PVP 23

Code: 23BS1102

I B.Tech - I Semester – Regular / Supplementary Examinations
DECEMBER 2025

CHEMISTRY

(Common for EEE, ECE, CSE)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	What is BMO and ABMO?	L2	CO1
1.b)	Explain conductivity.	L2	CO1
1.c)	Describe Fuel Cell.	L2	CO2
1.d)	List out any two applications of Fullerenes.	L3	CO2
1.e)	Choose any two applications of Schrodinger wave equation.	L3	CO2
1.f)	Explain nanomaterial.	L2	CO2
1.g)	Explain the functionality of monomers.	L2	CO3
1.h)	List two important applications of conducting polymers.	L2	CO3
1.i)	What is Electromagnetic spectrum?	L2	CO1
1.j)	Discuss the role of monochromator.	L2	CO3

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	a)	Give the important postulates of Molecular Orbital Theory.	L3	CO2	5 M
	b)	Explain de-Broglie's dual nature of hypothesis.	L3	CO2	5 M
OR					
3	a)	Differentiate between AOs and MOs with examples.	L4	CO4	5 M
	b)	Compare bonding in homo- and hetero nuclear diatomic molecules.	L4	CO4	5 M
UNIT-II					
4	a)	Discuss the preparation and properties of super conductors.	L3	CO2	5 M
	b)	What are Super capacitors? How are they classified?	L4	CO4	5 M
OR					
5	a)	Discuss the properties and applications of carbon nanotubes.	L3	CO2	5 M
	b)	Analyze the role of nanomaterials in medicine and environmental engineering.	L4	CO4	5 M
UNIT-III					
6	a)	Explain the principle involved in Conductometric titrations.	L4	CO4	5 M

	b)	Describe the construction and working of Hydrogen-Oxygen fuel cell.	L3	CO2	5 M
OR					
7	a)	Sketch Zn-Air battery. Explain the working principle of Zn-Air battery.	L3	CO2	5 M
	b)	Explain amperometric sensors with example.	L4	CO4	5 M
UNIT-IV					
8	Discuss the preparation, properties and applications of Buna-S rubber and Buna-N rubber.		L3	CO3	10 M
OR					
9	a)	Explain free radical addition polymerization mechanism with example.	L4	CO5	5 M
	b)	Explain the synthesis & applications of PVC.	L4	CO5	5 M
UNIT-V					
10	Explain the principle, instrumentation and applications of IR spectroscopy.		L4	CO5	10 M
OR					
11	a)	Illustrate types of electronic transitions in UV-Visible spectroscopy.	L3	CO3	5 M
	b)	Explain the classification of chromatography with real-time applications.	L3	CO3	5 M

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Code No: 23BS1102

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
I B.Tech – I Semester Regular Examinations-DECEMBR -2025
CHEMISTRY
(Common to EEE, ECE, CSE)

Duration: 3 Hours **Max. Marks: 70**

KEY AND SCHEME OF VALUATION

PART-A

1.a) What is BMO and ABMO? (2M)

1.b) Explain conductivity. (2M)

1.c) Describe Fuel Cell. (2M)

1.d) List out any two applications of Fullerenes. (2M)

1.e) Choose any two applications of Schrödinger wave equation. (2M)

1.f) Explain nanomaterial. (2M)

1.g) Explain the functionality of monomers. (2M)

1.h) List two important applications of conducting polymers. (2M)

1.i) What is Electromagnetic spectrum? (2M)

1.j) Discuss the role of monochromator.(2M)

PART-B

UNIT–I

2 a) Give the important postulates of Molecular Orbital Theory. 5 M

2.b) Explain de-Broglie's dual nature of hypothesis. 5 M

OR

3 a) Any five Differentiate between AOs and MOs with examples. 5 M

3b) Any five Compare bonding in homo- and hetero nuclear diatomic molecules. 5 M

UNIT–II

4 a) Discuss the preparation and properties of superconductors. 5 M

Preparation of Superconductor: 3 M

Properties of Superconductor: 2 M

4 b) What are Super capacitors? How are they classified? 5 M
Super Capacitors 2 M
Classification 3 M

OR

5 a) Discuss the properties and applications of carbon nanotubes. 5 M
properties : 2 M

Applications of carbon nanotubes: 3 M

5b) Analyze the role of nanomaterials in medicine and environmental engineering.5 M

OR

UNIT–III

6a) Explain the principle involved in conductometric titration 5 M

6· b) Describe the construction and working of Hydrogen–Oxygen fuel cell.5 M
construction: 2 M
working : 3 M

