyl Orange, Methyl Red, Phenolphthalein etc.

8. Mixture of which acids are used in % iron titrations. Why?

Answer- (i) H_2SO_4

(ii) H_3PO_4

Reason- we have to keep the solution acidic to prevent oxides or hydroxides precipitating before they are completely reacted.

The reduction potential of indicator system is not sufficiently high. Hence the addition of phosphoric acid to lower the reduction potential of $\text{Fe(II)}-\text{Fe(III)}$ couple by complexation improves endpoint considerably.

9. Colour of solution at end point is-.

Answer- **Blue-violet**

10. Write Nernst's equation

$$E_{\text{cell}} = E^0 - \frac{(RT)}{nf} \ln q \quad (1)$$

11. What is the formal potential of indicator system?

Answer- **0.76V**

12. What is the formal potential of Fe^{2+} to Fe^{3+} system?

Answer- **0.68V**

13. Colour of FeHPO_4 complex is-.

Answer- **Green**

14. Draw structure of Diphenylamine and Diphenylbenzidine

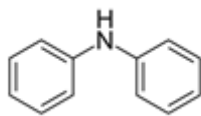


Figure 1: Diphenyl Amine

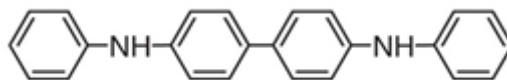


Figure 2: Diphenylbenzidine

Experiment – Determination of carbonates, bicarbonates and total alkalinity of a water sample.

Category – Volumetric Experiment

1. What is Alkalinity in water?

Answer- **Alkalinity in water refers to water's capacity to neutralize acid or resist decrease in pH. High alkalinity does not mean bad water quality Water will have unique level of alkalinity.**

2. Why is water alkaline?

Answer- **It is due to the presence of hydroxide, carbonate and bicarbonate ions.**

3. Why is it called acid-base titration?

Answer- **The total alkalinity analysis involves titration. In this test, titration is the addition of small, precise quantities of sulfuric acid (the reagent) to the sample until the sample reaches a certain pH (known as an endpoint). The amount of acid used corresponds to the total alkalinity of the sample.**

4. What are the possible combination of ions, which attribute alkalinity in water?

Answer- **Hydroxides only, Bicarbonates only, Carbonates only, Carbonates and Bicarbonates, Hydroxides and Carbonates.**

5. The possibility of hydroxides and bicarbonates existing together is ruled out . Why?

Answer- **Because of the fact that they combine with each other and forming carbonates.**

6. Indicators used in the acid base titration are...

Answer- **Methyl orange and Phenolphthalein.**

7. Why we use two type of indicators?

Answer- **Alkalinity is measured titrimetrically by titrating against Dilute Sulphuric Acid. Phenolphthalein and Methyl Orange are used as indicator to indicate pH 8.3 and pH 4.3. Phenolphthalein process a pink colour when pH is above 8.3 and colourless when pH is below 8.3**

8. What are the ions determined by phenolphthalein?

Answer- **Hydroxide ion and half of carbonate ion.**

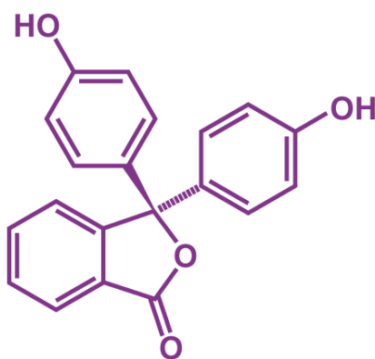
9. What is the role of methyl orange indicator in determining alkalinity?

Answer- **Total alkalinity is determined by using methyl orange.**

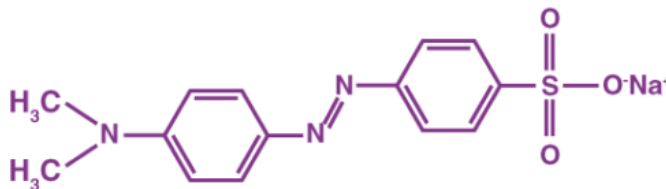
10. What is the colour of phenolphthalein in acid and alkaline medium?

