Department of Humanities & Science

Course File

ENGINEERING CHEMISTRY
(Course Code: CH202BS)

IB.Tech II Semester

2023-24

ECE

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Assistant Professor

Ananthagiri, Kodad, Telangana 508 206, India.

Department of Humanities & Science

ENGINEERING CHEMISTRY

Check List

Department of Humanities & Science

Int. Marks:30 Ext. Marks:70 Total Marks:100

ENGINEERING CHEMISTRY
(Common for all branches)

Course Code : CH202BS **L/T/P/C**
3/1/0/ 4

B.Tech I Year I & II Semesters

UNIT - I: Water and its treatment:

Introduction to hardness of water – Estimation of hardness of water by complexometric method and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break - point chlorination. Defluoridation - Determination of F^- ion by ion- selective electrode method.

Boiler Troubles: Sludges, Scales and caustic embrittlement, Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning - Colloidal conditioning, External treatment methods - Softening of water by ion- exchange process. Desalination of Brackish water - Reverse osmosis.

UNIT – II Battery Chemistry & Corrosion:

Introduction - Classification of batteries-primary (Leclanche cell) and secondary (Lead-acid), and reserve batteries with example. Construction, working and applications of Zn-air and Lithium-ion battery. Applications of Li-ion battery to electrical vehicles. **Fuel Cells**- Differences between battery and a fuel cell, Construction and applications of Methanol Oxygen fuel cell and Solid oxide fuel cell. Solar cells - Introduction and applications of Solar cells.

Corrosion: Causes and effects of corrosion–theories of chemical and electrochemical corrosion

–mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion: Nature of metal-Galvanic series, purity of metal, Nature of corrosion product, Nature of environment-Effect of temperature, Effect of pH, Humidity, Corrosion control methods- Cathodic protection – Sacrificial anode & impressed current methods.

UNIT - III: Polymeric materials:

Definition – Classification of polymers with examples – Types of polymerizations –addition and condensation polymerization with examples – Nylon 6:6, Terylene

Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC, Bakelite and Teflon.

Rubbers: Natural rubber and its vulcanization.

Synthetic Rubbers- Characteristics–preparation–properties and applications of Buna-S, Butyl and Thiokol rubber.

Conducting polymers: Characteristics and Classification with examples- mechanism of conduction in trans- poly acetylene and applications of conducting polymers.

Biodegradable polymers: Concept and advantages – Poly lactic acid and poly vinyl alcohol and their applications.

UNIT - IV: Molecular structure:

Introduction, Concept of atomic and molecular orbitals, LCAO, Molecular orbitals of di atomic molecules, Molecular orbital energy level diagrams of diatomic molecules(B_2, C_2, N_2, O_2 and F_2).

Pi-molecular orbitals of ethylene and butadiene.

Crystal field theory (CFT)

Crystal field theory, Crystal field splitting patterns of transition metal ion d- orbital- tetrahedral, octahedral and square planar geometries.

UNIT - V: Engineering Materials:

Cement: Portland cement, its composition, setting and hardening.

Smart materials and their engineering applications

Shape memory materials- Poly L- Lactic acid. Thermo response materials- Poly acryl amides and Poly vinyl amides

Lubricants: Classification of lubricants with examples-characteristics of a good lubricant - mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpat rai Publishing Company,2010
2. Text book of Engineering Chemistry by Jaya Shree Anireddy, Wiley Publications.
3. Engineering Chemistry by Rama Devi, VenkataRamana Reddy and Rath,Cengage learning,2016
4. A text book of Engineering Chemistry by M. Thirumala Chary, E.Laxminarayana and K. Shashikala, Pearson Publications, 2021.
5.

REFERENCE BOOKS:

1. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi(2015)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi(2011)

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Timetable

I B.Tech. II Semester – ECE

Day/Hour	9.30-10.20	10.20-11.10	11.20-12.10	12.00-12.50	12.50-1.35	1.35-2.20	2.30-3.15	3.15-4.00
Monday								
Tuesday				EC				
Wednesday								EC
Thursday				EC				
Friday		EC						
Saturday				EC				
Saturday	EC							

Department of Humanities & Science

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering, Technology and Management

DEPARTMENT OF HUMANITIES AND SCIENCE

Vision

To foster the students with excellence in education and moral values, thereby transform them to be eminent professional engineers and responsible citizens of tomorrow.

Mission

The Department Humanities and Sciences mission is to metamorphosis the students' community to get conversant with Scientific, Mathematical concepts and communication skills by providing perpetual thought provoking teaching, tremendous training and relentless research.

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Program Educational Objectives (B.Tech. – ECE)
Graduates will be able to

PEO I. Excel in professional career & higher education, by acquiring knowledge in related of Electronics & Communication Engineering.

PEO II. Exhibit leadership in their profession, through technological ability and contemporary knowledge for solving the real-life problems appropriately that are technically sound, economically feasible & socially acceptable.

PEO III. Adapt to the emerging technologies for sustenance by exhibiting professionalism, ethical attitude & communication skills in their relevant areas of interest by engaging in lifelong learning

Program Outcomes (B.Tech. – ECE)

At the end of the Program, a graduate will have the ability to

1) **PO1** An ability to apply Knowledge of mathematics, science, fundamentals of engineering to solve electronics and communication engineering problems.
2) **PO2** An ability to identify, formulate and analyze and solve complex electronics and communication engineering using the first principles of mathematics and engineering science.
3) **PO3** An ability to develop solutions to electronics and communication systems to meet the specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4) **PO4** An ability to design and perform experiments of electronic circuits and systems, analyze and interpret data to provide valid conclusions.
5) **PO5** An ability to learn ,select and apply appropriate techniques, resources and modern engineering tools including prediction and modeling ,to complex electronics and communication systems.
6) **PO6** An ability to assess the knowledge of contemporary issues to the societal responsibilities relevant to the professional practice.
7) **PO7** An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge for the need of sustainable development.
8) **PO8** An ability to demonstrate the understanding of professional, ethical responsibilities and norms of engineering practice.
9) **PO9** An ability to function effectively as an individual and as a member or leader in diverse teams and

in multidisciplinary settings.

10) **PO10** An ability to communicate effectively with engineering community and with society at large.
11) **PO11** An ability to demonstrate knowledge and understanding of engineering and management principles and apply these to manage projects.
12) **PO12** An ability to recognize the need for, and engage in lifelong learning in the broadest context of technological change.

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COURSE OBJECTIVES

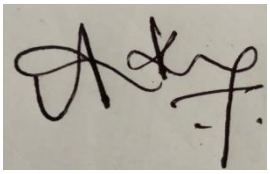
On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To bring adaptability to new developments in Engineering Chemistry andto acquire the skills required to become a perfect engineer.
2	To include the importance of water in industrial usage, fundamentalaspects of battery chemistry, and significance of corrosion - it's control to protect the structures
3	To know the importance of polymer Chemistry and biodegradable polymers.
4	To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
5	To acquire required knowledge about engineering materials like cement,smart materials and Lubricants

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1.	Understand the basic properties of water and its usage in domestic and industrial purposes.
2.	Acquire the basic knowledge of electrochemical procedures related to corrosion and its control.
3.	Learn the fundamentals and general properties of polymers and other engineering materials.
4.	Apply the knowledge of atomic, molecular and electronic changes related to conductivity.
5.	Apply the knowledge of Engineering materials in daily life.



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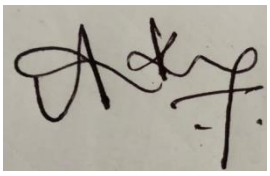
GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone



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COURSE SCHEDULE

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**UNIT - I: Water and its treatment:** Introduction to hardness of water – Estimation of hardness of water by complexometric method and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break - point chlorination. Defluoridation - Determination of F- ion by ion- selective electrode method. Boiler Troubles: Sludges, Scales and caustic embrittlement, Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning - Colloidal conditioning, External treatment methods - Softening of water by ionexchange process. Desalination of Brackish water - Reverse osmosis.	05.02.2024	29.02.2024	11
2.	**UNIT – II Battery Chemistry & Corrosion:** Introduction - Classification of batteries-primary (Leclanche cell) and secondary (Lead-acid), and reserve batteries with example. Construction, working and applications of Zn-air and Lithium-ion battery. Applications of Li-ion battery to electrical vehicles. Fuel Cells- Differences between battery and a fuel cell, Construction and applications of Methanol Oxygen fuel cell and Solid oxide fuel cell. Solar cells - Introduction and applications of Solar cells. **Corrosion:** Causes and effects of corrosion–theories of chemical and electrochemical corrosion–mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion: Nature of metal-Galvanic series, purity of metal, Nature of corrosion product, Nature of environment-Effect of temperature, Effect of PH, Humidity, Corrosion control methods- Cathodic protection – Sacrificial anode & impressed current methods	01.03.2024	26.03.2024	13
3.	**UNIT - III: Polymeric materials**: Definition – Classification of polymers with examples – Types of polymerizations – addition and condensation polymerization with examples – Nylon 6:6, Terylene Plastics: Definition and characteristicsthermoplastic and thermosetting plastics, Preparation, Properties and	28.03.2024	15.04.2024	09

	engineering applications of PVC, Bakelite and Teflon. Rubbers: Natural rubber and its vulcanization. Synthetic Rubbers- Characteristics–preparation–properties and applications of Buna-S, Butyl and Thiokol rubber. Conducting polymers: Characteristics and Classification with examplesmechanism of conduction in trans- poly acetylene and applications of conducting polymers. **Biodegradable polymers**: Concept and advantages – Poly lactic acid and poly vinyl alcohol and their applications.			
4.	**UNIT - IV: Molecular structure:** Introduction, Concept of atomic and molecular orbitals, LCAO, Molecular orbitals of di atomic molecules, Molecular orbital energy level diagrams of diatomic molecules(B2, C2, N2, O2 and F2). Pi-molecular orbitals of ethylene and butadiene. Crystal field theory (CFT) Crystal field theory, Crystal field splitting patterns of transition metal ion d-orbitaltetrahedral, octahedral and square planar geometries	18.04.2024	04.05.2024	12
5.	**UNIT - V: Engineering Materials:** Cement: Portland cement, its composition, setting and hardening. Smart materials and their engineering applications Shape memory materials- Poly L- Lactic acid. Thermo response materials- Poly acryl amides and Poly vinyl amides Lubricants: Classification of lubricants with examples-characteristics of a good lubricant - mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.	06.05.2024	12.06.2024	11

Total No. of Instructional periods available for the course: 56 Hours

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SCHEDULE OF INSTRUCTIONS - COURSE PLAN

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1	1	6-Feb-24	1	Introduction to hardness of water	1	Shashi Chawla, Dhanpatrai and Company & Text book of Engineering Chemistry by Jaya Shree Anireddy, Wiley Publications
	2	8-Feb-24	1	Estimation of hardness of water by EDTA method	1	Shashi Chawla
	3	9-Feb-24	1	Potable water and its specifications	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	4	13-Feb-24	1	Steps involved in the treatment of potable water	1	Shashi Chawla
	5	14-Feb-24	1	Disinfection of potable water by chlorination	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	6	15-Feb-24	1	Potable water and its specifications	1	Shashi Chawla
1	7	16-Feb-24	1	break - point chlorination, Defluoridation	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	8	17-Feb-24	1	Boiler Troubles	1	Shashi Chawla
	9	20-Feb-24	1	Internal treatment of Boiler feed water,Reverse osmosis.	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	10	21-Feb-24	1	Determination of F^- ion by	1	Shashi Chawla

				ion- selective electrode method		
	11	29-Feb-24	1	ion- exchange process	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	1	1-Mar-24	1	Introduction - Classification of batteries-primary	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	2	5-Mar-24	1	Leclanche cell and secondary Lead-acid Battery	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	3	6-Mar-24	1	Reserve batteries with example	1	Shashi Chawla
	4	7-Mar-24	1	Construction, working and applications of Zn-air	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	5	12-Mar-24	1	Lithium-ion battery and its Applications	1	Shashi Chawla
	6	13-Mar-24	1	Differences between battery and a fuel cell	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	7	14-Mar-24	1	Solar cells - Introduction and applications of Solar cells	1	Shashi Chawla
3	8	15-Mar-24	1	Methanol Oxygen fuel cell and Solid oxide fuel cell	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	9	16-Mar-24	1	Indroduction to Corrosion	1	Shashi Chawla
	10	21-Mar-24	1	Theories of chemical and	1	Text book of

				electrochemical corrosion		Engineering Chemistry by Jaya Shree Anireddy
	11	22-Mar-24	1	Types of corrosion	1	Shashi Chawla
	12	23-Mar-24	1	Factors affecting rate of corrosion	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	13	26-Mar-24	1	Sacrificial anode & impressed current methods	1	Shashi Chawla
	1	27-Mar-24		Introduction to Polymer chemistry,		
	2	30-Mar-24		Classification of polymers with examples		
	3	4-Apr-24		Thermoplastic and Thermosetting plastic		
	4	6-Apr-24	1	PVC, Bakelite,	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
3	5	10-Apr-24	1	Natural Rubber ,Vulcanization	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	6	11-Apr-24	1	Buna-S, Butyl and Thiokol rubber.	1	Shashi Chawla
	7	12-Apr-24	1	**Conducting polymers:** Characteristics and Classification	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	8	12-Apr-24	1	**Biodegradable polymers:** Concept and advantages	1	Shashi Chawla
	9	15-Apr-24	1	Poly lactic acid and poly vinyl alcohol and their	1	Text book of Engineering

				applications.		Chemistry by Jaya Shree Anireddy
	1	18-Apr-24	1	Unit-IV -Introduction, Concept of A.O & M.O	1	Shashi Chawla
	2	19-Apr-24	1	LCAO	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	3	20-Apr-24	1	B_2, C_2, N_2, O_2 and F_2	1	Shashi Chawla
	4	23-Apr-24	1	B_2, C_2, N_2, O_2 and F_2	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	5	24-Apr-24	1	Pi-molecular orbitals of ethylene and butadiene.	1	Shashi Chawla
	7	26-Apr-24	1	Crystal field theory - postulates	1	Shashi Chawla
	8	27-Apr-24	1	CFT patterns of- octahedral Complex	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
4	9	30-Apr-24	1	CFT patterns of- - tetrahedral	1	Shashi Chawla
	10	1-May-24	1	CFT patterns of- square planar geometries	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	11	2-May-24	1	Comparison b/w octahedral & tetrahedral complex	1	Shashi Chawla
	12	4-May-24	1	Examples for octahedral & tetrahedral complex, Advantages & Limitations of CFT	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	1	7-May-24	1	Unit-V -Introduction	1	Text book of Engineering

						Chemistry by Jaya Shree Anireddy
	2	8-May-24	1	REVISION	1	Shashi Chawla
	3	9-May-24	1	Cement: Portland cement ,composition	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	4	10-May-24	1	setting and hardening in Portland cement	1	Shashi Chawla
	5	03-Jun-24	1	Smart poymers and its applications	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	6	5-Jun-24	1	Thermoresponse polymers and its applications	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	7	6-Jun-24	1	Poly L- Lactic acid.	1	Shashi Chawla
	8	7- Jun -24	1	Poly acryl amides	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	9	10- Jun -24		Classification and characteristics a good lubricant	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	10	11-Jun-24		Thick film, thin film and extreme pressure	1	Text book of Engineering Chemistry by Jaya Shree Anireddy
	11	12-Jun-24		properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.	1	Text book of Engineering Chemistry by Jaya Shree Anireddy

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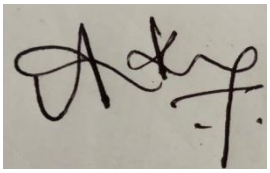

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LESSON PLAN (U-I)

Lesson No: 01,02 Duration of Lesson: 100 min

Lesson Title:, Introduction to hardness of water ,Estimation of hardness of water by EDTA method,

Instructional / Lesson Objectives:

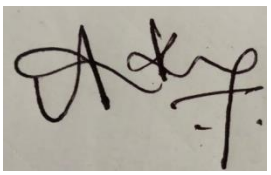
- To make students get awareness about hardness of water
- Make students to know the importance of EDTA method

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 mins for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-I)

Lesson No: 03, 04 Duration of Lesson: 100 min

Lesson Title: Numerical problems, Potable water and its specifications

Instructional / Lesson Objectives:

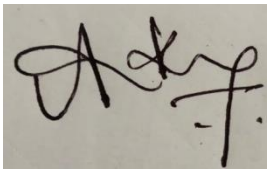
- To make students get awareness about Numerical problems on Hardness of water
- To familiarize students on Potable water

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 mins for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-I)

Lesson No: 05, 06 Duration of Lesson: 100 min

Lesson Title:, Steps involved in the treatment of potable water, Disinfection of potable water by chlorination

Instructional / Lesson Objectives:

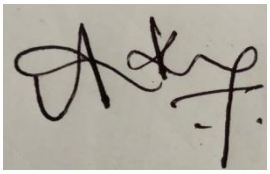
- To understand students the concept of potable water, chlorination
- To provide information on Disinfection,
-

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-I)

Lesson No: 07, 08 Duration of Lesson: 100 min

Lesson Title: break - point chlorination, Defluoridation,

Instructional / Lesson Objectives:

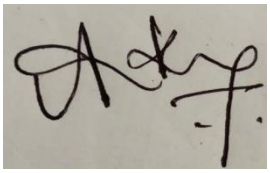
- To understand students the concept of break - point chlorination ,Defluoridation
- Make students to know the importance of boiler troubles

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-I)

Lesson No: 09 ,10,11 Duration of Lesson: 150 min

Lesson Title: boiler troubles, Internal treatment of Boiler feed water, Reverse osmosis

Instructional / Lesson Objectives:

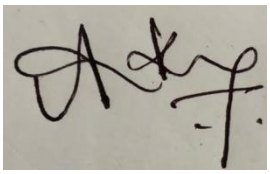
- Make students to know the importance of boiler troubles
- To understand students the concept of Boiler feed water
- To provide information on Reverse osmosis

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-II)

Lesson No: 01, 02 Duration of Lesson: 100 min

Lesson Title: Introduction - Classification of batteries-primary, Leclanche cell and secondary Lead-acid Battery

- To understand students the concept of fundamentalaspects of battery chemistry
- Students learn difference between primary, secondary Batteries

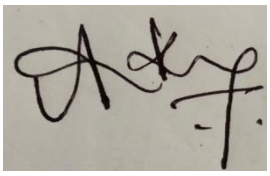
Instructional / Lesson Objectives:

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-II sheets



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LESSON PLAN (U-II)

Lesson No: 03, 4 ,5 Duration of Lesson: 150 min

Lesson Title: Reserve batteries with example Construction, working and applications of Zn-air,

Instructional / Lesson Objectives:

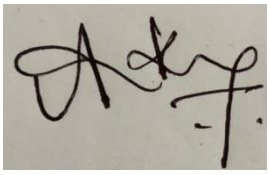
- To understand students the concept of fundamental aspects of battery chemistry
- Make students to know significance of Reserve batteries and Zn-air,

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-II)

Lesson No: 6,7,8 Duration of Lesson: 150 min

Lesson Title: Differences between battery and a fuel cell, Solar cells - Introduction and applications of Solar cells, Methanol Oxygen fuel cell and Solid oxide fuel cell

Instructional / Lesson Objectives:

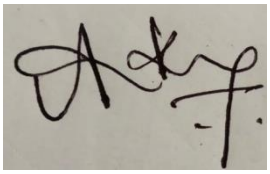
- To understand students the concept of fundamentalaspects of battery chemistry
- Students learn difference between fuel cell and Solar cells

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-II)

Lesson No: 9,10,11 Duration of Lesson: 150 min

Lesson Title: Introduction to Corrosion, **Corrosion:** Causes and effects of corrosion, Theories of chemical and electrochemical corrosion

Instructional / Lesson Objectives:

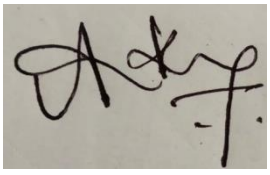
- To understand students the concept of corrosion
- To provide information on Theories of chemical and electrochemical corrosion

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-II)

Lesson No: 12,13, Duration of Lesson: 150 min

Lesson Title:, Factors affecting rate of corrosion, Sacrificial anode & impressed current methods

Instructional / Lesson Objectives:

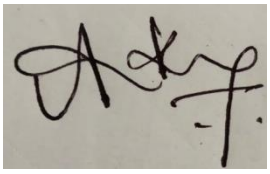
- To familiarize students on Sacrificial anode & impressed
- Make students to know significance of corrosion - it's control to protect the structures

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-III)

Lesson No: 01, 02, Duration of Lesson: 100 min.

Lesson Title: Introduction to Polymer chemistry, Classification of polymers with examples

Instructional / Lesson Objectives:

- To understand students the concept of polymer chemistry
- To make students understand types of polymers

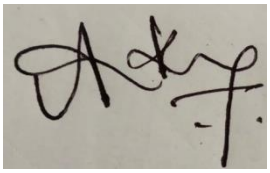
.

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-III)

Lesson No: 03, 04, Duration of Lesson: 100 min.

Lesson Title: thermoplastic & thermosetting plastics, PVC, Bakelite, Natural Rubber ,Vulcanization

Instructional / Lesson Objectives:

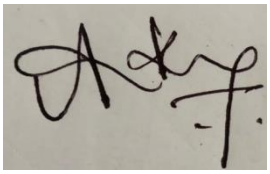
- To understand students the concept of polymer chemistry
- Students learn difference between thermoplastic & thermosetting plastics

Teaching AIDS: PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-III)

Lesson No: 05, 06, Duration of Lesson: 100 min

.

Lesson Title: Buna-S, Butyl and Thiokol rubber, **Conducting polymers:** Characteristics and Classification

Instructional / Lesson Objectives:

- To understand students the concept of polymer chemistry
- Make students to know the importance of Conducting polymers

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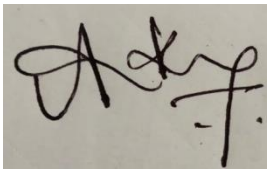
Teaching AIDS: PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – I & tutorial-I sheets



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LESSON PLAN (U-III)

Lesson No: 07,08,09 Duration of Lesson: 100 min

.

Lesson Title: **Biodegradable polymers:** Concept and advantages, Poly lactic acid and poly vinyl alcohol and their applications

Instructional / Lesson Objectives:

- To understand students the concept of polymer chemistry
- Make students to know the importance of biodegradable polymers

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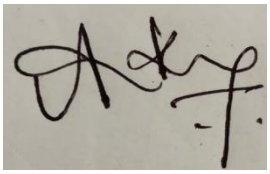
Teaching AIDS: PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – II & tutorial-III sheets



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LESSON PLAN (U-IV)

Lesson No: 01, 02 Duration of Lesson: 100 min.

Lesson Title: Unit-IV -Introduction, Concept of A.O & M.O., LCAO

Instructional / Lesson Objectives:

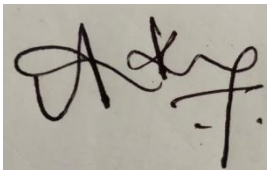
- To familiarize students on atomic, molecular and electronic modifications which make the student to understand the technology based on them.
- To understand students the concept of theory LCAO

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 min for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment – II & tutorial-III sheets



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LESSON PLAN (U-IV)

Lesson No: 03, 04,5 Duration of Lesson: 150 min.

Lesson Title: B_2, C_2, N_2, O_2 and F_2 , Pi-molecular orbital's of ethylene and butadiene

Instructional / Lesson Objectives:

- To familiarize students on atomic, molecular and electronic modifications which make the student to understand the technology based on them.
- Make students to know significance of Pi-molecular orbital's of ethylene and butadiene

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment – II & tutorial-IV sheets

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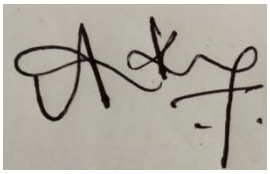

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LESSON PLAN (U-IV)

Lesson No: 06 ,07, 08 Duration of Lesson: 150 min.

Lesson Title: Crystal field theory – postulates, CFT patterns of- octahedral Complex

Instructional / Lesson Objectives:

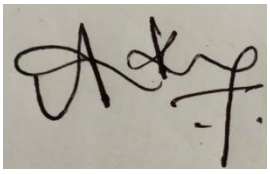
- To familiarize students on octahedral Complex
- Make students to know significance of crystal field theory

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-IV sheets.



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LESSON PLAN (U-IV)

Lesson No: 09 ,10, 11 Duration of Lesson: 150 min.

Lesson Title: CFT patterns of - tetrahedral.,CFT patterns of- square planar geometries,

Instructional / Lesson Objectives:

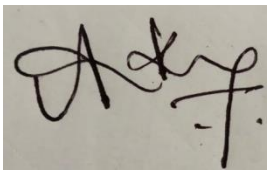
- Make students to know significance of crystal field theory
- Students learn difference between octahedral & tetrahedral Complexes

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-IV sheets.



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LESSON PLAN (U-IV)

Lesson No: 11,12, Duration of Lesson: 100 min.

Lesson Title: Comparison b/w octahedral & tetrahedral complex
Examples for octahedral & tetrahedral complex, Advantages & Limitations of CFT

Instructional / Lesson Objectives:

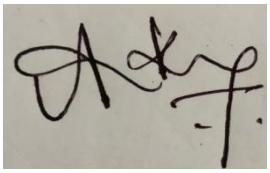
- Make students to know significance of crystal field theory
- Students learn difference between octahedral & tetrahedral Complexes

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

10 mins for taking attendance 10 for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-IV sheets.



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LESSON PLAN (U-V)

Lesson No: 01,02,03 Duration of Lesson: 150 min.

Lesson Title: Unit-V –Introduction, Cement: Portland cement ,composition,

Instructional / Lesson Objectives:

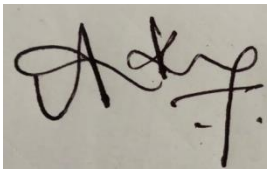
- To make students understand the concept of Portland cement
- To provide information on setting and hardening in Portland cement

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-V sheets.



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LESSON PLAN (U-V)

Lesson No: 04, 05 Duration of Lesson: 150 min.

Lesson Title:, setting and hardening in Portland cement Smart polymers and its applications,

Instructional / Lesson Objectives:

- To make students understand the concept of Smart polymers
- To provide information on Thermo response polymers

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-V sheets.

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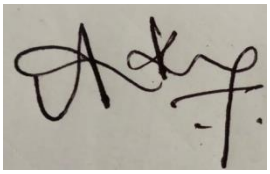

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LESSON PLAN (U-V)

Lesson No: 06, 07 Duration of Lesson: 150 min.

Lesson Title: Thermo response polymers and its applications, Poly L- Lactic acid,

Instructional / Lesson Objectives:

- To make students understand the concept of Poly L- Lactic acid,
- To provide information on Poly acryl amides
-

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-V sheets.

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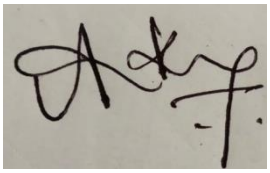

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LESSON PLAN (U-V)

Lesson No: 08 ,09 Duration of Lesson: 150 min.

Lesson Title: Poly acryl amides, Poly vinyl amides, Classification and characteristics a good lubricant

Instructional / Lesson Objectives:

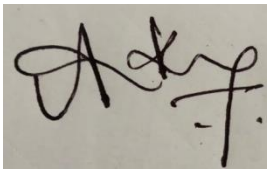
- To make students understand the concept of Poly vinyl amides
- To provide information on lubricants.

Teaching AIDS : PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-V sheets.



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LESSON PLAN (U-V)

Lesson No: 10 ,11 Duration of Lesson: 150 min.

Lesson Title: Thick film, thin film and extreme pressure, properties of lubricants: viscosity, cloud point, pour point, flash point and fire point

Instructional / Lesson Objectives:

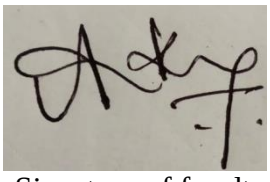
- To make students understand the concept of properties of lubricants
- To provide information on lubricants.

Teaching AIDS :PPTs, Digital Board

Time Management of Class :

15 min for taking attendance 15 for revision of previous class 105 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-V sheets.



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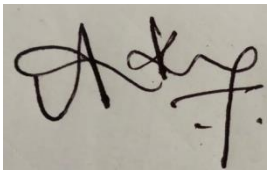
ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	How can you estimate the amount of permanent hardness by EDTA method ?	1	1
2	Explain steps involved in potable water	1	1
3	Explain softening of water by Ion exchange process.	1	1



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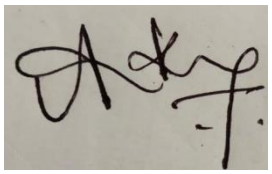
ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	Explain the various factors influencing on rate of corrosion.	2	2
2	Illustrate the construction of lead –acid battery with reactions occurring during Discharging and charging	2	2
3	How Bakelite can be prepared? Write properties and applications of it.	2	2



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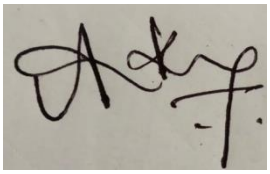
ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	1. i. How natural rubber obtained from latex. Explain ii. Explain vulcanization of rubber with chemical reactions and discuss the advantages of vulcanized rubber	3	3



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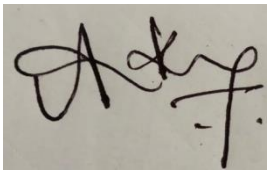
ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	Describe the L.C.A.O method	4	4
2	Draw the MO energy diagram of N_2 molecule .Mention its bond order and magnetic property	4	4
3	Describe the crystal field splitting of transition metal ion in tetrahedral complex.	4	4



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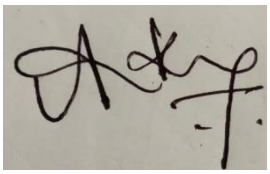
ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	How is Portland cement manufactured by wet and dry process?	5	5
2	What is lubricant? Explain mechanisms of lubrication.	5	5



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TUTORIAL – 1

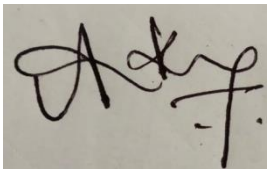
This tutorial corresponds to Unit No. 1 (Objective Nos.: 1, Outcome Nos.: 1)

1	Temporary hardness of water is removed by				
A)	Filtration	B)	Sedimentation		
C)	Boiling	D)	Coagulation		
Answer					

2	Blow-down operation causes the removal of				
A)	Base	B)	Sludges		
C)	Acidity	D)	Sodium chloride		
Answer					

3	Permanent hardness of water cannot be removed by				
A)	Treatment with lime soda	B)	Filtration process		
C)	Boiling	D)	Ion-exchange process		
Answer					

4	Brackish water mostly contains dissolved				
A)	Calcium salts	B)	Magnesium salts		
C)	turbidity	D)	Sodium chloride		
Answer					



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TUTORIAL – 2

This tutorial corresponds to Unit No. 2 (Objective Nos.: 2, Outcome Nos.: 2)

1	In water line corrosion the maximum amount of corrosion takes place				
A)	Along the line just the level of water meniscus	B)	Along a line at the level of the water level		
C)	Along a line just below the level of water meniscus	D)	At the bottom of the vessel		
Answer					

2	In methyl alcohol –oxygen fuel cell ,the methyl alcohol is used as				
A)	Anode	B)	cathode		
C)	electrolyte	D)	None of the above		
Answer					

3	Solar cells convert energy to electricity by one of the following effect				
A)	Photovoltaic effect	B)	photosynthesis		
C)	Photosensitive effect	D)	Photochemical effect		
Answer	A				

15	For the corrosion of iron one of the following factor is essential				
A)	Presence of moisture	B)	Presence of both moisture and O_2		
C)	Presence of hydrogen	D)	Presence of strong base		
Answer	B				

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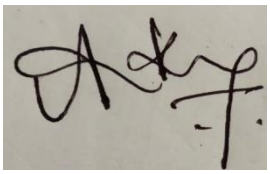

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TUTORIAL SHEET – 3

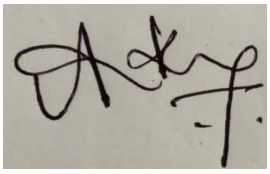
This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

1	The structural units of polymer are called				
A)	fibres	B)	monomers		
C)	fabrics	D)	Thermo units		
Answer					

2	Phenol –HCHO resin is commercially known as				
A)	PVC	B)	Nylon		
C)	Teflon	D)	Bakelite		
Answer					

3	Which one of the following is not a macromolecule				
A)	cellulose	B)	protein		
C)	wood	D)	rubber		
Answer					

4	The following is the monomer of teflon				
A)	$F_2C=CF_2$	B)	$H_2C=CHF$		
C)	$H_2C=CHCl$	D)	$F_2C=CHF$		
Answer					



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TUTORIAL – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 3, Outcome Nos.: 3)

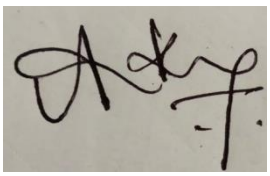
This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

1	One of the following is a lowest energy bonding molecular orbital				
A)	$\sigma *$	B)	$\pi *$		
C)	σ	D)	π		
Answer					

2	The overlapping of Atomic orbital's having same sign to produce				
A)	Bonding molecular orbitals	B)	Anti Bonding molecular orbitals		
C)	Non –bonding	D)	molecular orbitals		
Answer					

3	The bond order for oxygen molecule is				
A)	3	B)	2		
C)	Zero	D)	1		
Answer					

4	The lobes are orientated between axes are called				
A)	t2g	B)	eg		
C)	Both	D)	None of the above		
Answer					



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TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

1	One of the following is an example of themo responsive polymer				
A)	Nylon	B)	polyacetate		
C)	polyester	D)	PLA		

2	Lubricant can decompose should be				
A)	Hydrolysis	B)	oxidation		
C)	pyrolysis	D)	All the above		
Answer					

3	The initial setting of cement is due to				
A)	Hydration of calcium	B)	Hydration of aluminate		
C)	Hydration of silicate	D)	Hydration of di calcium		
Answer					