OR

7a a)Sketch Zn–Air battery. Explain the working principle of Zn–Air battery. 5 M
Neat Sketch : 2 M
working : 3 M

7 b) Explain amperometric sensors with example.5 M

UNIT–IV

8a) Discuss the preparation, properties and applications of Buna-S rubber and Buna-N rubber.10 M

Buna-S :
Preparation : 2 M
Properties : 1 M
Applications: 2 M

Buna-N :
Preparation : 2 M
Properties : 1 M
Applications: 2 M

OR

9 a)Explain free radical addition polymerization mechanism with example.5 M

9b) Explain the synthesis & applications of PVC.5 M
Synthesis : 2 M
Applications: 3 M

OR

10)Explain the principle, instrumentation and applications of IR spectroscopy.10 M
Principle : 3 M
Instrumentation : 4 M
Applications : 3 M

OR

11 a)Illustrate types of electronic transitions in UV-Visible spectroscopy.5 M

11b) Explain the classification of chromatography with real-time applications.5 M
Classification : 3 M
Applications : 2 M

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I B.Tech – I Semester – Regular / Supplementary Examinations

DECEMBER 2025

CHEMISTRY

(Common for EEE, ECE, CSE)

Duration: 3 hours. **Max. Marks: 70**

PART-A

1.a) What is BMO and ABMO? (2M)

BMO (Bonding Molecular Orbital): Formed by constructive overlap of atomic orbitals; has lower energy and increases molecular stability.

Ex:In H□ molecule, σ1s is BMO

ABMO (Antibonding Molecular Orbital): Formed by destructive overlap; has higher energy and decreases stability.

Example: In H□ molecule, σ*1s is ABMO.

1.b) Explain conductivity. (2M)

Conductivity is the ability of a material to allow the flow of electric current. It depends on the number of charge carriers (ions or electrons).

Example: Metals show high conductivity due to free electrons.

1.c) Describe Fuel Cell. (2M)

A fuel cell is an electrochemical device that converts chemical energy directly into electrical energy using a fuel and an oxidant.

Example: Hydrogen–oxygen fuel cell used in spacecraft.

1.d) List out any two applications of Fullerenes. (2M)

1. Used as lubricants due to spherical shape.
2. Used in drug delivery systems in medicine.

1.e) Choose any two applications of Schrödinger wave equation. (2M)

1. To determine the energy levels of atoms and molecules.
2. To predict the nature and behavior of particles, such as the probability distribution of electrons in an atom.

1.f) Explain nanomaterial. (2M)

1. Nanomaterials are materials having at least one dimension in the range of 1–100 nm.

2.They show unique optical, electrical, and mechanical properties.

3.Example: Carbon nanotubes, silver nanoparticles.

1.g) Explain the functionality of monomers. (2M)

Functionality is the number of reactive sites or functional groups present in a monomer molecule.

Example: Ethylene (–C=C–) has functionality of 2.

1.h) List two important applications of conducting polymers. (2M)

1. Used in rechargeable batteries.
2. Used in electronic devices such as sensors, LEDs, and display units.

1.i) What is Electromagnetic spectrum? (2M)

The electromagnetic spectrum is the complete range of electromagnetic radiations arranged in order of increasing wavelength or decreasing frequency.

Example: Gamma rays, X-rays, UV, visible, IR, microwaves, radio waves.

1.j) Discuss the role of monochromator.(2M)

A monochromator isolates light of a single wavelength from a polychromatic source.It improves accuracy in spectroscopic analysis..

PART-B

UNIT–I

2 a) Give the important postulates of Molecular Orbital Theory. 5 M

POSTULATES OF MO THEORY

1.**Atomic Orbitals Combine**: Atomic orbitals from individual atoms combine to form molecular orbitals. This combination can be constructive (adding) or destructive (subtracting), leading to bonding and antibonding molecular orbitals.
2.**Conservation of Electrons**: The total number of molecular orbitals formed is equal to the total number of atomic orbitals that combine. Electrons are conserved in this process.
3.**Bonding Molecular Orbitals:** When atomic orbitals combine in-phase (constructively), they form lower-energy bonding molecular orbitals (σ and π bonds). Electrons in these orbitals stabilize the molecule.

4.**Antibonding Molecular Orbitals:** When atomic orbitals combine out of phase (destructively), they form higher-energy antibonding molecular orbitals (σ^* and π^* bonds). Electrons in these orbitals destabilize the molecule.

5.**Overlap and Interaction:** The extent of orbital overlap between two atoms determines the strength of the bond. Greater overlap results in stronger bonds.

6.**Electron Filling:** Electrons are filled into molecular orbitals following the Aufbau principle, Hund's rule, and the Pauli exclusion principle, similar to how electrons fill atomic orbitals.