Answer- **Colourless in acid and pink in alkaline.**

11. What is the structural formula of phenolphthalein?



12. What is the structural formula of Methyl Orange?



13. If $P=0$ then which ions are responsible for attributing alkalinity in water sample?

Answer- **Bicarbonate only.**

14. If $P=M$, then which ions are responsible for attributing alkalinity in water sample?

Answer- **Hydroxide only.**

15. Formula for Carbonate alkalinity?

Answer- **2P**

16. Formula for Bicarbonate alkalinity?

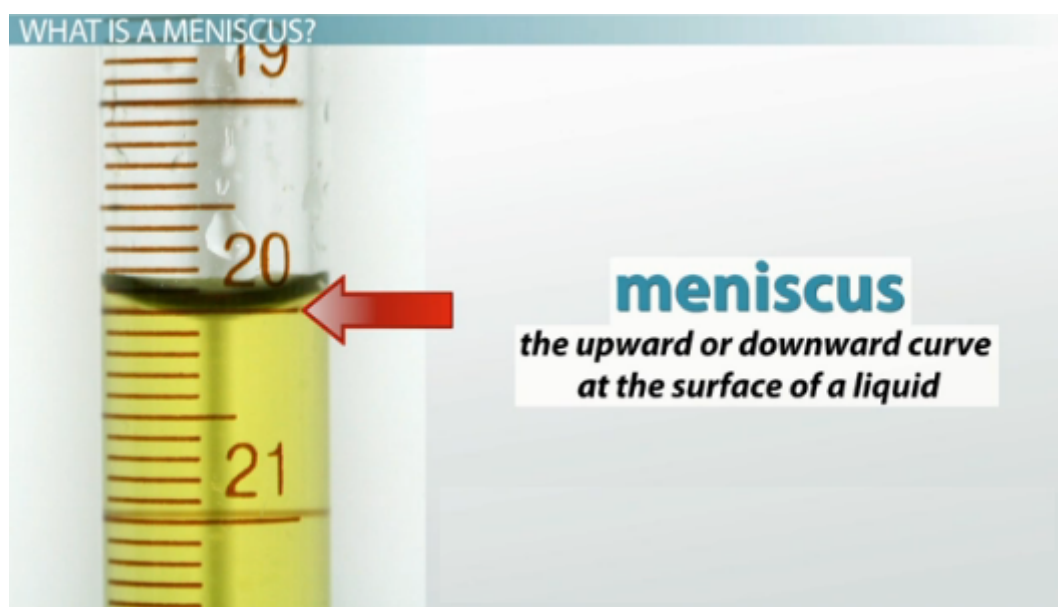
Answer- **T-2P**

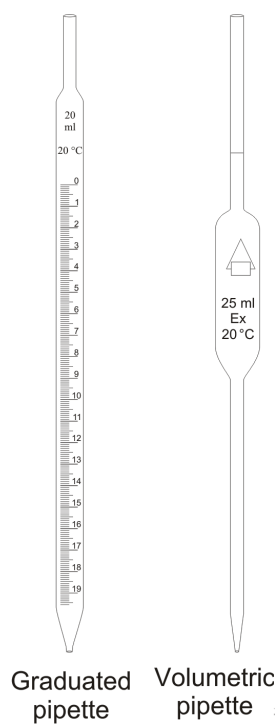
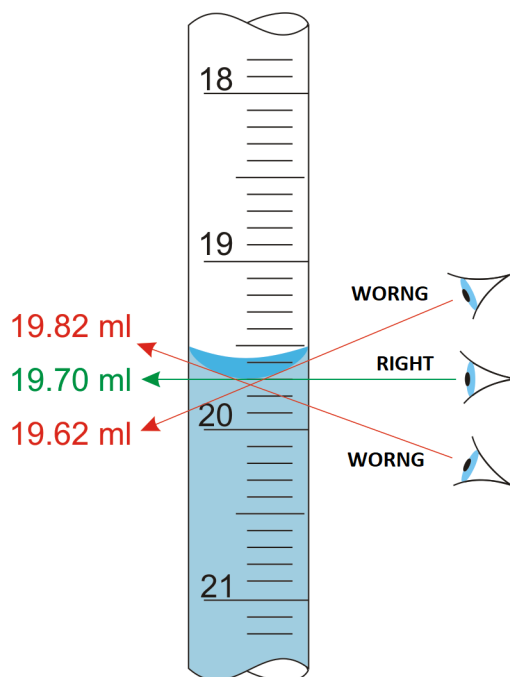
17. Formula for Total alkalinity?