4	Pour point of a lubricant should be				
A)	high	B)	low		
C)	pyrolysis	D)	None of the above		
Answer					

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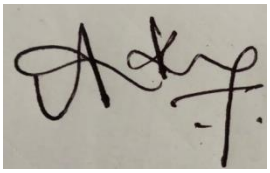

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EVALUATION STRATEGY

Target (s)

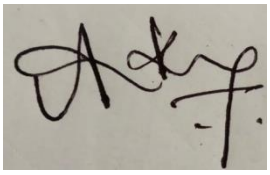
a. Percentage of Pass : 95%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

a. Daily Attendance
b. Assignments
c. Online Quiz (or) Seminars
d. Continuous Internal Assessment
e. Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application



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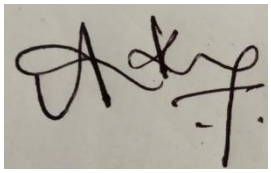
COURSE COMPLETION STATUS

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 29.02.2024	1	1
Unit 2	completed on 26.03.2024	2	2
Unit 3	completed on 15.04.2024	3	3
Unit 4	completed on 04.05.2024	4	4
Unit 5	completed on 12.06.2024	5	5



Signature of HOD

Signature of faculty

Department of Humanities & Science

Mappings

1. **Course Objectives-Course Outcomes Relationship Matrix**
   (Indicate the relationships by mark "X")

Course-Outcomes / Course-Objectives	1	2	3	4	5
1	H		M		
2		H		M	
3			H		
4				H	
5	M				H

2. **Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix**
   (Indicate the relationships by mark "X")

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	H	M	H	L			M	M	M			M			
CO2	M	H	H	M	M	L	H	H	M	L					
CO3			H		L	M	M	M	M			L			
CO4			L		M	L	M	M		L					
CO5	M	H	M			M	M	L				L			

H-High; M-Moderate; L-Low

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Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	2	3	4
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

Anurag ENGINEERING COLLEGE (An Autonomous Institution)

Department of Humanities & Science

I B.TECH II SEMESTER I MID EXAMINATIONS - APRIL 2024

Branch : B.Tech. (ECE& IT) **Subject : Engineering Chemistry,CH202BS** **Max. Marks: 30**
Date : 01.04.2024 **Time: 120 Minutes**

PART - A

ANSWER ALL QUESTIONS **10 X 1M = 10M**

Q.No	Question	CO	BTL
1.	Disinfection by ozone is due to liberation of ( ) (A). Oxygen (B). Nascent oxygen (C). Molecular oxygen (D). Oxide	CO1	L2
2.	Brackish water mostly contains dissolved ( ) (A). calcium salts (B). magnesium salts (C). turbidity (D). sodium chloride	CO1	L1
3.	Permanent hardness of water cannot be removed by ( ) (A). Treatment with lime soda (B). Filtration process (C). Boiling (D). Ion-exchange process	CO1	L1
4.	Calgon is a trade name given to ( ) (A). Sodium silicate (B). Sodium hexameta phosphate (C). Sodium meta phosphate (D). Calcium phosphate	CO1	L1
5.	The chemical reaction in Primary cell ( ) (A). Reversible reaction (B). Irreversible reaction (C). Both A & B (D). none of the above	CO2	L1
6.	The following ion is used as cathode in solid oxygen fuel cells ( ) (A). Chloride (B). sulphide (C). fluoride (D). oxide	CO2	L2
7.	The preocess of decay of meatal by environ ment attatck is ( ) (A). Corrosion (B). primary cell (C). secondary battery (D). none of the above	CO2	L1
8.	Lithium ion battery related to ( ) (A). primary battery (B). secondary battery (C). fuel cell (D). none of the above	CO2	L1
9.	The structural units of polymer are called ( ) (A). fibres (B). monomers (C). fabrics (D). Thermo units	CO3	L1
10.	A thermoplastic resin if formed by the ( ) (A). niration (B). chlorination (C). Condensation polymerization (D). Addition polymerization	CO3	L1

PART - B

ANSWER ANY FOUR **4 X 5 M = 20 M**

Q.No	Question	CO	BTL
11.	How can you estimate the amount of permanent hardness by EDTA method.	CO1	L4
12.	How can you determine the concentration of F- ion by ISE method?	CO1	L2
13.	Explain the Sacrificial anode and impressed current cathodic protection.	CO2	L2
14.	Explain the various factors influencing on rate of corrosion	CO2	L2
15.	Explain preparation, properties and applications of PVC	CO3	L4
16.	Distinguish between –Thermoplastic and Thermosetting polymerizations	CO3	L4

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Department of Humanities & Science
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www.anurag.ac.in +91 9553122270

I B.TECH II SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. ECE & IT **Max. Marks : 30M**
Date : 18-Jun-2024 Session : Afternoon **Time : 120 Min**
Subject : Engineering Chemistry,CH202BS

PART - A

ANSWER ALL THE QUESTIONS **10 X 1M = 10M**

Q.No	Question		CO	BTL
1.	`Functionality of trimethylol phenol is (A). 2 (B). 3 (C). 4 (D). 1	( )	CO3	L1
2.	Styrene butadiene rubber is produced by making use of one the following as catalyst (A). Mg (B). Al (C). Na (D). Zn	( )	CO3	L1
3.	One of the following is a highest energy bonding molecular orbital (A). (B). (C). (D).	( )	CO4	L2
4.	The bond order for oxygen molecule is (A). 2 (B). 3 (C). 4 (D). 1	( )	CO4	L2
5.	One of the following is a lowest energy bonding molecular orbital (A). (B). (C). (D).	( )	CO4	L2
6.	The lobes are orientated between axes are called (A). t2g (B). eg (C). both (D). none of the above	( )	CO4	L2
7.	One of the following is an example of themo responsive polymer (A). Nylon (B). polyacetate (C). polyester (D). PLA	( )	CO5	L2
8.	Which of the following least temperature zone in kiln (A). drying (B). calcinations (C). clinkering (D). None of the above	( )	CO5	L1
9.	Which of the following for tri calcium silicate (A). C2S (B). C2A (C). C3S (D). C3A	( )	CO5	L2
10.	The initial setting of cement is due to (A). Hydration of calcium (B). Hydration of aluminate (C). Hydration of silicate (D). Hydration of di calcium	( )	CO5	L2

PART - B

ANSWER ANY FOUR **4 X 5M 20M**

Q.No	Question	CO	BTL
11.	. Explain vulcanization of rubber with chemical reactions and discuss the advantages of vulcanized rubber	CO3	L2
12.	Explain the mechanisms of conducting polymer	CO3	L2
13.	Describe the crystal field splitting of transition metal ion in tetrahedral complex	CO4	L2
14.	Draw the MO energy diagram of N2 molecule .Mention its bond order and magnetic property	CO4	L2
15.	Illustrate the classification of Lubricants	CO5	L3
16.	write the chemical composition of Portland cement	CO5	L2

Anurag ENGINEERING COLLEGE (An Autonomous Institution)

Department of Humanities & Science

Continuous Internal Assessment (R-22)

Programme**: BTech** Year: **I-II** Course: **Theory** **A.Y: 2023-24**

Course: Engineering Chemistry Section: ECE Faculty Name: Dr. A.Nageswararao

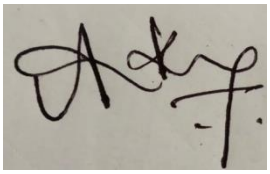
S. No	Roll No	MID-I (35M)	MID-II (35M)	Avg. of MID I & II	Viva-Voce/Poster Presentation (5M)	Total Marks (40)
1	23C11A1201	18	16	17	5	22
2	23C11A1202	8	0	4	3	07
3	23C11A1203	35	32	34	5	39
4	23C11A1204	18	10	14	5	19
5	23C11A1205	25	18	22	5	27
6	23C11A1206	32	35	34	5	39
7	23C11A1207	35	33	34	5	39
8	23C11A1208	14	5	10	3	11
9	23C11A1209	34	22	28	5	33
10	23C11A1210	35	33	34	5	39
11	23C11A1211	20	22	21	5	26
12	23C11A1212	34	22	28	5	33
13	23C11A1213	35	34	35	5	40
14	23C11A1214	19	17	18	5	23
15	23C11A1215	35	30	33	5	38
16	23C11A1216	18	15	17	5	22
17	23C11A1217	7	5	6	3	10

18	23C11A1218	19	13	16	5	21
19	23C11A1219	17	10	14	5	19
20	23C11A1220	27	16	22	5	27
21	23C11A1221	35	29	32	5	37
22	23C11A1222	27	31	29	5	34
23	23C11A1223	35	29	32	5	37
24	23C11A1224	13	5	9	5	12
25	23C11A1225	34	29	32	5	37
26	23C11A1226	14	13	14	5	19
27	23C11A1227	33	34	34	5	39
28	23C11A1228	17	12	15	5	20
29	23C11A1229	15	12	14	5	19
30	23C11A1230	35	25	30	5	35
31	23C11A1231	32	23	28	5	33
32	23C11A1232	35	33	34	5	39
33	23C11A1233	17	10	14	5	19
34	23C11A1234	23	15	19	5	24
35	23C11A1235	9	5	7	3	8
36	23C11A1236	16	16	16	5	21
37	23C11A1237	35	28	32	5	37
38	23C11A1239	30	28	29	5	34
39	23C11A1242	32	34	33	5	38
40	23C11A1243	15	14	15	5	20
41	23C11A1244	26	15	21	5	26
42	23C11A1245	31	31	31	5	36

43	23C11A1246	31	31	31	5	36
44	23C11A1247	30	28	29	5	34
45	23C11A1248	19	14	17	5	22
46	23C11A1249	17	12	15	5	20
47	23C11A1250	23	28	26	5	31
48	23C11A1251	33	31	32	5	37
49	23C11A1252	24	16	20	5	26
50	23C11A1253	35	34	35	5	40
51	23C11A1254	29	24	27	5	32
52	23C11A1255	35	30	33	5	38
53	23C11A1256	18	13	16	5	21
54	23C11A1257	17	10	14	5	19
55	23C11A1259	28	19	24	5	29

No. of Absentees: 05

Total Strength: 50



Signature of Faculty

: **Signature of HoD**

Department of Humanities & Science

ANURAG Engineering College

(An Autonomous Institution)

Ananthagiri (V & M), Kodad, Suryapet (Dist.), Telangana. PIN – 508206

I B.Tech. II Semester (R22) Mid-I Assignment, April-2024

SUB : ENGINEERING CHEMISTRY **Branch : ECE & IT**

H.T.No: ---------- Name: ----------Branch: ----------

1. How can you estimate the amount of permanent hardness by EDTA method?

2. Explain steps involved in Potable water.

3.Illustrate the construction of Lead –Acid battery with reactions occurring during

4.Explain the various factors influencing on rate of corrosion

5. How Bakelite is prepared? Explain properties and applications of Bakelite.

ANURAG Engineering College

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Ananthagiri (V&M), Suryapet (Dt). Pin: 508 206.

I B.Tech. I Semester (R22) Mid-II Assignment

ENGINEERING CHEMISTRY

1

H.T.No: ---------- Name: ----------Branch: ----------

UNIT-III

1. i. How natural rubber obtained from latex. Explain

ii. Explain vulcanization of rubber with chemical reactions and discuss the advantages of vulcanized rubber

UNIT-IV

2.i. Describe the L.C.A.O method

ii. Draw the MO energy diagram of N_2 molecule .Mention its bond order and magnetic property

3. Describe the crystal field splitting of transition metal ion in tetrahedral complex. Describe the crystal field splitting of transition metal ion in Octhedral complex.

UNIT-V

4. How is Portland cement manufactured by wet and dry process?

5. What is lubricant? Explain mechanisms of lubrication.

ANURAG Engineering College

25/5 | 5

(An Autonomous Institution)
Ananthagiri (V&M), Suryapet (Dt). Pin: 508 206.

I B.Tech. I Semester (R22) Mid-II Assignment

ENGINEERING CHEMISTRY **Branch : ECE**

H.T.No: 23C11A04011 Name: Hasi Teja R Branch: ECE

UNIT-III

1. i. How natural rubber obtained from latex. Explain

ii. Explain vulcanization of rubber with chemical reactions and discuss the advantages of vulcanized rubber

UNIT-IV

2.i. Describe the L.C.A.O method

ii. Draw the MO energy diagram of N_2 molecule .Mention its bond order and magnetic property

3. Describe the crystal field splitting of transition metal ion in tetrahedral complex.

UNIT-V

4. How is Portland cement manufactured by wet and dry process?

5. What is lubricant? Explain mechanisms of lubrication.

1. **Natural Rubber** Natural Rubber is a high molecular weight hydrocarbon Polymer represented by the formula $(C_5H_8)_n$. it is obtained from a milk emulsion called latex by tapping the bark of the tree. "Heva Brasiliensis". Natural Rubber is a Polymer isoprene (2-methyl Butadiene).

$$n H_2C=C(CH_3)-CH=CH_2 \xrightarrow{\text{Polymerisation}} \left[H_2C-C(CH_3)=CH-CH_2 \right]_n$$

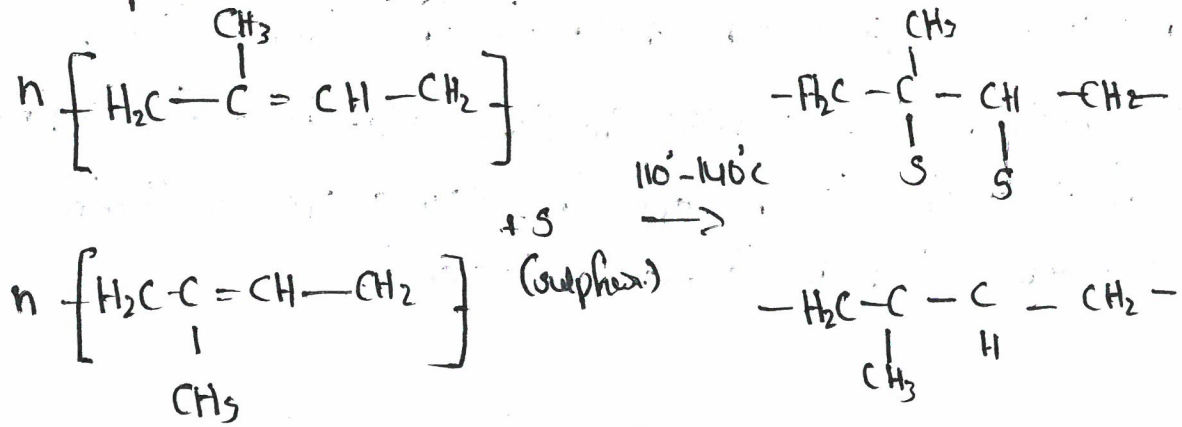
Isoprene (2-Methyl Butadiene).

Natural rubber (Poly isoprene).

Characteristics

→ It becomes soft at high temperature & is brittle at low temperature.
→ It swells in water - absorption capacity.
→ It swells in organic solvents.
→ It shows high elasticity.
→ It attacked by atmospheric oxygen
→ It shows low tensile strength.
→ It suffers Permanent deformation on stretching
→ It shows little durability.

ii) Vulcanization :- Vulcanization is defined as the process in which sulphur is added to the raw rubber at 110-140°C to improve the quality of rubber.



Raw Rubber → Vulcanized Rubber.

Advantages :-

(i) The major application of natural rubber is in the manufacture of tyres.

(ii) In heavy duty tyres, the major portion of the rubber used is natural rubber.

(iii) The tank lining in chemical plants where corrosive chemicals are stored are prepared from rubber

(iv) To reduce machine vibration, rubber is used for sandwiching b/w two metal surface.

(v) Foam rubber is used for making cushion, mattress padding etc.

2 L.C.A.O (Linear Combination of Atomic orbitals).

Molecular orbital Theory (MOT) was developed by Mullikan.

1. The maximum number of electron accommodated in each atomic orbital & molecular orbitals is 2.
2. The number of molecular orbitals obtained always equal to the number of atomic orbitals combining together
3. Linear combination of atomic orbitals give molecular orbitals

Linear combination is classified into two types,

i) Additive overlapping

ii) Subtractive overlapping

4. Atomic orbitals in Additive overlapping gives bonding molecular orbitals.
5. Atomic orbitals in Additive overlapping gives anti bonding molecular orbitals
6. The energy of bonding molecular orbitals is always lower than energy of combining is always lower than the energy of combining atomic orbitals.
7. The energy of anti bonding molecular orbitals is always higher than the energy of combining atomic.