1) **Aufbau principle** : Molecular orbitals are filled in order of the increasing energies.

2) **Pauli exclusion principle**: Molecular orbital can have maximum of 2 electrons and these must have opposite spin.

3)**Hund's rule of maximum multiplicity** :Pairing of electrons in the degenerate molecular orbitals does not take place until each of them has got one electron each.

7.**Bond Order:** The bond order is calculated as (Number of electrons in bonding orbitals - Number of electrons in antibonding orbitals)/2. It reflects the strength and stability of the bond.

8.**Molecular Properties:** Molecular properties such as bond length, bond strength, and bond energy can be explained by MO Theory. A higher bond order generally corresponds to shorter and stronger bonds.

9.**Delocalization:** MO Theory allows for the concept of electron delocalization, where electrons are not confined to a specific bond but are spread over multiple atoms, as seen in resonance structures.

2.b) Explain de-Broglie's dual nature of hypothesis. 5 M

De Broglie Hypothesis (1924): Suggested that like photons, all matter (electrons, protons, atoms, molecules) shows dual nature (particle + wave).Matter Wave (De Broglie Wave): Wave associated with a particle.

Derivation: de Broglie deduced an equation that relates particle and wave nature of matter. He related Planck's quantum theory and Einstein theory.

According to Planck's quantum theory, the energy E associated with photon of frequency ν and wavelength λ is

$$E = h\nu = \frac{hc}{\lambda}$$

According to Einstein, mass m and energy E are related by $E = mc^2$ where 'c' is velocity of light.

$$\therefore \frac{hc}{\lambda} = mc^2$$

$$\Rightarrow \lambda = \frac{hc}{mc^2} = \frac{h}{mc}$$

This equation is called de Broglie equation.
Since mass x velocity = momentum, p

$$\therefore \lambda = \frac{h}{p} \Rightarrow \lambda \propto \frac{1}{p}$$

Thus, wavelength and momentum (or velocity) of a moving particle are inversely proportional to each other.

OR

3 a) Differentiate between AOs and MOs with examples. 5 M

Atomic Orbitals (AOs)	Molecular Orbitals (MOs)
1. Atomic orbitals are regions of space around a single atom where the probability of finding an electron is maximum.	1. Molecular orbitals are regions of space around two or more nuclei in a molecule where electrons are present.
2. AOs are associated with individual atoms only.	2. MOs belong to the entire molecule.
3. AOs are represented as s, p, d, f orbitals.	3. MOs are represented as σ, π, δ and antibonding orbitals σ*, π*.
4. Energy of AOs depends on the atomic number.	4. Energy of MOs depends on the type of bonding and antibonding interaction.
5. AOs do not explain molecular stability directly. Ex: 1s orbital of hydrogen	5. MOs explain bond order, stability, and magnetic properties of molecules. Ex: σ1s orbital of H□

3b) Compare bonding in homo- and hetero nuclear diatomic molecules. 5 M

Homonuclear Diatomic Molecules	Heteronuclear Diatomic Molecules
1. Formed by two identical atoms.	1. Formed by two different atoms.
2. Atomic orbitals involved have equal energies.	2. Atomic orbitals involved have different energies.
3. Bond formed is generally non-polar.	3. Bond formed is generally polar.
4. Electron density is symmetrically distributed between atoms.	4. Electron density is unevenly distributed.
5. Examples: H□, N□, O□.	5. Examples: CO, HF, NO.

UNIT–II

4 a) Discuss the preparation and properties of superconductors. 5 M

Preparation of Superconductor:

1. High-purity calcium carbonate (CaCO□) and titanium dioxide (TiO□) are selected as the starting materials.
2. The required stoichiometric amounts of CaCO□ and TiO□ are accurately weighed.
3. The weighed powders are thoroughly mixed to obtain a homogeneous mixture.
4. The uniform mixture is placed in a suitable crucible that can withstand high temperatures.
5. The crucible is kept in a high-temperature furnace capable of operating in the range of 1400–1600 °C.

6. The mixture is heated in an oxygen-rich atmosphere to facilitate proper solid-state reaction.
7. During heating, CaCO□ decomposes and reacts with TiO□ to form CaTiO□.
8. The formed product is cooled, ground, and characterized using techniques such as XRD and SEM to confirm phase formation and properties.