Answer- **P+M**

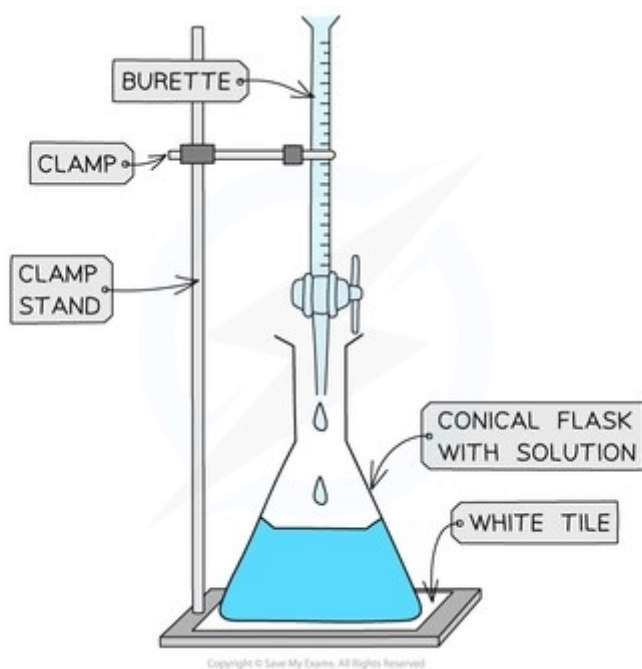
18. What is meniscus

Answer- When observing a volume of a liquid in a graduated cylinder, graduated pipette, or buret, read the point on the graduated scale that coincides with the bottom of the curved surface of the liquid. The curved surface of the liquid is called the meniscus.





Graduated pipette Volumetric pipette :



The End

Question Bank of Chemistry(CH10516) for B.Tech I Year

Unit-I: Green Chemistry

1. What is green chemistry?
2. What are the goals of green chemistry perspective?
3. What are the basic components of green chemistry research?
4. Discuss the various applications of green chemistry for achieving sustainable development?
5. What are the basic principles of green chemistry?
6. Write informative notes on
 - Atom economy
 - Designing Safer Chemicals
 - Safer solvents and Auxiliaries

Unit II-Water

1. Why we add two indicators during determination of alkalinity of water by acid base titration.
2. Draw the structure of metal EDTA complex and indicator EBT.
3. Write an informative note on Caustic Embrittlement in boilers.
4. Describe the ion exchange method of softening of water under following heads:
 - Principle involved
 - Structure of resins and chemical reaction
 - labelled diagram
 - Advantages and Disadvantages.
5. Explain boilers problems: a) Scale and Sludge b) Priming and Foaming
6. Write a short note on Zeolite with their types, reaction, advantages and disadvantages
7. Giving reaction, compare calgon conditioning and phosphate conditioning.
8. Give the chemical reactions involved in determination of hardness of water by EDTA titration.
9. Distinguish between:
 - (a) Temporary hardness and Permanent hardness
 - (b) Purification and Softening of water
 - (c) Softening and Demineralization of water.

Unit –III – Lubricant

1. Illustrating various examples, write an informative note on Solid Lubricants. (Graphite and Molbednum disulphide)
2. Giving significance, define Flash point, Aniline point, Acid value and SEN of an oil.
3. Write the functions of semisolid lubricants with their examples.
4. Write a note on Extreme Pressure Mechanism of lubricant. What are additives?
5. Explain following in short: a) Iodine Value b) Carbon Residue

Unit-IV : Polymers

1. Distinguish between thermoplastics and thermosetting polymers.
2. Discuss, with examples the types of polymerization.
3. Define the Tacticity of polymers.
4. Explain the Free radical polymerisation mechanism.
5. Write the informative note on: Teflon, PVC, Polyethene
6. Explain th cationic and anionic mechanism of polymerisation.
7. Classify the polymers on the basis of their structures.
8. Write the structure, properties and uses of the following polymers:- Nylon 6,6 ,Kevlar, Bakelite
9. Differentiate between homopolymer and copolymer.
10. Write a short note on Elastomers.
11. Define the terms – Polymers, Polymerization and degree of polymerization

Unit-V : Questions for Chromatography

1. What is chromatography?
2. What is adsorption chromatography?
3. What is meant by partition coefficient?
4. Define R_f value.
5. What are the applications of chromatography techniques? Explain in detail.
6. Describe the principle involved in column chromatography?
7. Discuss Gas-Liquid Chromatography under the following heads : Principle involved, Schematic Diagram of apparatus and its applications.
8. Discuss fundamental principles involved in chromatographic separation.
9. Write a detailed note on Column chromatography.
10. Write informative notes on paper chromatography.