Orbitals

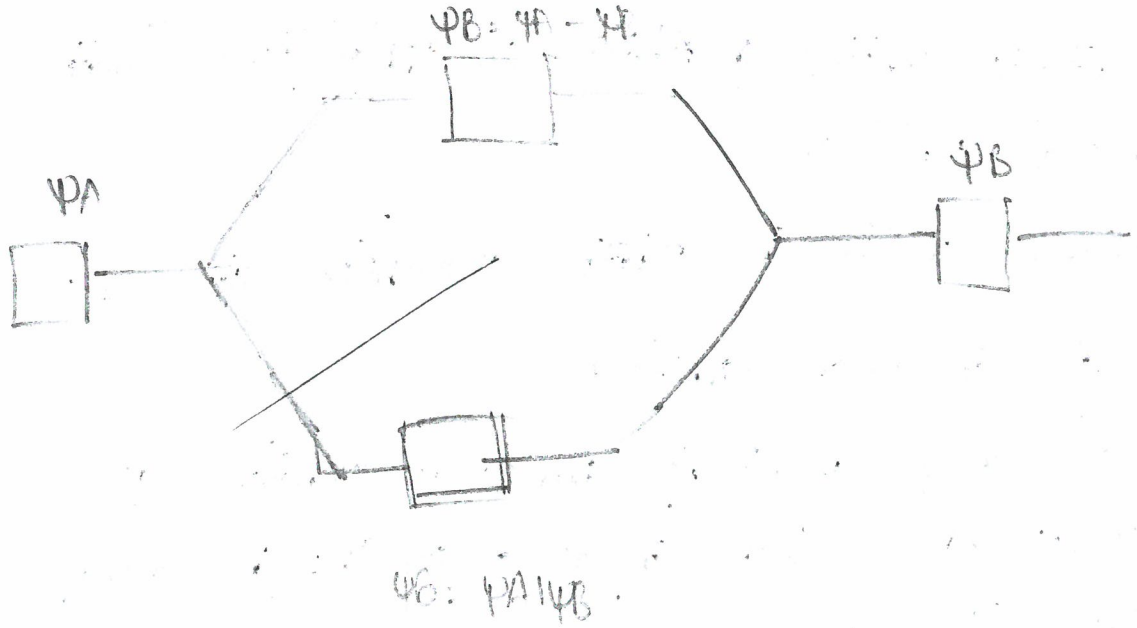
Bonding molecular orbitals represented as σ, π, δ Anti Bonding molecular orbitals represented as $\sigma^*, \pi^*, \delta^*$

Bondiy molecular orbitals represented in terms of wave function ϕ

Anti Bondiy molecular orbitals represented in terms of wave functions ϕ^*

8. Let the wave function of the two atoms A & B by ψA & ψB respectively. Then two atomic orbitals may be combined in 2 ways.

i) $\psi\sigma = \psi A + \psi B$ (Bonding) ii) $\psi\sigma = \psi A - \psi B$ (Anti Bondiy)



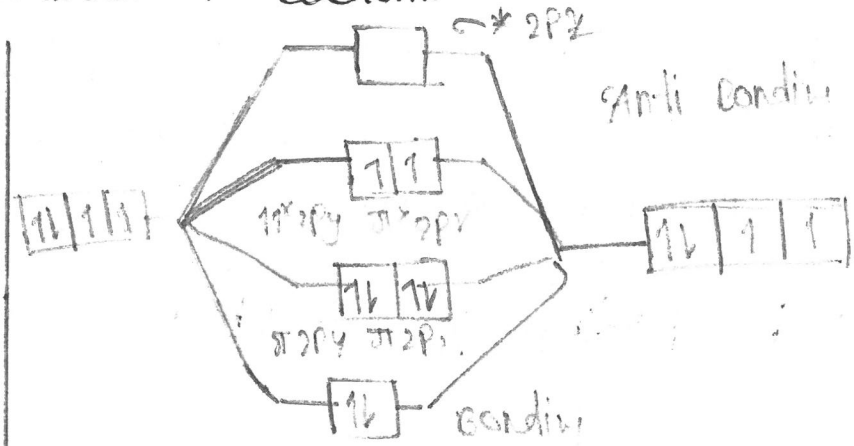
Energy diagram of molecular orbital.

ii) MOED of Oxygen (O_2) Molecule:-

Oxygen molecule = O_2.

Electronic configuration of oxygen = $1s^2\ 2s^2\ 2p^4$

Total number of electronic in O_2 = 16.



Number of Bonding electrons = 10

Number of anti Bonding electrons = 6

Bond order = ½ (Number of bonding electrons − Number of anti bonding electrons)

Bond order $= 1/2\ (10-6) = 4/2 = 2$

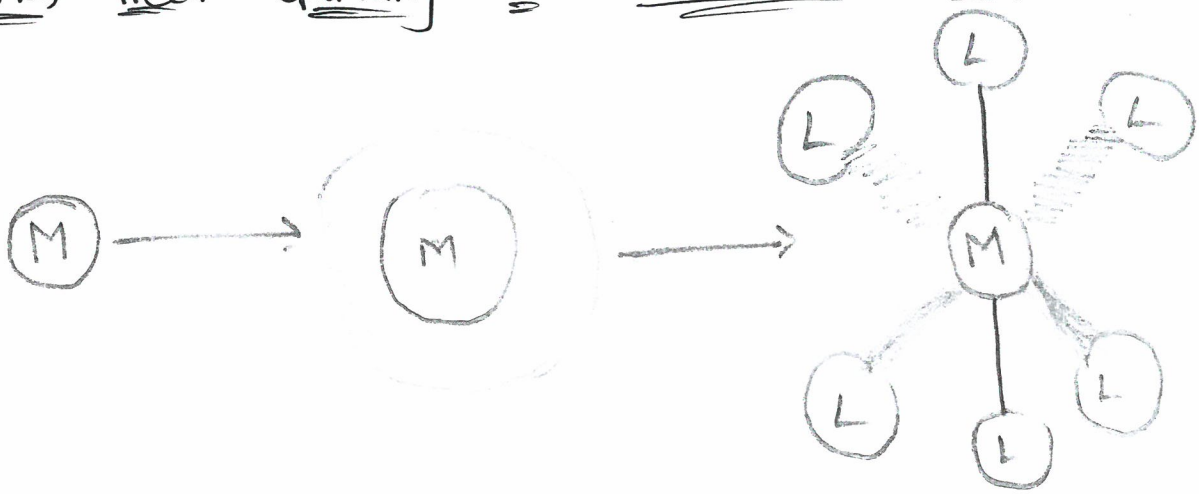
It indicates double bond is existe b/w oxygen atoms (O=O)

oxygen molecular electronic configuration:

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$

=> oxygen molecule is a Paramagnetic nature due to Presence of unpaired electrons.

3. Crystal field splitting in octahedral Complexes:



In these complexes the co-ordination number is 6 Hence. 6 ligands approach the metal ion along the axis. The energy of two e_g orbitals ($d_{x^2-y^2}$, d_{z^2}) which are oriented along the axis increases. so the energy of t_{2g} orbitals. (d_{xy}, d_{yz}, d_{xz}) which are oriented in b/w the axis decrease due to lesser repulsion. b/w ligands and t_{2g} orbitals.

The energy difference b/w e_g orbitals and t_{2g} orbitals. is known as Crystal field splitting Energy (Δ_o).

Stage-1 Represent the degenerate orbitals in free. metalion.

Stage-2 Represent the degenerate orbitals of higher energy level.

Stage-3 Represent the splitting of orbitals in octahedral field.

Based on the above splitting we can say that, each electron enter to the t_{2g} orbitals stabilizes the complex ion by $-0.1\ \Delta_o$ & each electron entering eg orbital destabilizes the complex ion by $0.6\ \Delta_o$.

4. Manufacture of Portland cement:- Raw materials required for the manufacture of Portland cement are as follows

1. Calcareous materials, which supply lime (CaO). for example. calcite, aragonite, marine shells. lime stone ($CaCO_3$) & Chalk.
2. Argillaceous materials which supply silica (SiO_2), alumina (Al_2O_3) and iron oxide (Fe_2O_3). for example. clay shale, fly ash, & blast furnace.
3. Gypsum ($CaSO_4, 2H_2O$)
4. Powdered coal or fuel oil.

(i) Dry Process:- The powdered ingredients are mixed in the required proportions to get dry raw mix. The raw mix is stored in storage tanks & then fed to rotary kiln.

(ii) wet process:- The ingredients are mixed in the right proportions (lime stone & clay are mixed in 3:1 proportion) in the presence of water to form slurry. The slurry is stored in storage tanks & then fed to rotary kiln.

meaning liquid & dynamic meaning relative motion lubrication. In this case fluid is formed by mixing of hydrocarbon oils are anti-oxidants with long chain polymer so as to maintain viscosity. fluid film lubricants is used in delicate & light machines. like watches, clocks, gun scintific equipments.

2. Thin film or boundary lubricant.

In this type of lubrication a thin film of lubrication is absorbed on the surface of metal by weak vander waals forces. This adsorbed layer helps to avoid a direct metal to metal called like the rubbing surface

5. Lubricant :- Lubricant may be defined as the substance which reduces the friction b/w the two rubbing surfaces.

Mechanism of Lubrication

1. Thick film (or) fluid film lubrication (or) hydrodynamic lubrication :- Under the condition of low load & high speed a thick lubricating film (1000 A° thick) is maintained b/w two solid surfaces. Since the two solid surfaces are separated by a thick film there is reduced wear. It is carried out with the help of liquid lubricants. Therefore it is known as thick film or fluid film lubrication or hydrodynamic (hydro).

3. Extreme pressure (or) Temperature Lubrication

In this mechanism, moving or slidy surfaces are under high pressure & speed, therefore this is known as extreme pressure lubriation. In such a case high temperature generated due to friction, under these condition liquid lubricate are fail to strak & decompose or vaporize. These additives form durable films on metal surfaces which are withstand high loads & high temperature. Important additives are organic compound having group life chloride, Sulphur Phosphorous Etc. They reach with metalic surface to form metallic compound (oxide) high melting points are as good lubricat under extreme temperature & pressure like chlorides, Sulphids phosphate are more durable film.

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I B.TECH II SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. ECE & IT **Max. Marks : 30M**
Date : 18-Jun-2024 Session : Afternoon **Time : 120 Min**
Subject : Engineering Chemistry,CH202BS

PART - A

ANSWER ALL THE QUESTIONS **10 X 1M = 10M**

Q.No	Question		CO	BTL
1.	`Functionality of trimethylol phenol is (A). 2 (B). 3 (C). 4 (D). 1	( )	CO3	L1
2.	Styrene butadiene rubber is produced by making use of one the following as catalyst (A). Mg (B). Al (C). Na (D). Zn	( )	CO3	L1
3.	One of the following is a highest energy bonding molecular orbital (A). (B). (C). (D).	( )	CO4	L2
4.	The bond order for oxygen molecule is (A). 2 (B). 3 (C). 4 (D). 1	( )	CO4	L2
5.	One of the following is a lowest energy bonding molecular orbital (A). (B). (C). (D).	( )	CO4	L2
6.	The lobes are orientated between axes are called (A). t2g (B). eg (C). both (D). none of the above	( )	CO4	L2
7.	One of the following is an example of themo responsive polymer (A). Nylon (B). polyacetate (C). polyester (D). PLA	( )	CO5	L2
8.	Which of the following least temperature zone in kiln (A). drying (B). calcinations (C). clinkering (D). None of the above	( )	CO5	L1
9.	Which of the following for tri calcium silicate (A). C2S (B). C2A (C). C3S (D). C3A	( )	CO5	L2
10.	The initial setting of cement is due to (A). Hydration of calcium (B). Hydration of aluminate (C). Hydration of silicate (D). Hydration of di calcium	( )	CO5	L2

PART - B

ANSWER ANY FOUR **4 X 5M = 20M**

Q.No	Question	CO	BTL
11.	. Explain vulcanization of rubber with chemical reactions and discuss the advantages of vulcanized rubber	CO3	L2
12.	Explain the mechanisms of conducting polymer	CO3	L2
13.	Describe the crystal field splitting of transition metal ion in tetrahedral complex	CO4	L2
14.	Draw the MO energy diagram of N2 molecule .Mention its bond order and magnetic property	CO4	L2
15.	Illustrate the classification of Lubricants	CO5	L3
16.	write the chemical composition of Portland cement	CO5	L2

ANURAG ENGINEERING COLLEGE

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Ananthagiri (V & M), Kodad, Suryapet (Dist), Telangana.

Program		
B.Tech. ✓	M.Tech.	M.B.A.

HALL TICKET NO.									
23	C	1	1	A	0	4	1	7	

Course: Engineering Chemistry

Q.No. and Marks Awarded										
1	2	3	4	5	6	7	8	9	10	11

YEAR	SEMESTER	MID EXAMINATION
I	II	II

Regulation : R22 | Branch or Specialization: ECE

Signature of Student: A. Lakshmi Pradeep

Signature of invigilator with date: 18/6/24

Signature of the Evaluator:

Maximum Marks: 30 | Marks Obtained: 20

(Start Writing From Here)

Part - A

1 [B] ✓

2 [C] ✓

3 [●A] ✓

4 [A] ✓

5 [C] ✗

6 [D] ✗

7 [D] ✗ ✓

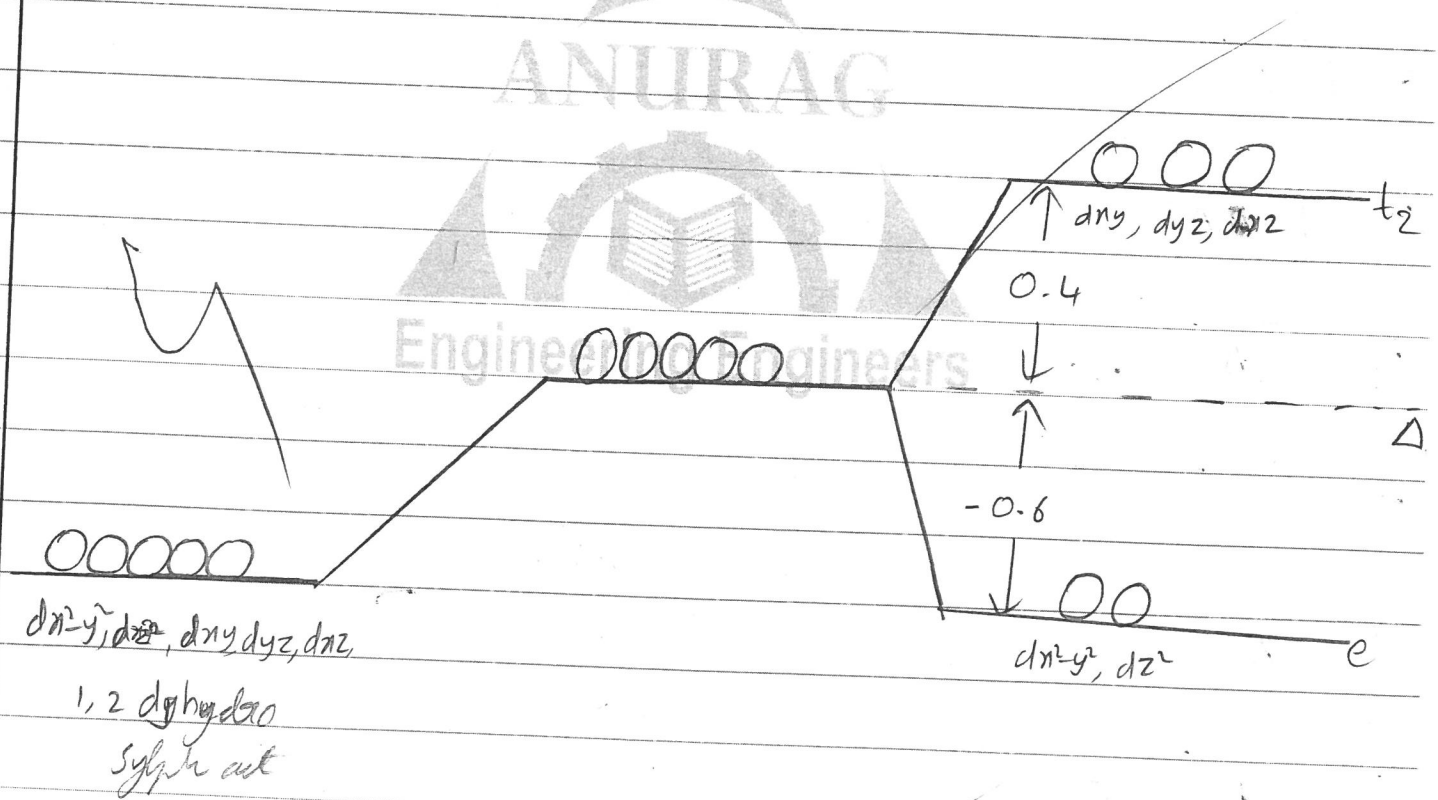
8 [C] ✗

9 [C] ✓

Part - B

13) Crystal field splitting of transition metal ion in tetrahedral complex

- The tetrahedral is the complex of the crystal field Spliting it the bonding the tetrahedral complex
- If the t_2 is the increasing the bond molucles of atomic orbic.
- If the e is the decreay the bond molucles of the atomic orbic.
- When the it is the tetrahedral is the reverse of octahedral.