Properties of Superconductor:

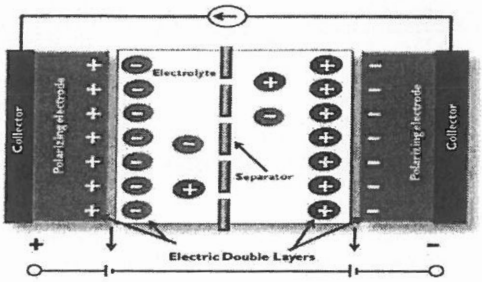
1. It exhibits superconducting behavior at relatively high critical temperatures compared to conventional superconductors.
2. It shows zero electrical resistance below its critical temperature.
3. It displays the Meissner effect, completely expelling magnetic fields in the superconducting state.
4. It possesses high critical magnetic field and current density, making it suitable for practical applications.
5. It has good thermal and chemical stability at elevated temperatures.

4 **b) What are Super capacitors? How are they classified? 5 M**

It also known as ultra-capacitors or electric double-layer capacitors) are energy storage devices
that store and release electrical energy much like traditional capacitors. However, they have a much higher energy density, making them excellent for a variety of applications.
Types of super conductors
¬ Double-layer capacitors (Store charge electrostatically)
¬ Pseudo-capacitors(Store charge electrochemically)
¬ Hybrid capacitors(store charge electrostatically & electrochemically)

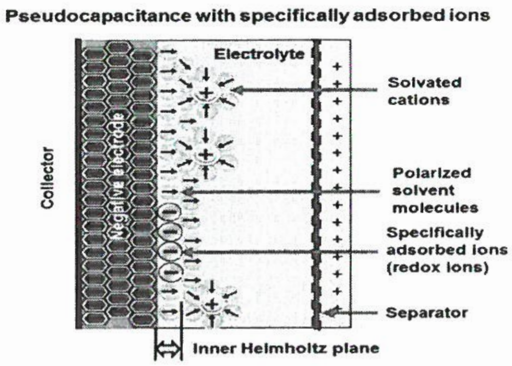
Double-layer capacitors

Electrostatic Double Layer Capacitors comprises two electrodes, a separator, and an electrolyte.
• Electrolyte is a mixture comprising positive and negative ions dissolved in water.
• The two electrodes are separated from each other through a separator.
• The super capacitors use carbon electrodes with much higher electrostatic double-layer capacitance.
• The separation of charge in electrostatic double-layer capacitors is much less than in a conventional capacitor which ranges from 0.3–0.8 nm.



Pseudo-capacitors :

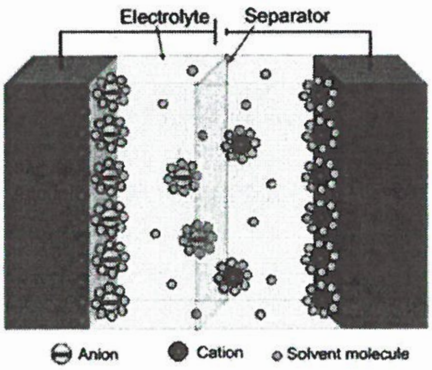
- Pseudo Capacitors are also referred to as electrochemical pseudo-capacitors.
- They make use of metal oxide or conducting polymer electrodes that have a high amount of electrochemical pseudo capacitance.
- They store electrical energy by electron charge transfer between electrode and electrolyte.
- It is done through the oxidation and reduction reaction commonly known as a redox reaction.



Hybrid super capacitor

- Hybrid Capacitors are made by using the techniques of double-layer capacitors and pseudo-capacitors.
- In these capacitors, electrodes with different characteristics are used.
- One electrode has the capacity to display electrostatic capacitance and the other electrode showcases electrochemical capacitance.

An example of a hybrid capacitor is the lithium-ion capacitor



OR

5 a) Discuss the properties and applications of carbon nanotubes. 5 M

properties :

1. Carbon nanotubes have very high mechanical strength and stiffness due to strong carbon–carbon bonding.

2. They show excellent electrical conductivity and can behave as metals or semiconductors depending on structure.
3. They possess high thermal conductivity along the tube axis.
4. They have large surface area and low density, making them lightweight and efficient.
5. They are used in nano-electronics, sensors, field-emission displays, reinforced composites, energy storage devices, and drug delivery systems.

Applications of carbon nanotubes:

1. Used in nano-electronic devices such as transistors and sensors.
2. Used as reinforcing materials in polymers and composites due to high strength.
3. Used in energy storage devices like lithium-ion batteries and supercapacitors.
4. Used in field-emission displays and flat panel screens.
5. Used in biomedical applications such as drug delivery and biosensors.

