QUESTION BANK

UNIT – I DYNAMIC ELECTROCHEMISTRY

Part- A

1. What is electrode potential. How it is developed?

It is the measure of tendency of a metallic electrode to lose or gain electrons when it is in contact with with a solution of its own salt.

It is develoed when a metal is placed in a solution of its own salt.

2. Expalin the term single electrode potential.

It is the measure of tendency of a metallic electrode to lose or gain electrons when it is in contact with with a solution of its own salt.

3. Define standard electrode potential.

It is the measure of tendency of a metallic electrode to lose or gain electrons when it is in contact with with a solution of its own salt of 1M concentration at $25^{o}C$.

4.Mention the factors which affect electrode potential.

(i) Nature of the metal

(ii) The temperature

(iii) The concentration of metal ions in the solution.

4. What do you mean by re-dox reaction?

Both reduction and oxidation takes place simultaneously in a cell reaction then it is known as redox reaction of an electrochemical cell.

5. Define an origin of electrode potential.

When a metallic electrode is placed in its own salt solution, two types of reaction takes place.

a) +ve ions may pass into the solution. $M \rightarrow Mn+ + ne-$ (oxidation)

b) +ve ions from the solution may deposit over the metal. $Mn+ + ne- \rightarrow M$ (reduction)

The above reaction takes place in an electrode then it is known as an origin of electrode potential.

6. Define oxidation potential and reduction potential.

Oxidation potential: The tendency of a metallic electrode to lose electrons, Reduction potential: The tendency of a metallic electrode to gain electrons.

7. Define electrochemical series.

When various types of metallic electrodes are arranged in their increasing order of standard reduction potential on the basis of hydrogen scale is known as emf series.

8. Write the significance of electrochemical series.

a) To calculate the standard emf of the cell.
b) Relative ease of oxidation or reduction.
c) Displacement of one element by the other.,

d) Hydrogen displacement behavior.
e) Determination of equilibrium constant (K) for the reaction.

9. Predict the following cell reaction is feasible or not.
$Zn/Zn^{2+}(1M)//Cu^{2+/}Cu$; Given that $E^{o}_{Cu2+/Cu}$=0.34V and $E^{o}_{Zn2+/Zn}$= -0.76V.
We know that
E^{o}cell = E^{o}right - E^{o}left
= 0.34- (-0.76) = 1.1V
Since, E^{o} of the cell is positive, and the cell reaction is feasible.

10. Which of the following cannot displace hydrogen from an acid: Cu, Fe, Pb and Mg.
Copper, since others are above hydrogen in the electrochemical series.

11. How will you predict the spontaneity of any redox system using emf?
If the standard emf of the cell (E^{o}) calculated is positive value, the cell reaction is spontaneous. The standard free energy change (ΔG^{o}) of the reaction must be negative.

12. Zinc reacts with dil. H_2SO_4 to give hydrogen but Ag does not. Explain.
E^{o}_{Ag} = 0.80 V; E^{o}_{Zn} = -0.76 V
Since, zinc has negative reduction potential with respect to hydrogen electrode; it liberates hydrogen from dil. H_2SO_4.
But silver has positive reduction potential with respect to hydrogen electrode; it does not liberate hydrogen from dil. H_2SO_4.

13. Define corrosion
Corrosion is defined as the gradual destruction of a metal or alloy by the chemical or electrochemical reaction with its environment.

14. Why do metals undergo corrosion?
Most of the metals (except noble metals) naturally exist in combined form. During metallurgy metals are extracted from the ores by reduction. In pure metallic state these are unstable and considered to be in the excited state. So these metals have a tendency to attain stable state, which is known as corrosion.

15. What are the consequences of corrosion?
- The efficiency of machine will be lost due to the loss of useful properties of metals.
- Products get contaminated due to corrosion
- Increase in maintenance and production cost.
- Preventive maintenance like metallic (or) Organic coating is required.
- Toxic products are released.

16. Rusting of iron is quicker in saline water than in ordinary water. Why?
- The presence of sodium chloride in water leads to increased conductivity of water layer in contact with the iron surface, thereby corrosion current increases and rusting is speeded up.

17. What is the need for preliminary treatment of metal surfaces?

Generally metal surfaces are covered with impurities like rust, scale, oil and grease. Presence of these impurities will produce porous and discontinuous coatings.

In order to obtain uniform, smooth, cohesive and adherent coating, these impurities must be removed from the metalsurfaces to be coated

18. Define electroplating.

"Electroplating is the process in which the coating metal is deposited on the base metal by passing a direct current through an electrolytic solution containing the soluble salt of the coating metal."

19. What are the objectives of electroplating?

(i) To increase the resistance to corrosion
(ii) To improve the hardness and appearance
(iii) To increase the decorative value
(iv) To increase the chemical attack
(v) To improve the surface properties

20. Write the names of anode, cathode and electrolyte used in electroplating of copper.

Anode: Copper plate or rod.
Cathode: Article to be placed.
Electrolyte: Copper sulphate solution.