Property:-

1) If it is the isorational of the free metal ion
2) If it is the isoation of the Strong electron
3) If it is the crystal filed splitting tetrahedral Complex

Eg :- $(NiCl_4)^{+2}$

atomic number = [Ar] $3d^8 4s^2$

∴ E.C = [Ar] $3d^8 4s^2$

Ni^{+2} E.C = [Ar] $3d^8$

If the range of the Aendle gude

E.C = 5(-0.6) + 4(0.4)

= ~~2.0 - 0.2~~ = -3.0 + 1.6

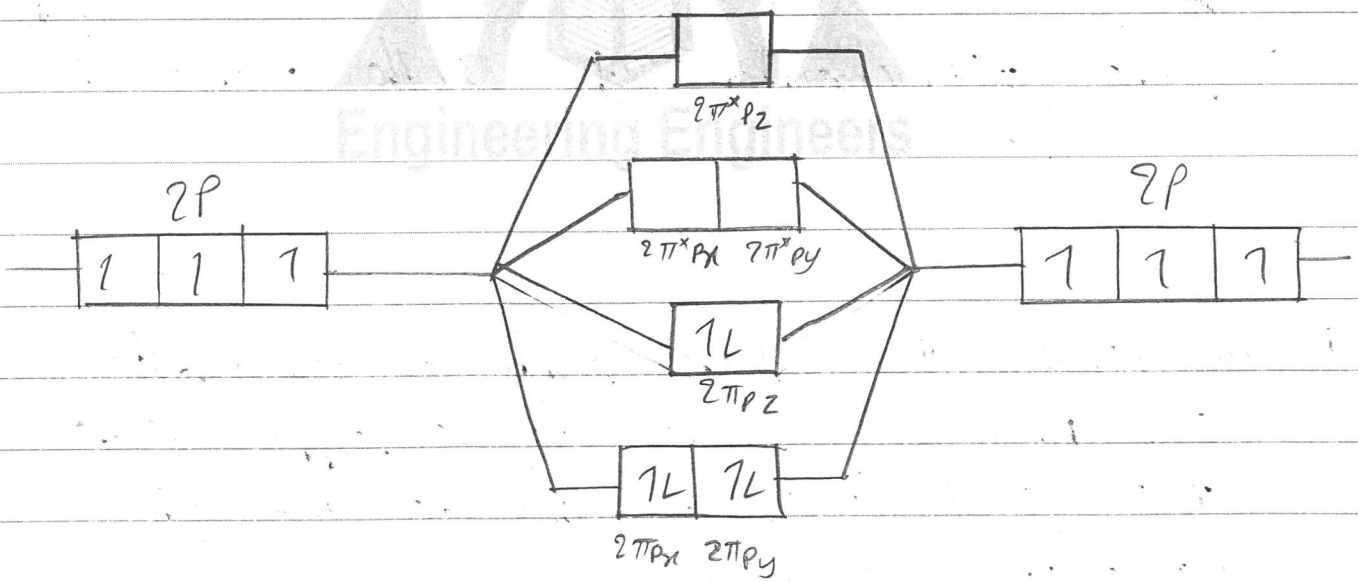
= ~~0.8~~ = -1.4

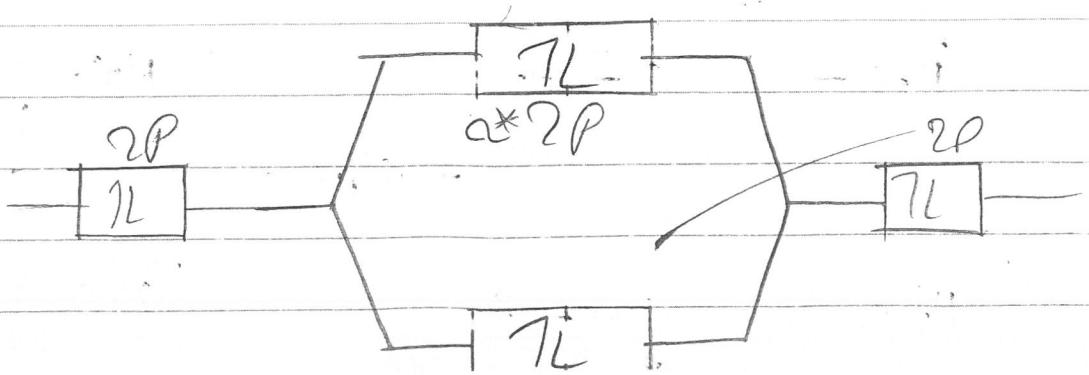
14) Atomic number = 7

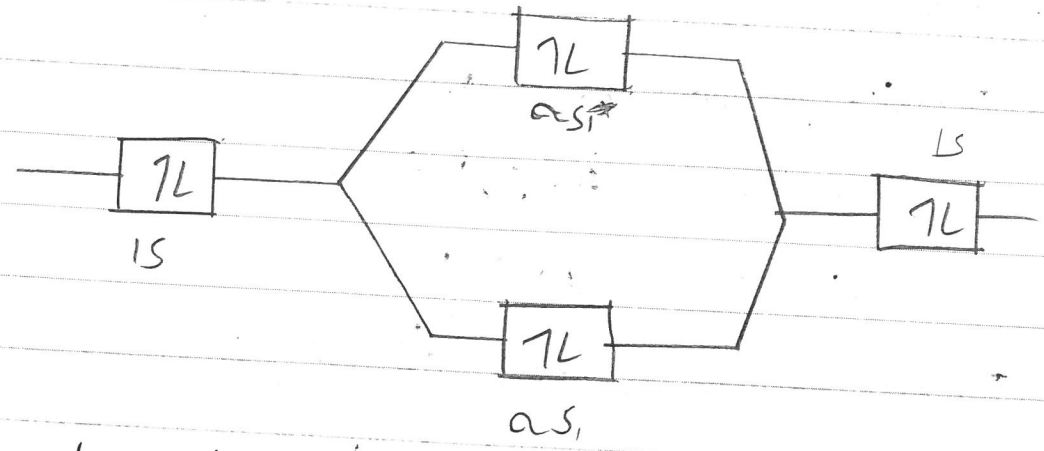
atomic Bibitic = N_2

· bond zde = $1s^2 2s^2 2p^3$

Total atomic number = 14







• The atomic anti bond order of the is the

• Bond order = ½ (bond molecular atom − anti bond molecular atom)

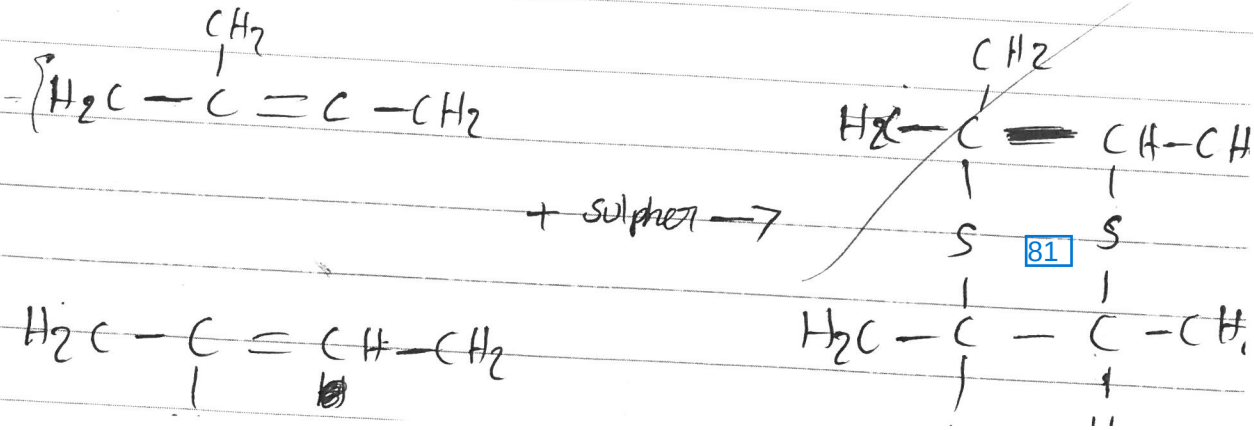
• Bond order = ½ (10 − 4) = 3

• If the order is

$\sigma 2s < \sigma^* 2s < \sigma 2p < \sigma^* 2p < \pi 2p_x = \pi 2p_y < \pi 2p_z$

If the diamagnetic is the observation

ii) Vulcanized rubber: If the rubber is raw material and 100 to 140 C° of heat to the sulphur of the natural rubber it can converted into the vulcanized rubber.



Property :-

- If the valacanized rubber is the softe and swells of strengtho
- It is Increase strength
- It is Increase water resistance
- It is Increas Stifness
- It is Increas bordaton
- It is Increas tiention
- If it is the Increas the valucanized rubor haye be the longer strength.

Application :-

- If it be manfactuoe the tyries
- If it can be used the butto bollown
- If it can be Slipor and some daily wator
- If it can be defiend as the chemical reation reqest of the formaton of volcanized rubbor

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Affiliated to JNTUH, Hyderabad, Accredited by NAAC with A+ Grade)

Ananthagiri (V & M), Kodad, Suryapet (Dist), Telangana.

Program		
B.Tech. ✓	M.Tech.	M.B.A.

YEAR	SEMESTER	MID EXAMINATION
I	II	II

HALL TICKET NO.: 2 3 C 1 1 A 0 4 4 4

Regulation : R-22 | Branch or Specialization:

Signature of Student: Surya Tejs

Course: E.C

Signature of invigilator with date: 10/3/26

Signature of the Evaluator:

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Marks Awarded											

Maximum Marks: 30 | Marks Obtained: 08

(Start Writing From Here)

Part-A

1) B

2) C

3) D

4) ~~A~~

5) A

6) A

7) B

8) A

9) C

10)

(11) Rubber: To defined has a rubber is strechble material it working a some places used to rubber it's like a smooth particle of streching and jumping it's used to money pack and paper and some materials packing to used of rubber.

Advantages of Rubber:

* It is used to packing materials
* It's balanced to the two particles
* It is strechible property by using a main working place.
* If vulcanization of rubber in othe position.
* It is used to vehicles tyres and playin balls etc---

chemical reaction of rubber.

It has a chemical used to N_2, NaCl, ngth to devided the molecules of slicate of two mixing of plastic materials an non-use rubber materials of mixed to prepare the rubber material and of devides the some shapes on useful two materials are mixed to prepare a rubber in the process of rubber.

Vulcanization of Rubber:

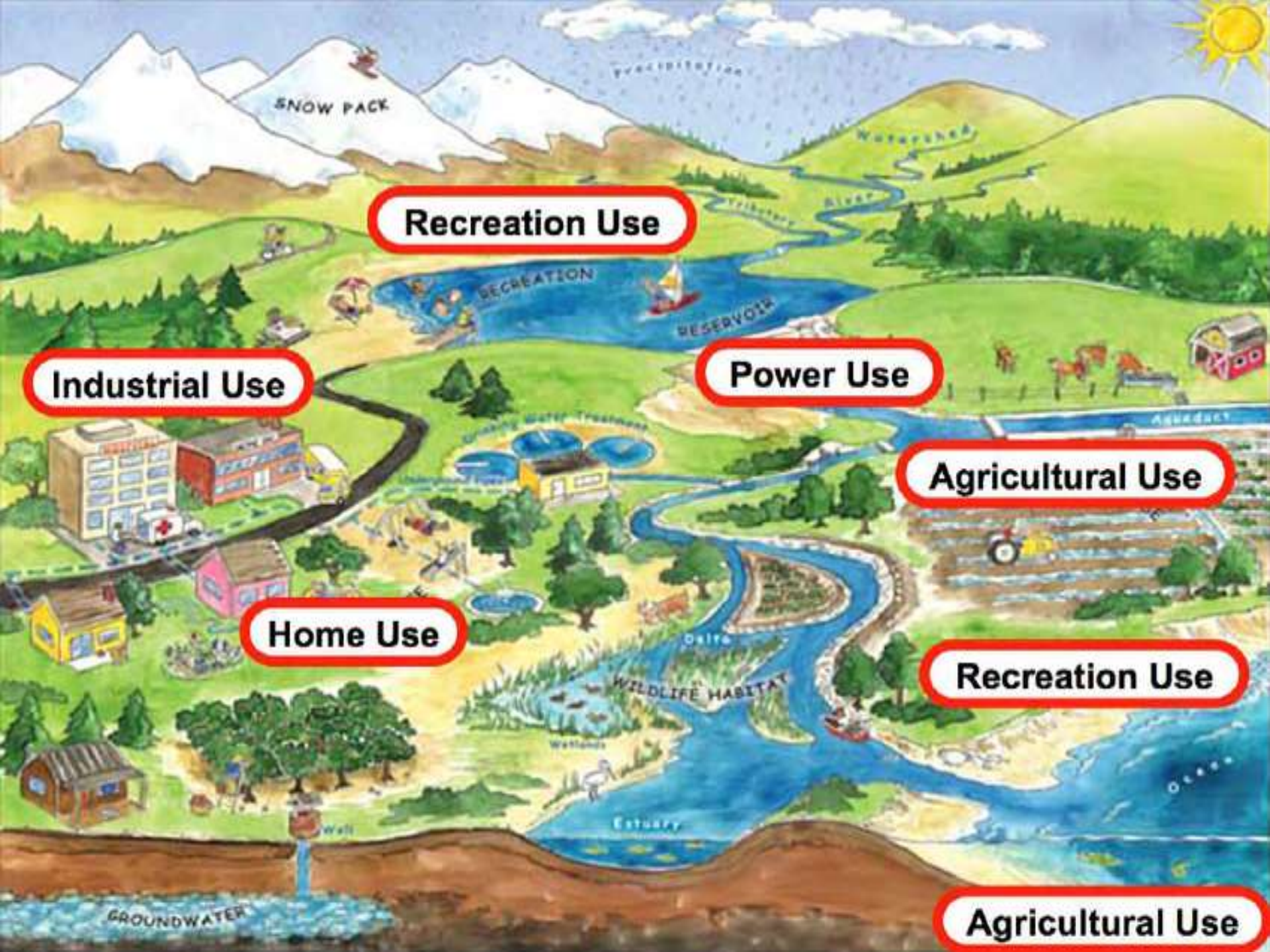
Take some waste materials are doing th process of rubber to shell to prepare in rubber tubes and vehicle tyres

in chemicall added to make the machind of rubber.

13) TO metal ion in tetrahedral complex in crystal field splitting of transition of property to make sure hard quality of splitting of transistion of some way of tetrahedral complex.

WATER TECHNOLOGY

Unit-4


SNOW PACK
Recreation Use
RECREATION
RESERVOIR
Industrial Use
Power Use
Agricultural Use
Home Use
WILDLIFE HABITAT
Recreation Use
GROUNDWATER
Agricultural Use

Uses of WATER

Drinking

Washing Hands

Brushing Teeth

Bathe

Cooking

Watering Plants

Uses of Water

Drinking

Cooking Food

Extinguishing Fire

Bathing

Washing Clothes

Introduction:

- water is nature’s most wonderful, abundant and useful compound.
- Water is not only essential for the lives of animals and plants, but also occupies a unique position in industries.
- It is widely used in drinking, bathing, sanitary, washing, irrigation, fire-fights, air-conditioning and also production of industrial materials.

❖The distribution of water on the Earth's surface is extremely uneven.

Only 3% Of freshwater (69% resides in glaciers, 30% underground, and less than 1% is located in lakes, riversand swamps.)

of water on the surface is fresh; the remaining 97% resides in the ocean.

❖ Looked at another way, only one percent of the water on the Earth's surface is usable by humans,and 99% of the usable quantity is situated underground.

Hardness of water

Hardness of water defined as which prevent the lathering of soap.

- This is due to presence of certain salts like Ca+2, Mg+2 and other heavy metals dissolved in water.
- Soaps (Sodium or Potassium salts of higher fatty acids) like Stearic acids ($C_{17}H_{35}COONa$).

Soft Water: The water which gives more lather with soap is called soft water.

$C_{17}H_{35}COONa + H_2O \rightarrow C_{17}H_{35}COOH + NaOH$.

soap Stearic acid

Hard Water: The water which does not give lather with soap is called hard water.

This is due to presence of salts like Ca+2, Mg+2 and other heavy metals dissolved in water

$$2C_{17}H_{35}COONa + CaCl_2/MgCl_2 \rightarrow (C_{17}H_{35}COO)_2 Ca/Mg + 2NaCl$$

soap (soluble) salts (soluble) insoluble

Causes of Hardness

Hardness of water is due to the presence of Bicarbonates, Chlorides, Sulphates and Nitrates of Calcium and Magnesium

Types of hardness

- **Hardness of water is mainly two types:**
- **1. Temporary Hardness**
- **2. Permanent Hardness**

•Temporary Hardness: Temporary Hardness mainly caused by the presence of dissolved bicarbonates of Calcium, Magnesium (Ca (HCO3)2, Mg(HCO3)2).

Temporary Hardness can be largely removed by boiling of water.

$Ca(HCO_3)_2$ by heating $CaCO3\downarrow + H_2O + CO_2$

Calcium bicarbonate

$Mg(HCO_3)_2$ by heating $Mg(OH)2\downarrow + 2CO2$

Magnesium bicarbonate

- **Permanent Hardness**:

It is due to the presence of dissolved Chlorides, Nitrates and Sulphates of Calcium, Magnesium, Iron and other metals.

- Permanent hardness responsible salts are
- $CaCl_2$, $MgCl_2$,
- $CaSO_4$, $MgSO_4$,
- $Ca(NO_3)_2$, $Mg(NO_3)_2$.
- Permanent Hardness cannot be removed by boiling
- but it can be removed by the use of chemical agents.

EXPRESSION AND UNITS OF HARDNESS

The expression of hardness producing salts usually expressed in terms of an equivalent amount of $CaCO_3$.