5b) Analyze the role of nanomaterials in medicine and environmental engineering.5 M

1. Nanomaterials are used in targeted drug delivery systems, which deliver medicines directly to diseased cells and reduce side effects.
2. They are widely used in medical diagnostics and imaging, such as biosensors and contrast agents for early disease detection.
3. In environmental engineering, nanomaterials are used for water purification, removing heavy metals, dyes, and microorganisms.
4. They help in air pollution control by adsorbing and decomposing harmful gases and pollutants.
5. Nanomaterials are used in environmental remediation to clean contaminated soil and wastewater effectively.

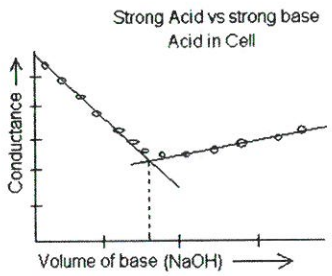
UNIT–III

6a) Explain the principle involved in conductometric titration

Conductometric titration is based on the measurement of electrical conductance of a solution during a chemical reaction.

1. In conductometric titration, a known volume of HCl (strong acid) is taken in a beaker and its initial conductance is measured using a conductivity cell.
2. NaOH (strong base) is added from the burette in small increments and the conductance is recorded after each addition.
3. Initially, the conductance decreases because highly mobile H^+ ions of HCl are replaced by less mobile Na^+ ions.
4. At the equivalence point, all H^+ ions are neutralized by OH^- ions forming water, and the conductance reaches a minimum value.
5. After the equivalence point, further addition of NaOH increases conductance due to the presence of excess OH^- ions.
6. On the X-axis, plot the volume of NaOH added (mL).
7. On the Y-axis, plot the conductance of the solution.
8. Initially, the graph shows a downward straight line, indicating decrease in conductance due to replacement of highly mobile H^+ ions by Na^+ ions.

9. At the equivalence point, the graph shows a minimum point, where complete neutralization of HCl occurs.
10. After the equivalence point, the graph shows an upward straight line due to increase in conductance caused by excess OH^- ions.



6. **b) Describe the construction and working of Hydrogen–Oxygen fuel cell.5 M**
construction:

1. The hydrogen–oxygen fuel cell consists of two porous electrodes (anode and cathode) made of carbon or graphite coated with platinum catalyst, separated by an electrolyte such as aqueous potassium hydroxide (KOH).
2. Hydrogen gas is continuously supplied to the anode, and oxygen gas is supplied to the cathode under controlled pressure.

working of Hydrogen–Oxygen fuel cell

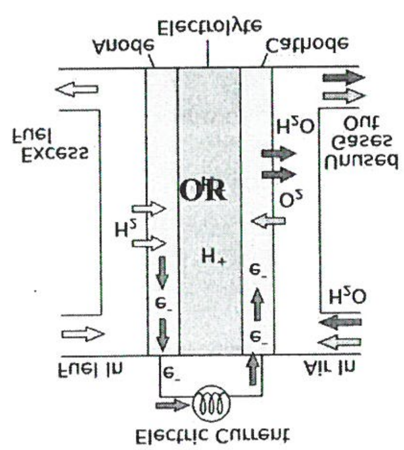
3. At the anode, hydrogen molecules are oxidized to form protons and electrons:

$H_2 \rightarrow 2H^+ + 2e^-$

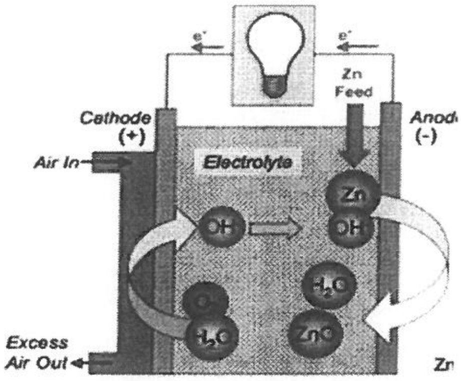
4. The electrons flow through the external circuit, producing electrical energy, while ions move through the electrolyte.
5. At the cathode, oxygen reacts with protons and electrons to form water:

$\frac{1}{2}O\square + 2H^+ + 2e^- \rightarrow H_2O$

Thus, chemical energy is directly converted into electrical energy with water as the only by-product.



7a a)Sketch Zn–Air battery. Explain the working principle of Zn–Air battery. 5 M



Working principle of Zn–Air battery

1. The Zn–air battery consists of a zinc metal anode, a porous air cathode, and an alkaline electrolyte such as potassium hydroxide (KOH).
2. Oxygen from air enters the air cathode and is reduced in the presence of catalyst.
3. At the anode, zinc is oxidized releasing electrons:

   $Zn + 4OH^- \rightarrow Zn(OH)_4{}^{2-} + 2e^-$

4. The released electrons flow through the external circuit, producing electrical energy.
5. At the cathode, oxygen reacts with water and electrons:

   $O\square + 2H\square O + 4e^- \rightarrow 4OH^-$

   The overall reaction produces electrical energy with high efficiency.

   $Zn + ½O_2 \rightarrow ZnO$

7· b) Explain amperometric sensors with example.5 M

1. Amperometric sensors are electrochemical sensors that measure the electric current produced due to oxidation or reduction of an analyte at a fixed applied potential.
2. The magnitude of the measured current is directly proportional to the concentration of the analyte present in the solution.
3. These sensors consist of a working electrode, reference electrode, and counter electrode immersed in an electrolyte.
4. When the analyte undergoes an electrochemical reaction at the working electrode, a steady-state current is generated and measured.
5. Example: Glucose sensor, where glucose is oxidized at the electrode surface and the resulting current is used to determine glucose concentration in blood.
6. Reaction in glucose sensor:
   Glucose + $O_2 \rightarrow$ Gluconic acid + H_2O_2 (in presence of glucose oxidase enzyme)

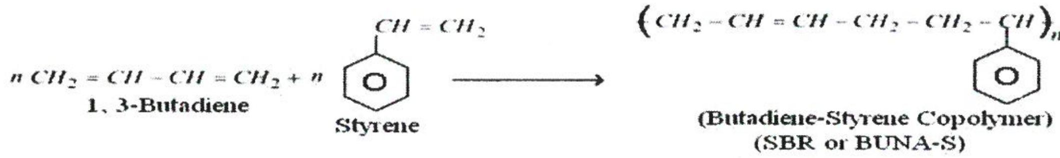
   Electrode reaction:

   $H\square O\square \rightarrow 2H^+ + O_2 + 2e^-$

UNIT–IV

8a) Discuss the preparation, properties and applications of Buna-S rubber and Buna-N rubber.10 M

Preparation of Buna S rubber



Buna S rubber is prepared by copolymerization of 1 3 butadiene and styrene by emulsion polymerization in the presence of sodium or peroxide catalyst. The polymerization is carried out at low temperature to obtain good quality rubber.

Properties

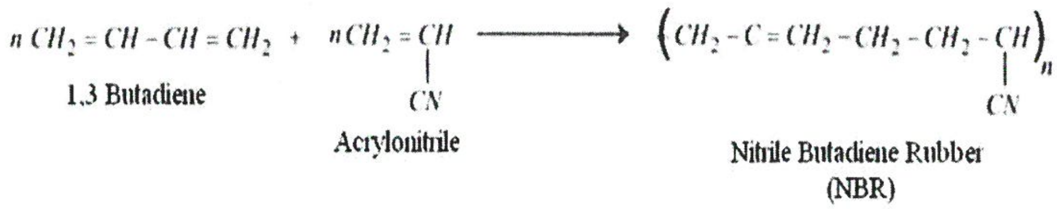
1. Buna S rubber has high tensile strength and good elasticity
2. It shows excellent abrasion and wear resistance
3. It has good resistance to heat and ageing
4. It has moderate resistance to chemicals and water
5. It has good mechanical strength but poor oil resistance

Applications

1. Used in automobile tyres and tubes
2. Used in footwear and shoe soles
3. Used in conveyor belts and transmission belts
4. Used in hoses and rubber sheets
5. Used as insulation material for electrical cables

Preparation of Buna N rubber

Buna N rubber is prepared by copolymerization of 1 3 butadiene and acrylonitrile using emulsion polymerization technique in the presence of a suitable catalyst. The rubber obtained shows good oil and fuel resistance.



Properties

1. Buna N rubber shows excellent resistance to oils fuels and greases
2. It has high tensile strength and good abrasion resistance
3. It shows good resistance to heat and ageing

4. It has low gas permeability
5. It has good resistance to chemicals and solvents

Applications

1. Used in oil seals gaskets and O rings
2. Used in fuel hoses and oil pipes
3. Used in petroleum handling equipment
4. Used for protective gloves and aprons
5. Used in chemical resistant linings and coatings

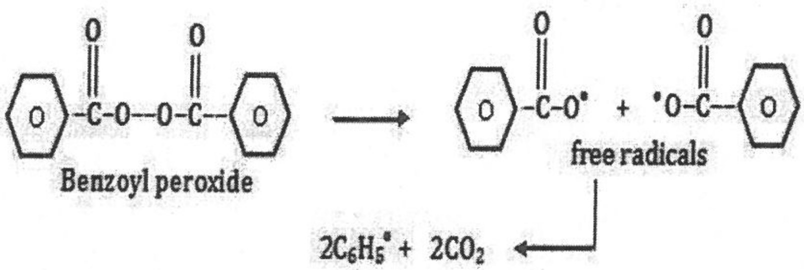
OR

9 a)Explain free radical addition polymerization mechanism with example.5 M

Free radical addition polymerization occurs in three steps.