Calcium Carbonate is chosen as a standard because:

1. Its molecular weight (100) and equivalent weight (50) is a whole number, so the calculations in water analysis can be simplified.

2. It is the most insoluble salt that can be precipitated in water treatment.

The conversion of the hardness causing salts into $CaCO_3$ equivalents can be achieved by using the following formula:

$$\text{Degree of Hardness} = \frac{\text{The weight of hardness causing salts}}{\text{Molecular weight of hardness causing salts}} \times 100 \text{ (Molecular weight of } CaCO_3\text{)}$$

M

Units of Hardness:

- **Parts per Million (ppm):**

The number of parts of calcium carbonate equivalent hardness presents in 106 parts of water.

1ppm = 1 part of $CaCO_3$ eq hardness in 10^6 parts of water.

- **Milligrams per litre (mg/l):**

The number of milligrams of calcium carbonate equivalent hardness presents in litre of water.

1 mg/L = 1 mg of $CaCO_3$ eq hardness in 1 litre of water.

But one litre of water weights =1 kg =1000g = 1000 x 1000 mg = 106 mg = 1 ppm.

Clark’s degree (°Cl):

•The number of parts of calcium carbonate equivalent hardness presents in 70,000 or (7×104) parts of water.

1° Clarke = 1 part of $CaCO_3$ eq hardness per 70,000 parts of water.

Degree French (°Fr):

The number of parts of calcium carbonate equivalent hardness presents in 105 parts of water.

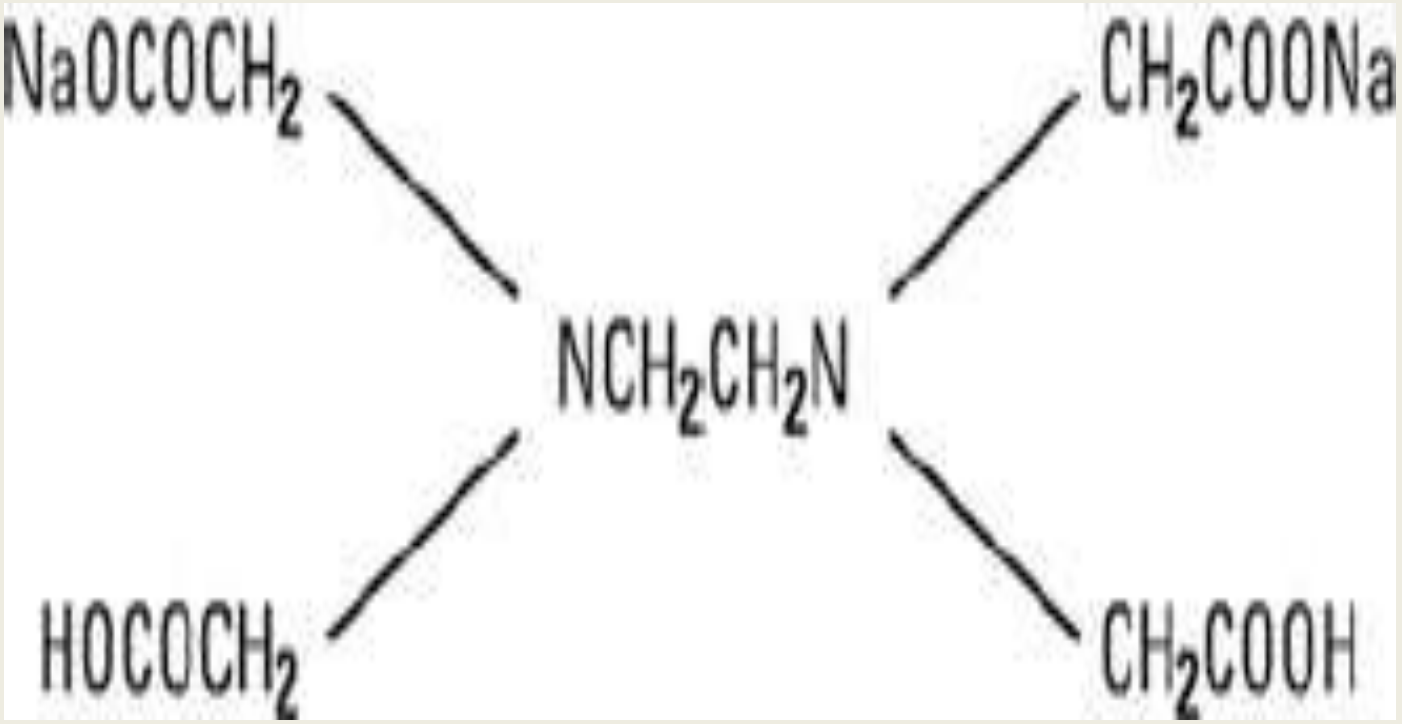
1° Fr = 1 part of $CaCO_3$ hardness eq per 10^5 parts of water.

Relationship between various units of hardness:

1 ppm = 1 mg/L = 0.1° Fr = 0.07° Cl

Determination of hardness By Complexometric Method / EDTA Method

Principle: The determination of hardness is carried out by titrating water sample with Sodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) using Eriochrome Black-T as an indicator and keeping the pH of the water at 9.0 - 10.0. The end point is the change in colour from wine - red to blue, when the EDTA solution complexes the calcium and magnesium salt completely.


NaOCOCH2
CH2COONa
NCH2CH2N
HOCOCH2
CH2COOH

(Ca2+ or Mg2+) +EBT → [Ca – EBT] (or) [Mg – EBT]

Hardness-salts indicator unstable complex (wine red)

[Ca – EBT] (or) [Mg – EBT] + EDTA →

Unstable complex (wine red)

[Ca – EDTA] (or) [Mg – EDTA] + EBT

stable complex (colourless) blue

Chemicals Required:

- standard hard water (0.01M)
- EDTA solution
- Indicator (EBT)
- Buffer solution

- ***Standardization of EDTA solution***:
- Rinse and fill the burette with EDTA solution.
- Pipette out 20 ml of standard solution of $ZnSO_4$(M1) in a conical fl
- Add 4ml of buffer solution and 2 drops of EBTindicator.
- Titrate with EDTA solution till wine-red colour changes to clear blue. Let volume used by'X' ml.

$$M1\ V1 = M2\ V2$$

Where, M1 = Molarity of $ZnSO_4$ solution =0.01M
V1 = Volume of $ZnSO_4$ solution =20 ml
M2 = Molarity of EDTA=?
V2 = Volume of EDTA **(Xml)**.

- **Determination of Total Hardness:**
- Rinse and fill the burette with EDTA solution.
- Pipette out 20 ml of sample water (V3) in a conical flask.
- Add 4 ml of buffer solution and 2 drops indicator.
- Titrate with EDTA solution till wine-red colour changes to clear blue. Let volume used by **'Y' ml**.

$M_2 V_2 = M_3 V_3$

Where, M_2 = Molarity of EDTA,

V_2 = Volume of EDTA **(Yml)**.

M_3 = Molarity of sample water,

V_3 = Volume of Sample water =20 ml

Total Hardness = $M_3 \times$ Molecular weight of $CaCO_3$ (100) × One

$= M_3 \times 10^5$ ppm

Determination of Permanent Hardness:

- Take 100 ml of sample water in 250 ml beaker.
- Boil it to remove temporary hardness to about half of its
- volume and cool to room temperature, filter through filter paper
- to remove insoluble salts.
- Make up the volume to the original 100ml by adding distilled water.

Now Pipette out 20 ml of this solution (V4) in a conical flask.
Add 4 ml of buffer solution and 2 drops indicator.
Titrate with EDTA solution till wine-red colour changes to clear blue. Let volume used by **'Z' ml**.

$$M2\ V2 = M4\ V4$$

Where, M2 = Molarity of EDTA,

V2= Volume of EDTA (**Z ml)**.

M4 = Molarity of Permanent hard water,

V4=Volume of water=20ml

Permanent Hardness = M4 × Molecular weight of $CaCO_3$ (100) × One Litre (1000ml)

= M4 × 10^5 ppm

Determination of Temporary Hardness:

Temporary Hardness = Total Hardness - Permanent Hardness

Alkalinity of water and its determination

Alkalinity: The alkalinity of water is due to

- hydroxides in the form of NaOH ,KOH,
- carbonates in the form of Na_2CO_3,K_2CO_3
- bicarbonates in the form of $NaHCO_3$, $KHCO_3$,$Mg(HCO_3)_2$, $Ca(HCO_3)_2$.

Alkalinity is classified as

Depending up on the anions that are responsible for the alkalinity of water, there are three types of alkalinity:

- Hydroxide alkalinity – due to hydroxide ions
- Carbonate alkalinity - due to carbonate ions
- Bicarbonate alkalinity - due to bicarbonate ions

ALKALINITY is defined as the the capacity of base to neutralise the acid.

- The alkalinity due hydroxide and carbonate can be detected by Phenolphthalein indicator and so they are collectively called as Phenolphthalein Alkalinity , represented by P.
- The alkalinity due hydroxide, carbonate and bicarbonate can be detected by Methyl orange indicator and so it is called as in Methyl orange Alkalinity, represented by M.

- ***Determination of Phenolphthalein Alkalinity ,P :***

100 ml of given water sample is taken in the conical flask , a few drops of Phenolphthalein Indicator are added and titrated against N/50 H2SO4 ; let the titre value when the solution becomes colourless, be V_1.

Calculation of P:

Volume of the acid= V_1

Normality of the acid = N

Volume of water Sample = V_s

$$\text{Partial alkalinity} = \frac{N \times V_1 \times 50 \times 1000}{V_s}$$

- ***Determination of Methylorange Alkalinity ,M :***

  The in the same solution a few drops of Methylorange indicator are added and titrated against the same acid until the colour changes from yellow to red ; let the titre value be V_2.

  Total alkanity $= \dfrac{N \times V_2 \times 50 \times 1000}{V_s}$

  Volume of the acid $= V_2$

  Normality of the acid $= N$

  Volume of water Sample $= V_s$

Potable water and its specifications

Water free from contaminants or water that is safe for human consumption is called potable water.

The following are the specifications of water drinking purpose.

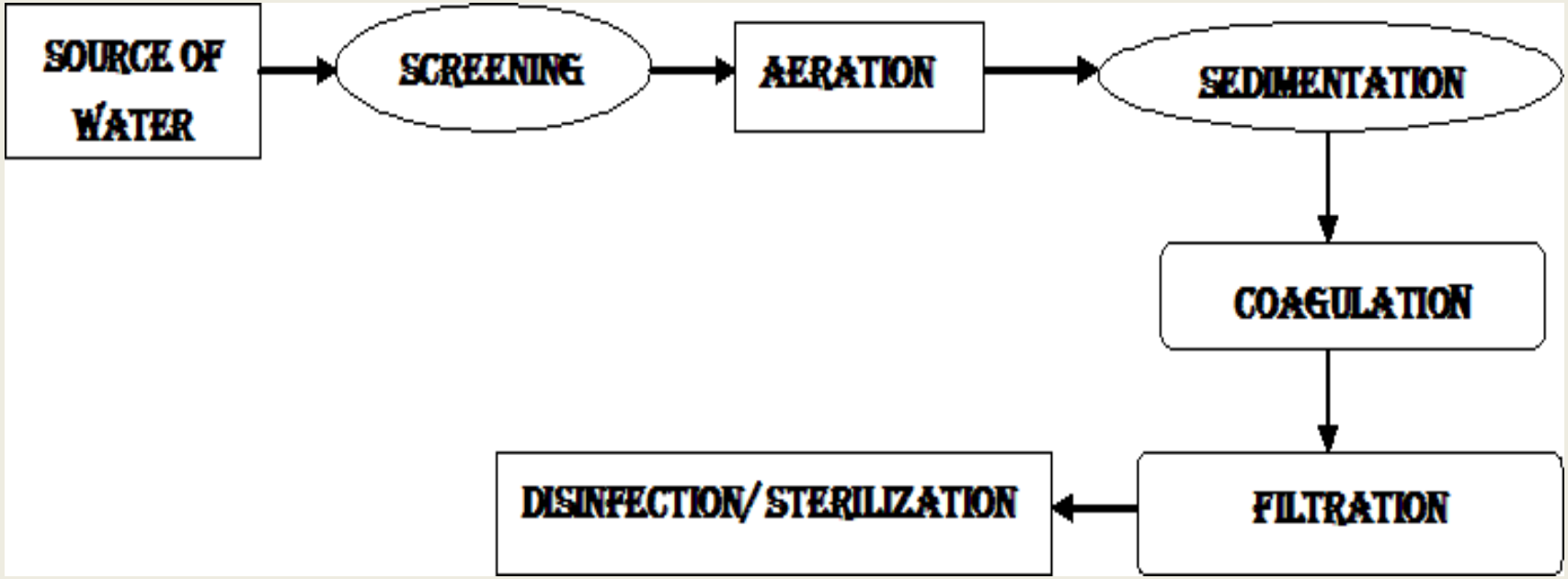
- The water should be clear (colorless), odourless and pleasant taste.
- The optimum hardness of water must be 125ppm.
- The pH of potable water should be 7.0 to 8.5.
- The recommended maximum concentration of total dissolved solids (TDS) in potable water must not exceed 500 ppm.

- The turbidity in drinking water should not exceed 25 ppm.
- The water must be free from heavy metals like Lead, Arsenic, Chromium and Manganese.
- The water must be free from pathogenic bacteria
- The water must be free from dissolved gases like H_2S, CO_2 and NH_3.

TREATMENT OF POTABLE / MUNCIPAL/DOMESTIC SUPPLY OF WATER

Treatment of water for drinking purposes mainly includes the removal of suspended impurities, colloidal impurities and harmful pathogenic bacteria.

The following stages are involved in purification.



1.Screening

The water is passed through screens having larger number of holes;

it retains floating impurities like wood pieces, leaves, heaver objectives etc.,

2.Aeration

The water is then subjected to aeration (reacting with air)

which helps in exchange of gases between water and air, increases the oxygen content and removes the impurities like iron, manganese and dissolved gases like H_2S, CO_2 and NH_3.

3.Sedimentation

it is a process of removing suspended impurities by allowing the water to stand undisturbed for 2-6 hours, due to force of gravity heavier particles are settled.

Sedimentation process removes 75% of suspended impurities.

4.Coagulation

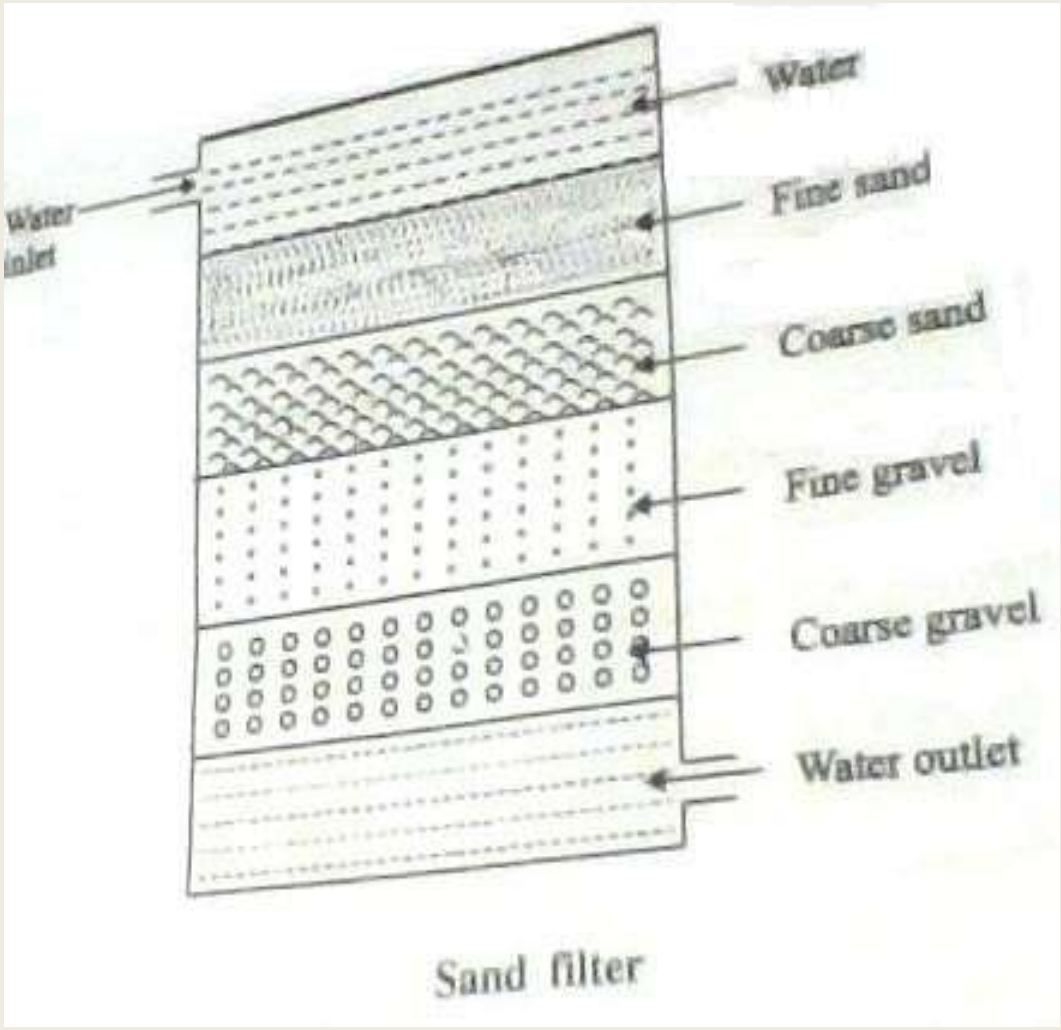
- Coagulants like alum, sodium aluminates and
Aluminum sulphate are added which produce gelatinous precipitates called flock.

- Flock attracts and helps accumulation of the
colloidal particles resulting in setting of the colloidal particles.

5.Filtration

it is the process of removal of bacteria,colour , odour, the colloidal and suspended impurities by passing the water through filter beds containing fine sand coarse sand and gravels.

When the water passes through various beds slowly the Bacteria partially removed by this process.


Water
Fine sand
Coarse sand
Fine gravel
Coarse gravel
Water outlet

Sand filter

Disinfection of water by sterilization

The process of destroying the harmful bacteria's is known as sterilization or disinfection.

1.Boiling

By boiling water 15-20 minutes, harmful bacteria are killed it is not possible for the municipal supply of water.

2.By Ozonization

Ozone is a powerful disinfectant and is readily absorbed by water. Ozone is highly unstable and breaks down to give nascent oxygen.

$O_3 \rightarrow O_2 + [O]$ nascent oxygen

The nascent oxygen is a powerful oxidizing agent and kills the bacteria.

Disadvantages:

This process is costly and cannot be used in large scale, due to unstable of ozone cannot be stored for long time.

3.By Chlorination: The process of adding chlorine to water is called chlorination. Chlorination can be done by the following methods.

By adding Chlorine gas: Chlorine gas is a very good disinfectant, which can be bubbled in the water. In this process calculated amount of chlorine gas is passed in order to destroy the pathogenic bacteria is called chlorination

$Cl_2 + H_2O \rightarrow HOCl$ (Hypochlorous acid) + HCl

$HOCl \rightarrow HCl + [O]$ nascent oxygen

By adding Chloramine: When chlorine and ammonia are mixed in the ratio 2:1 a compound chloramine is formed.

$$Cl_2 + NH_3 \rightarrow ClNH_2 + HCl$$

Chloramine

$$ClNH_2 + H_2O \rightarrow NH_3 + HOCl \text{ (Hypochlorous acid)}$$

$$HOCl \rightarrow HCl + [O] \text{ nascent oxygen}$$

4.By adding bleaching powder

when bleaching powder isadded to water it produced hypochlorous acid, which killed bacteria, it is a powerful disinfectant.

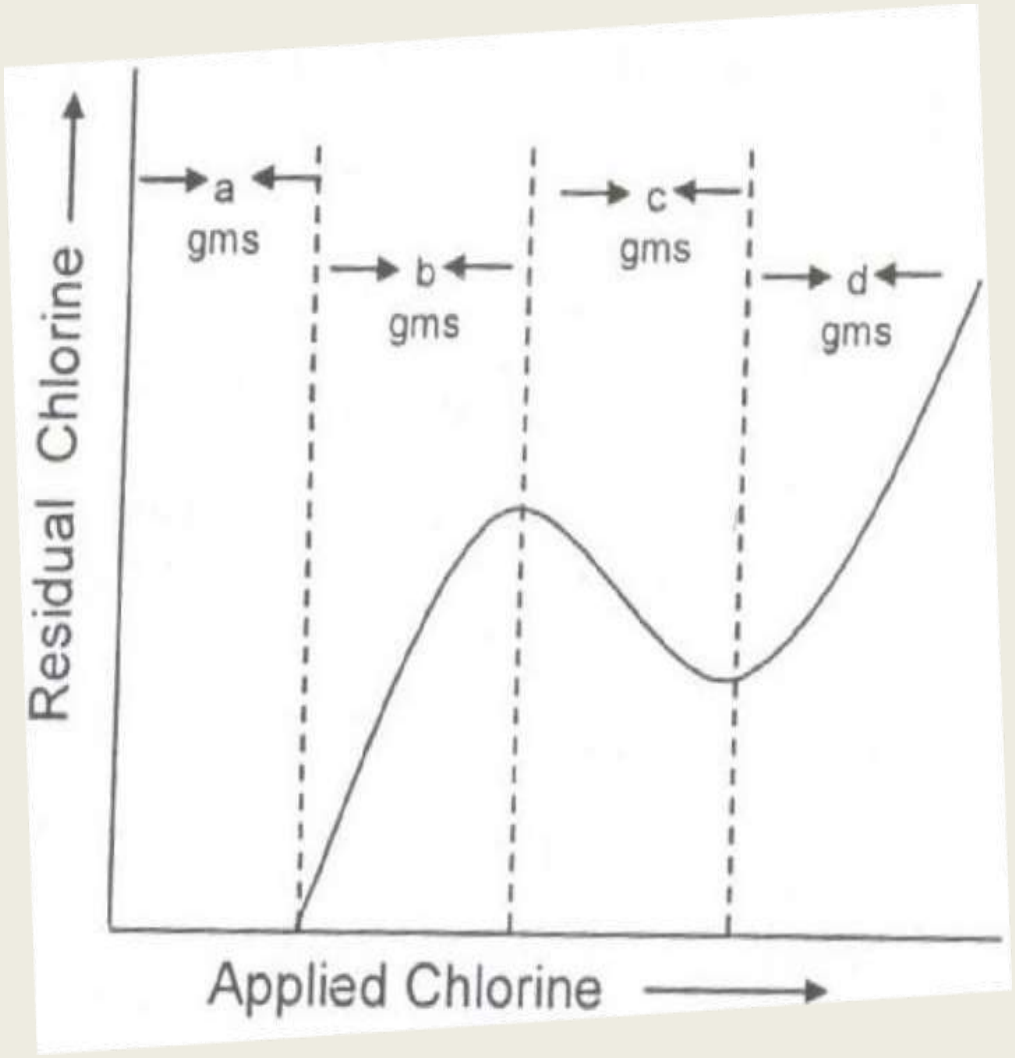
$$Caocl_2 + H_2O \rightarrow Ca(OH)_2 + HOCl$$

$$HOCl \rightarrow HCl + [O] \text{ nascent oxygen}$$

Break-point chlorination

The amount of chlorine required to kill bacteria and to remove organic matter is called break-point chlorination.

The water sample is treated with chlorine and estimated for the residual chlorine in water and ploted a graph as shown below which gives th break-point chlorination.


Residual Chlorine
a
gms
b
gms
c
gms
d
gms
Applied Chlorine

From graph it is clear that:

- ‘a’ gms of chlorine added oxidizes reducing impurities of water.
- ‘b’ gms of chlorine added forms chloramines and other chloro compounds.
- ‘c’ gms of chlorine added causes distruction of bacteria.
- ‘d’ gms of chlorine is residual chlorine.
- ‘c’ gms is the break point for addition of chlorine to water. This is called **break- point chlorination**.

Advantages of break-point chlorination:

- It removes bad taste, colour, oxidizes completely organic compounds, ammonia and other reducing impurities
- It destroys completely (100%) all disease producing bacteria.
- It prevents growth of any weeds in water.

Desalination of water -Reverse Osmosis

- The process of removing common salt (Sodium Chloride) from the water is known as **desalination.**
- The water containing dissolved salts with a salty or brackish taste is called **brackish water**.
- Sea water and brackish water can be made available as drinking water through desalination process. Desalination is carried out either by reverse osmosis or electro dialysis.

.

Reverse Osmosis:

- Reverse Osmosis is a process in which pressure greater than the osmotic pressure is applied on the high concentration side of the membrane, the **flow of solvent move from concentrated side to dilute side** across the membrane.

Osmosis

Osmosis is the phenomenon by virtue of which flow of solvent takes place from a region of **low concentration to high concentration** when two solutions of different concentrations are separated by a semi-permeable membrane.

In this process pure water is separated from salt water. 15-40 kg/cm2 pressure is applied for separating the water from its contaminants.

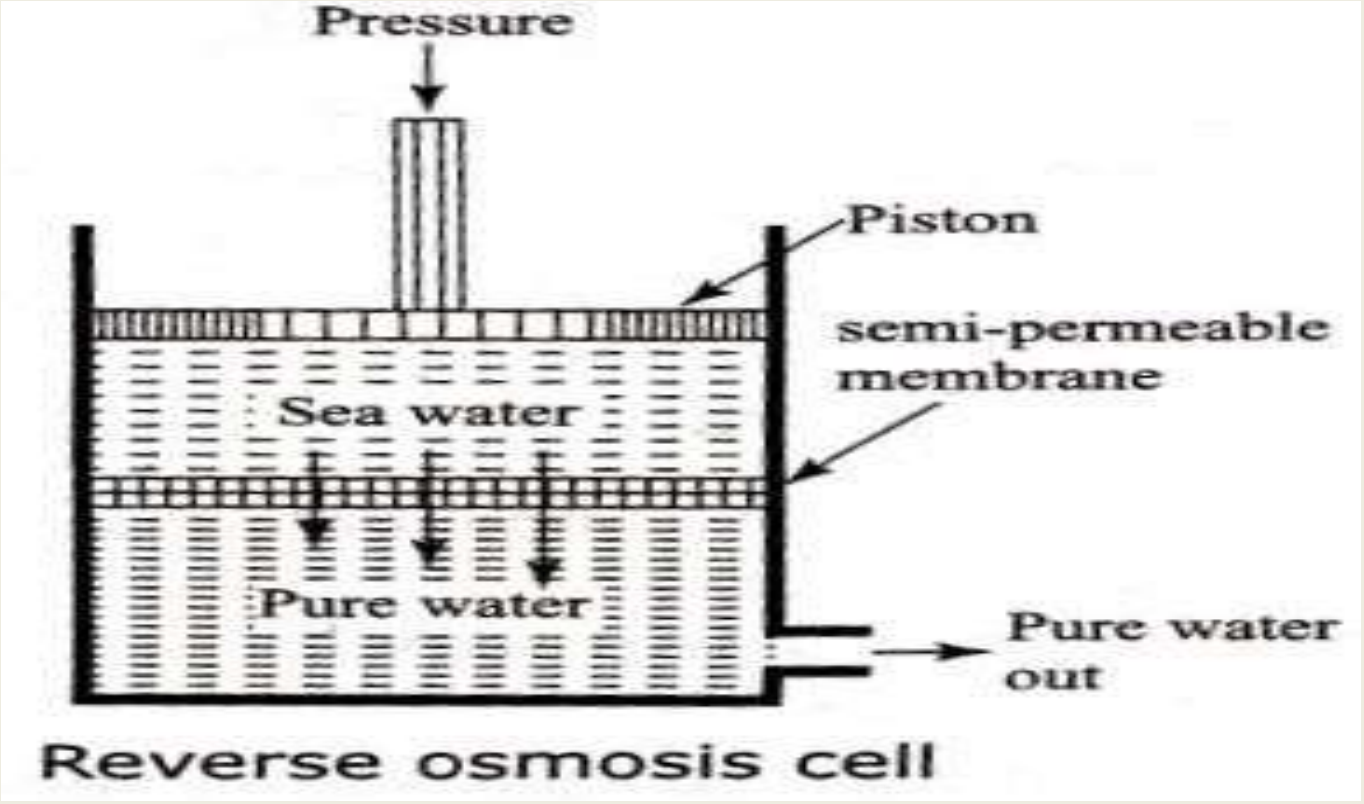
The membranes used are

- cellulose acetate,
- polymethyl acrylate
- polyamide polymers.

The process is also known as **super or hyper filtration**.

Advantages:

- It is simple and reliable process & Capital and operating expenses are low.
- The life of the semi-permeable membrane is about two years
- It can be easily replaced within a few minutes.



Reverse osmosis cell

Softening of Water by ion exchange process

- ***Ion exchange process is also known as demineralization process. Ion- Exchange resins are insoluble. Cross linked long chain organic polymers with a micro porous structure, and the "functional Groups" attached to the chains are responsible for the ion-exchanging properties.***

Resins are classified as:

- i. Cation Exchange Resins
- ii. Anion Exchange Resins.

Cation Exchange Resins

- **:** Cation exchange resins are styrene divinyl benzene co-polymers, which on sulphonation (or) carboxylation, which contains –COOH, –SO3H .Resins with acidic functional group are capable of exchanging H+ ions with other cations
- $2RH + Ca(HCO_3)2 \rightarrow R2Ca + H2CO3$
- $2RH + MgCl2 \rightarrow R2Mg + 2HCl$
- $2RH + CaSO4 \rightarrow R2Ca + H2SO4$

(RH = Cation exchange resin)

Anion Exchange Resins

- Anion exchange resins are Phenol formaldehyde (or) amine formaldehyde copolymers, which contains amino or .. Resins with basic functional groups are capable of exchanging OH^- ions with other anions.
- $ROH + HCl \rightarrow RCl + H_2O$
- $2ROH + H_2SO_4 \rightarrow R_2SO_4 + 2H_2O$
- $ROH + H_2CO_3 \rightarrow RHCO_3 + H_2O$

  (ROH = anion exchange resin)

Procedure

- In ion-exchange process, hard water is allowed to pass through cation exchange resins, which remove Ca^{+2} and Mg^{+2} ions and exchange equivalent amount of H^+ ions.

- Anions exchange resins remove bicarbonates, chlorides and sulphates from water exchange equivalent amount of OH^- ions.

Thus by passing hard water through cation and anion exchange resins, hardness is observed by the following reactions.

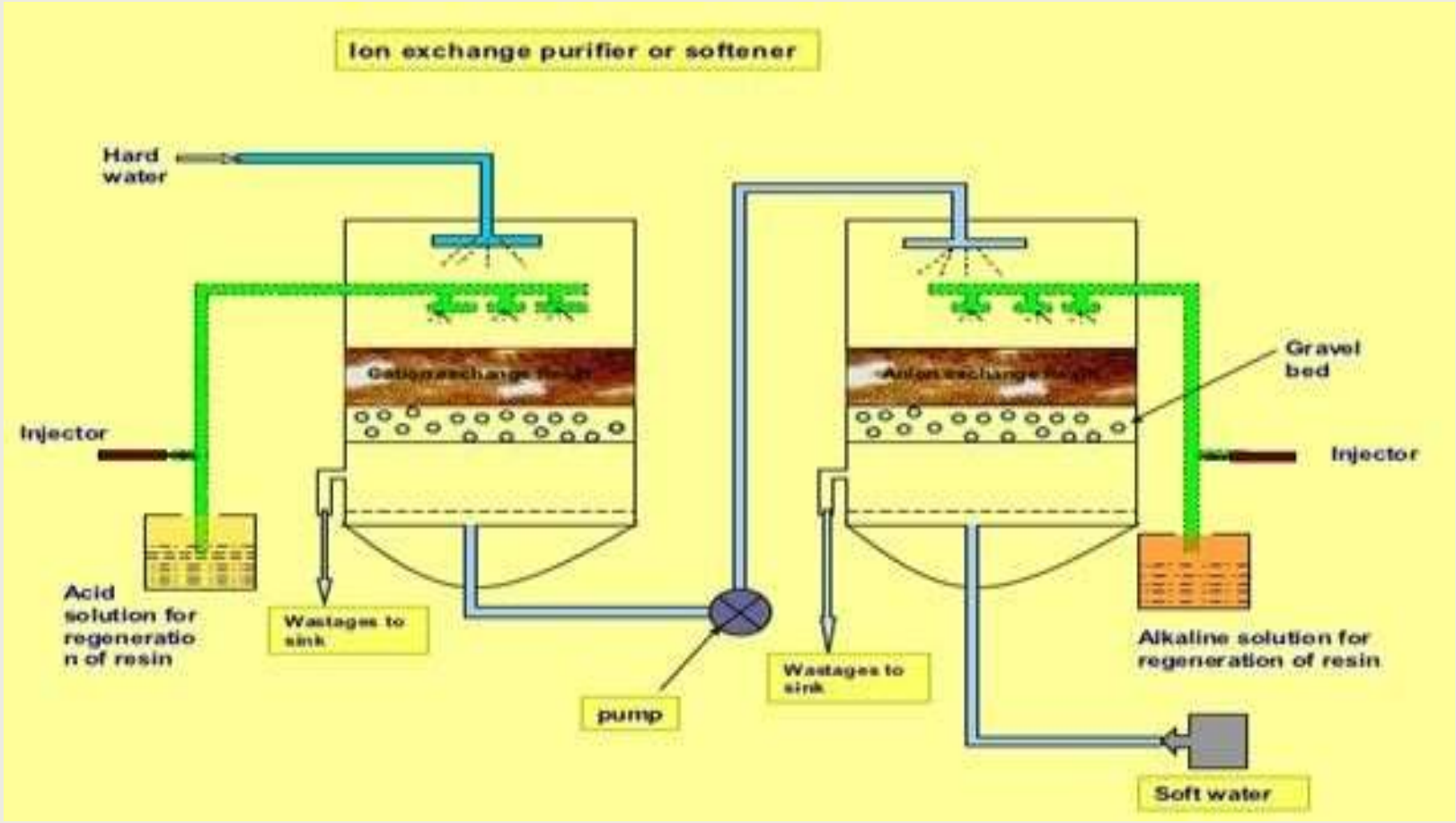
H+ and OH−ions, thus released in water from respective cation and anion exchange columns, get combined to produce water molecules.