Initiation

In this step an initiator such as benzoyl peroxide decomposes on heating to form free radicalsThese free radicals attack the monomer molecule and form an active free radical



a) Formation of free radicals from the initiator.

Initiator ⟶ 2 R• free radicals

b) Addition of free radicals to monomer to form a free radical intermediate.

$$R^{\bullet} + CH_2{=}\underset{X}{\underset{|}{CH}} \longrightarrow R{-}{-}CH_2{-}{-}\underset{X}{\underset{|}{CH^{\bullet}}}$$

X = substituent group   Free radical Intermediate

2. Chain propagation:-

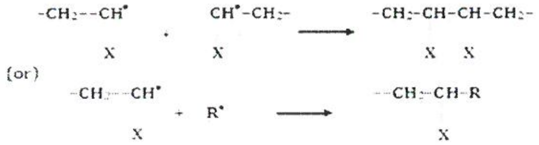
Here addition of monomer molecules to the intermediate takes place one by one leads to the formation of macro-radicals.

3. Chain termination:-

The growing polymer chain is terminated by many ways.

a) Recombination:-

Combination of two free radicals leads to termination.



At 60°C poly styrene or Acrylonitrile chains terminate mainly by recombination.

b) Disproportination.-

Transfer of 'H' atom from one radical to another leads to formation of two macro molecules, one of them with a double bond.

9b) Explain the synthesis & applications of PVC.5 M

Synthesis of PVC:

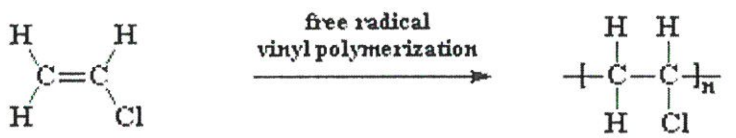
1 PVC is prepared by polymerization of vinyl chloride monomer

2 The polymerization is carried out by free radical mechanism

3 Peroxide initiators are used in the reaction

4 Suspension or emulsion polymerization method is followed

5 The repeating unit in PVC is vinyl chloride.



vinyl chloride

poly(vinyl chloride)

Applications

1 Used for making water pipes and drainage pipes

2 Used as insulation material for electrical wires and cables

3 Used in plastic sheets and flooring materials

4 Used in bottles and packaging materials

5 Used in medical products like blood bags and tubing

UNIT–V

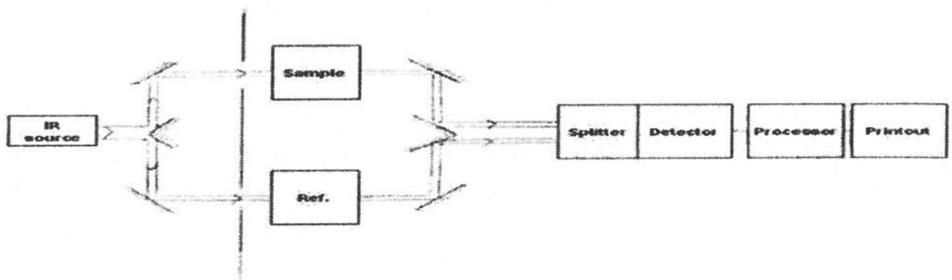
10)Explain the principle, instrumentation and applications of IR spectroscopy.10 M

Principle of IR spectroscopy

Infrared spectroscopy is based on the interaction of infrared radiation with molecules. When infrared radiation is passed through a sample, molecules absorb specific frequencies of IR radiation. This absorption causes vibration of chemical bonds such as stretching and bending. Each functional group absorbs IR radiation at a characteristic frequency, so IR spectroscopy is used to identify functional groups present in a molecule.

Instrumentation of IR spectroscopy

The electromagnetic spectrum consists of radiations with different wavelengths of energy. Infrared radiation lies just beyond the visible region of the spectrum and extends approximately from 700 nanometers to 1 millimeter.