$H^+ + OH^- \rightarrow H2O$

The water coming out from the exchanger is ion free from anions and cations. Thus water of zero hardness is obtained.

Regeneration

- When cation exchanger losses capacity of producing H+ ions and exchanger losses capacity of producing OH− ions, they are said to be exhausted. The exhausted cation exchanger is regenerated by passing it through dilute sulphuric acid.
-
- $R_2Ca + 2HCl \rightarrow 2RH + CaCl_2$
- $R_2Mg + 2H2SO4 \rightarrow 2RH + MgSO_4$


Ion exchange purifier or softener
Hard water
Injector
Acid solution for regeneratio n of resin
Wastages to sink
pump
Wastages to sink
Gravel bed
Injector
Alkaline solution for regeneration of resin
Soft water

The exhausted anion exchanger is regenerated by passing a dilute solution of NaOH.

$$R2SO4 + NaOH \rightarrow 2ROH + Na2SO4$$

$$RCl + NaOH \rightarrow ROH + NaCl$$

$$RHCO_3 + NaOH \rightarrow ROH + NaHCO_3$$

Merits of Ion-exchange process

- The process can be used to soften highly acidic or alkaline water.
- It produces water of very low hardness (2ppm)
- So it is very good for treating water for use in high-pressure boilers.

Demerits of Ion-exchange process

- The equipment is costly and more expensive chemicals are needed.
- If water contains turbidity, the output of the process is reduced.
- The turbidity must be below 10ppm; else it has to be removed by coagulation and filtration.

Boiler Troubles

- A boiler is a closed vessel in which water under pressure is transformed into steam by the application of heat.
- The steam so generated is used in industries and generation of power.
- In modern pressure boilers and laboratories, the water required is used pure than the distilled water.

A boiler feed water should correspond with the following composition

- Its hardness should be below 0.2ppm.
- Its caustic alkalinity (due to OH-) should lie between 0.15ppm to 0.45ppm.
- It's should be free from dissolved gases like O2, CO2, in order to prevent boiler corrosion.

Boiler troubles or Disadvantages of using hard water in boilers

The boiler feed water should be free from turbidity, oils, dissolved gases, alkali, hardness causing substances.

If hard water obtained from natural sources is fed directily in to the boiler the following troubles may arise

The major boiler troubles are

1.Priming and foaming

2.Scale and sludge formation

3.Caustic embrittlement

4.Boiler corrosion

Priming and foaming

When a boiler is producing steam rapidly, some particles of the condensed liquid water are carried along with the steam.

The process of wet steam formation is called priming.

Reasons for priming

a).The presence of large amounts of dissolved solids

b).High steam velocities

c). Sudden boiling

d).Improper boiler design

e).Sudden increase in the steam production rate.

Prevention of priming

1. Fitting mechanical purifiers

2.Avoid rapid change in steam rate

3.Maintaning low water levels in boiler

4.Blow down of the boiler (replacing concentrated water with fresh water)

Foaming

- Foaming is the production of persistent foam or bubbles in boilers, which do not break easily.

- Foaming is due to the presence of substances like oils in water, which reduce the surface tension of water. Priming and foaming usually occur together.

Prevention of Foaming

a). Adding anti foaming agents like castor oil, the amount of castor oil to be added varies with impurities

Excess of castor oil can cause foaming Besides castor oil other substances like Gallic acid, tannic acid, cotton seed oil, corn oil, tartaric acid and citric acid also used as anti foaming agents.

b). Blow down of the boiler can prevent foaming.

Sludges

Sludge is a soft, loosy and slimy precipitate formed within the boiler. It is formed at comparatively colder portions of the boiler and collects in the area where flow rate is slow.

Ex: $MgCO_3$, $MgCl_2$, $CaCl_2$, $MgSO_4$.

Reasons for formation of sludges:

The dissolved salts whose solubility is more in hot water and less in cold water produce sludges.

Disadvantages of sludges

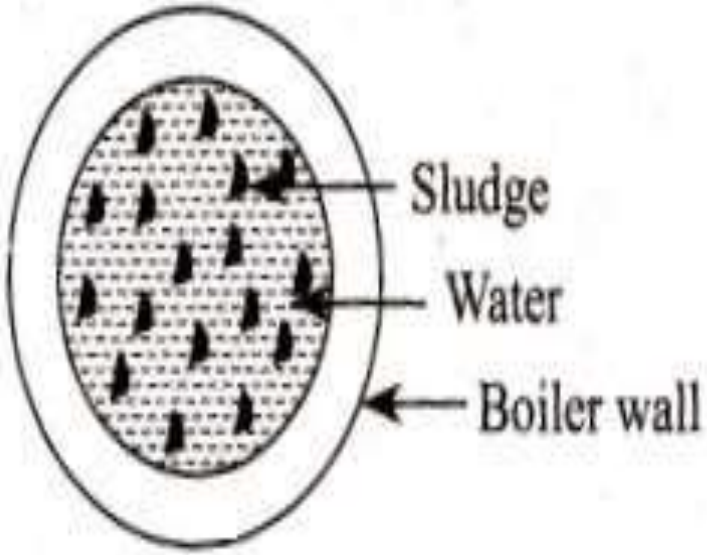
- Sludges are bad conductors of heat and results in the wastage of heat and fuel.

- Excessive sludge formation leads to the settling of sludge in slow circulation areas such as pipe connections, plug openings, gauge–glass connections leading to the choking of the pipes.

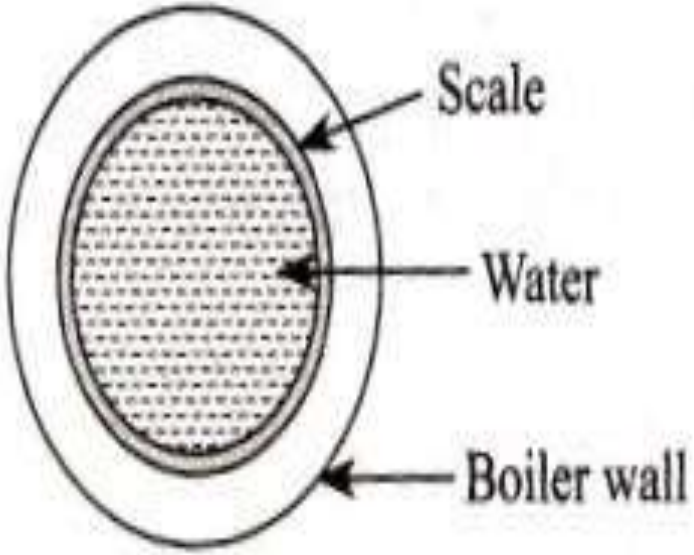
Prevention of sludge formation

1.By using soft water which is free from dissolved salts like $MgCO_3$, $MgCl_2$, $CaCl_2$ and $MgSO_4$ can be prevent sludge formation.

2.By blow down operation carried out frequently can prevent sludge formation.



(a) Sludge in boiler



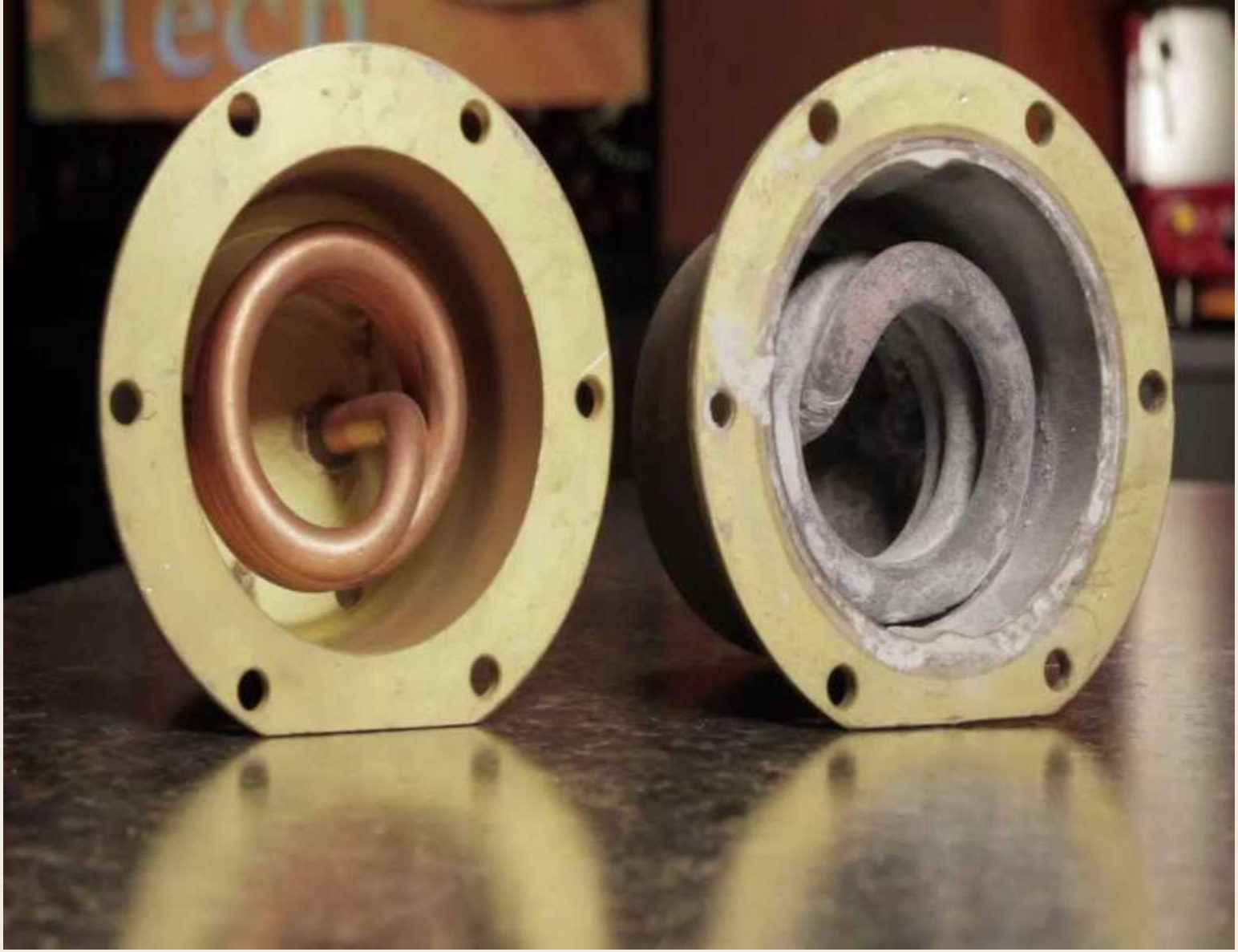
(b) Scale in boiler

Sludges and scales in boiler

Scales

Scales are hard, adhering precipitates formed on the inner walls of the boilers. Scales are stick very firmly on to the inner walls of the boiler.Scales are formed by substances like $Ca(HCO3)2$ $CaSO4$, $MgCl2$.


Pipe
Scale Formation
preventing water flow



Disadvantages of Scales

1.Wastage of heat and fuels.

2.Lowering of boiler safety .

3.Decrease in efficiency .

4.Danger of explosion .

Prevention of scales

1. If the scale formation is soft it can be removed by a scrapper, wire brush.
2. By giving thermal shocks, by sudden heating and sudden cooling which makes scale brittle and removed by scrubbing with wire brush.
3. Scale formation can be removed by washing with acids like HCl ,H_2SO_4.

Differences between scale and Sludge

Scale

- **Scale is hard and adherent .**
- **formed by the salts likeCalcium bicarbonate , Calcium sulphate , etc.**
- ***formation can b****e prevented by* dissolving scale using dilute acids like HCl , H_2SO_4 .

Sludge

- **Sludge is loose , slimy and non adherent.**
- **formed by the saltslike magnesium Sulphate , magnesium carbonate , etc,.,**
- ***formation can be prevented by***

i. periodically removing the concentrated water by fresh water

ii. taking soft water

3. Caustic Embrittlement

The formation of brittle and crystalline hairy cracks in the boiler shell is called caustic embrittlement.

The main reason for this is the presence of alkali-metal carbonates and bicarbonates in feed water.

This Na_2CO_3 decomposes to give NaOH and CO_2, due to which the boiler water becomes "Caustic Soda".

$$Na_2CO_3 + H_2O \rightarrow 2NaOH + CO_2$$

The H2O evaporates, the concentration of NaOH increase progressively creating a concentration cell as given below thus dissolving the iron of the boiler as sodium ferrate (Na2FeO2).

(-)Anode: ‘Fe’ at bents|Conc.NaOH ‖ Dil.NaOH| ‘Fe’ at plane Surface: Cathode (+)

- This causes embrittlement of boiler parts such as bends, joints, reverts etc, due to which the boiler gets fail.

- The iron at plane surfaces surrounded by dilute NaOH becomes cathodic while the iron at bends and joints surrounded by highly concentrated NaOH becomes anodic which consequently decayed or corroded.

Caustic embrittlement can be prevented

1.By maintaining the pH value of water and neutralization of alkali.

2.By using Sodium Phosphate as softening reagents, in the external treatment of boilers.

3.Caustic embrittlement can also be prevented by adding Tannin or Lignin or Sodium sulphate which prevents the infiltration of caustic-soda solution blocking the hair-cracks.

4.BOILER CORROSION

Boiler corrosion is the decay of boiler material (iron) either by chemical or electro chemical attack of its environment. Main reasons for the boiler corrosion are:

1 Dissolved oxygen

2.Dissolved carbon dioxide

***3*. Acids from dissolved salts**

1 Dissolved oxygen

Water usually contains 8 mg of dissolved oxygen per liter at room temperature.

Dissolved oxygen in water in the presence of prevailing high temperature of the boiler, attacks the boiler material as

$$2Fe + 2\,H_2O + O_2 \rightarrow 2\,Fe(OH)_2$$

$$4\,Fe(OH)_2 + O_2 \rightarrow 2\,[Fe_2O_3.2\,H_2O]$$

Removal of the dissolved oxygen

1.By adding calculated amount of sodium sulphite or hydrazine or sodium sulphide.

$$2Na_2SO_3 + O_2 \rightarrow 2\ Na_2SO_4$$

$$N_2H_4 + O_2 \rightarrow N_2 + 2\ H_2O$$

$$Na_2S + O_2 \rightarrow Na_2SO_4$$

2.Mechanical de-aeration

2.Dissolved carbon dioxide

Carbon dioxide dissolved in water forming carbonic acid, has a slow corrosive effect on the boiler material.

Carbon dioxide is also released inside the boiler, if water, containing bicarbonates is used for steam generation

$$CO_2 + H_2O \rightarrow H_2CO_3$$

$$Mg(HCO_3)_2 \rightarrow MgCO_3 + CO_2 + H_2O$$

Removal of dissolved carbon dioxide

1. By adding calculated amount of ammonia

$$2NH_4OH + CO_2 \rightarrow (NH_4)_2CO_3$$

2.By mechanical de-aeration process along with oxygen (described above)

3. Acids from dissolved salts

Water containing dissolved salts of magnesium liberates acids on hydrolysis.

$$MgCl_2 + H_2O \rightarrow Mg(OH)_2 + 2\ HCl$$

The liberated acid reacts with the iron material of the boiler in chain like processes,producing HCl again and again.

$$Fe + 2HCl \rightarrow FeCl_2 + H_2$$

$$FeCl_2 + 2H_2O \rightarrow Fe(OH)_2 + 2\ HCl$$

Prevention of acids

1.Softening of boiler water to remove $MgCl_2$ from water.

2.By frequent blow down operation

3. Addition of inhibitiors like sodium silicate,sodium phosphate, sodium chromate

Internal treatment of Water

Suitable chemicals are added to the boiler water either to precipitate or to convert the scale into compounds is called internal treatment of the boiler feed water.

Internal treatment can be done following types.

Calgon conditioning

Involves in adding calgon to boiler water. It prevents the scale and sludge formation by forming soluble complex compound with CaSO4.

Calgon = Sodium hexa meta phosphate = $Na_2 [Na_4 (PO_3)_6]$

$$Na_2 [Na_4 (PO_3)_6] \rightarrow 2Na^+ + [Na_4P_6O_{18}]^{-2}$$

$$2CaSO4 + [Na_4P_6O_{18}]^{-2} \rightarrow [Ca_2 P_6O_{18}]^{-2} + 2Na2SO4$$

Colloidal conditioning

- The addition of organic substances such as Kerosene, tannin, Gel.

- These substances gets coated over the scale forming precipitates and gives a loose and non-sticky precipitates which can be removed by using blow-down operation.

Phosphate conditioning

The addition of sodium phosphate in hard water reacts with the hardness causing salts and gives calcium and magnesium phosphates which are soft and non-adhere and can be removed easily by blow-down operation.

$$3CaCl_2 + 2\ Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaCl$$

$$3MgSO_4 + 2\ Na_3PO_4 \rightarrow Mg_3(PO_4)_2 + 3Na_2SO_4$$


SAVE WATER
SAVE LIFE
AND SAVE
THE WORLD

The picture can't be displayed.