1 The source of IR radiation is usually a Nernst glower ,Often a ceramic type which produces continuous infrared radiation

2 The monochromator separates IR radiation into different wavelengths

3 The sample is placed in the sample holder which may be a solid liquid or gas cell

4 The detector detects the transmitted IR radiation after passing through the sample

5 The recorder records the IR spectrum as a plot of transmittance versus wavenumber

Applications of IR spectroscopy

1 Used for identification of functional groups in organic compounds

2 Used to study molecular structure and bonding

3 Used for purity analysis of chemical substances

4 Used in pharmaceutical and polymer industries for quality control

5 Used in environmental analysis for detection of pollutants

OR

11 a)Illustrate types of electronic transitions in UV-Visible spectroscopy.5 M

In UV Visible spectroscopy, absorption of radiation causes excitation of electrons from lower energy orbitals to higher energy orbitals. The important types of electronic transitions are:

$\sigma \rightarrow \sigma^*$ transition

1 Electron is excited from sigma bonding orbital to sigma antibonding orbital

2 This transition requires very high energy

3 It is observed in saturated compounds like alkanes

$n \rightarrow \sigma^*$ transition

1 Electron is excited from non bonding orbital to sigma antibonding orbital

2 It requires less energy than sigma to sigma star transition

3 It occurs in compounds containing oxygen nitrogen or halogens

$\pi \rightarrow \pi^*$transition

1 Electron is excited from pi bonding orbital to pi antibonding orbital

2 It requires moderate energy

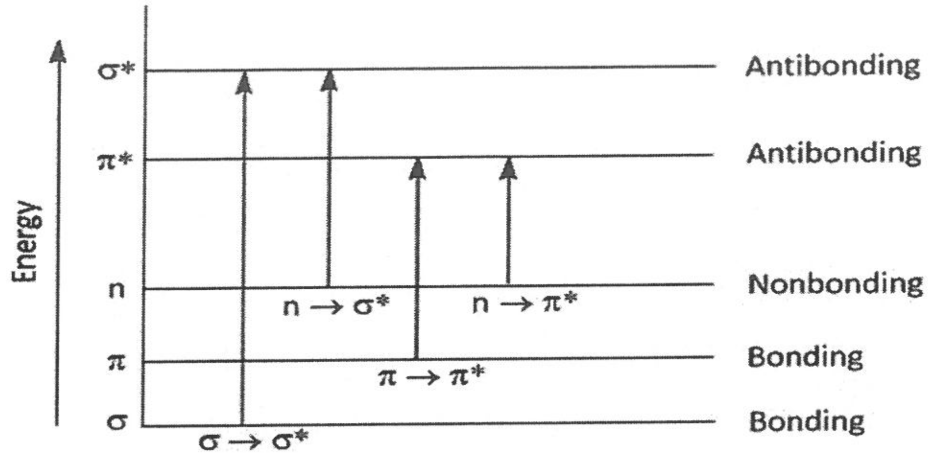
3 It is observed in unsaturated compounds like alkenes and aromatic compounds

$n \rightarrow \pi^*$ transition

1 Electron is excited from non bonding orbital to pi antibonding orbital

2 It requires the least energy among all transitions

3 It occurs in compounds containing carbonyl group



11b) Explain the classification of chromatography with real-time applications.5 M

Chromatography is a separation technique used to separate the components of a mixture based on their different rates of movement between a stationary phase and a mobile phase.

In this technique one phase remains fixed called stationary phase while the other phase moves called mobile phase. The components of the mixture travel at different speeds depending on their interaction with these two phases and get separated. Chromatography is widely used in chemical analysis pharmaceutical industries environmental studies and biological research.

Chromatography is classified as:

1 Gas Chromatography (GC)

Separation is based on the interaction of sample components with a stationary phase present inside a column.It is suitable for volatile and gaseous substances as a carrier gas is used as the mobile phase.

2 Liquid Chromatography (LC)

In this method a liquid is used as the mobile phase along with a stationary phase.

Example include High Performance Liquid Chromatography.

3 Thin Layer Chromatography (TLC)

It uses a thin layer of adsorbent material coated on a flat plate.It is a fast and simple technique mainly used for qualitative analysis.

4 Ion Exchange Chromatography (IEC)

Separation is based on the charge present on the ions using ion exchange resins. It is used for separation of proteins peptides and amino acids.

6 Size Exclusion Chromatography (SEC)

Separation is based on the size and shape of molecules. Larger molecules elute first as they do not enter the pores of stationary phase.

7 Column Chromatography

It uses a vertical glass column packed with stationary phase and a mobile phase for elution.It is used for separation and purification of compounds based on their affinity.

Applications:

1 Used in pharmaceutical industries to separate and analyze drugs

2 Used in hospitals and laboratories for blood and urine analysis

3 Used in food industry to detect preservatives colors and adulterants

4 Used in environmental studies to detect pollutants in air water and soil

5 Used in forensic science to identify drugs poisons and explosives.