21. Mention the applications of electroplating of copper.

- It serves as an undercoat for chrome plating.
- It is used for smoothening out the irregularities on the surface.
- It is used as a protective coating for steel articles.
- It is coated at the bottom of stainless steel (copper bottom) in cooking utensils to effect better hear transfer

22. Why is moderate current density employed during electroplating?

- High current density leads to evolution of hydrogen in larger quantity which in turn leads to burnt or powdery or dull or irregular deposit.
- On the other hand, low current density leads to formation of large grains, which are loosely held.
- Moderate current density, however, produces smooth and fine gained, tightly adhering deposit.

23. During electroplating, pH of the bath is strictly maintained. Give reasons.

- Low pH and higher conductivity results in increased evolution of hydrogen gas at cathode, thereby foaming a burnt deposit.
- At high pH, the plating is delayed, thereby leading to uneven and thick deposit.

- Consequently, proper pH of electroplating bath is maintained by using suitable buffer solutions.

24. Why is moderate temperature used during electroplating?

- High temperature leads to energy spongy and loosely held deposit.
- Low temperature favours burnt deposit (dark and powdery deposit).
- Hence, a moderate temperature is used.

25. What is electrophoretic coating?

Electrophoretic deposition EPD is a method of coating a conductive part with particles suspended in a fluid dispersion under the influence of an electric field applied between the work part and the counter electrode.

26. What is electrochemical machining?

Electrochemical machining is a process of a selective dissolution of the anodically connected work piece material submerged in an electrolyte together with an anodically connected tool.

Write down the factors affecting the quality of an electrodeposit.

(a) Temperature
(b) pH
(c) Current density
(d) Throwing power
(e) Concentration of the coating metal ions.

Part - B

1. What are electrochemical series? Give its applications.
2. What is electroplating? Discuss the plating composition, mechanism and application of electroplating of copper.
3. Discuss the various process involved in electropolishing.
4. Describe the electrophoretic coating process in detail.
5. Write notes on electrochemical machining process.
6. What is meant by electrochemical etching? Explain in detail about the electrochemical etching of Cu from PCB.

Unit II

ELECTROCHEMICAL SENSORS

Part – A

1. What is reference electrode? Give an example.

The potential of unknown electrode can be measured by coupling it with another electrode, called reference electrode whose potential is already known or arbitrarily fixed as zero.

Example: Standard hydrogen electrode

2. Name two standard reference electrodes?

(a) Standard hydrogen electrode

(b) Calomel electrode

3. Why SHE is called as primary reference electrode?

(a) The e.m.f developed by the SHE is arbitrarily fixed as zero at 1 atm pressure and the value of which is treated as constant at all temperature.

(b) It is an electrode with which the potential of other electrodes are compared.

4. What are the limitations of SHE?

(i) It requires H_2 gas and is difficult to set up and transport.

(ii) It requires considerable volume of test solution.

(iii) The solution may poison the surface of the platinum electrode.

(iv) The potential of the electrode is altered by changing the pressure of H_2 gas.

5. What is secondary reference electrode? Give an example.

To overcome the limitations of hydrogen electrode, the secondary electrode is developed. The electrode potential of secondary electrode is determined by standard hydrogen electrode whose potential is arbitrarily taken as "0" at all temperature.

Example: Calomel electrode

6. Calculate the standard e.m.f. of the cell ? $Zn/ZnSO_4//CuSO_4/Cu$.

Standard reduction potential for Zn^{2+}/Zn and Cu^{2+}/Cu are -0.763 and +0.337 volts respectively.

Solution: Standard e.m.f. of the above cell is given by

$E^o cell = E^o_{(right)} – E^o_{(left)}$; = 0.337 – (-0.763) volts ; 1.1 volts Ans: 1.1 volts.

7. What is ion-selective electrode?

Any electrode having the ability to generate a potential due to the presence of specific ions in a solution is known as ion-selective electrode or ion-sensitive electrode.

Example: Glass electrode

8. How will you construct the glass electrode?

A glass electrode consists of a long glass tube with thin walled bulb at the bottom. Thin walled bulb is made by special glass having low melting point and high electrical conductivity.

The electrode also contains Pt wire or Ag coated with AgCl and 0.1 N HCl solution.

9. Write the advantages of glass electrode?

- It is very simple.
- It is not affected by oxidizing and reducing agents.
- The results are very accurate.
- Even a small amount of the solution is sufficient for analysis.

10. What are the applications of ISE's?

(i) ISEs are used in determining the concentrations of cations like H^+, Na^+, K^+, Ag^+, Li^+.

(ii) ISEs are used for the determination of hardness (Ca^{2+} and Mg^{2+} ions).

(iii) Concentrations of anions like NO^{3-}, CN^-, S^{2-}, halides (X-) can be determined.

(iv) ISEs are used in the determination of concentration of a gas by using gas-sensing electrodes.

(v) pH of the solution can be measured by using gas-sensing electrode.

11. Define Galvanic cell.

- An electrochemical cell is a device which converts Chemical energy into electrical energy. It is also called a galvanic cell or voltaic cell.

12. What is Helmoltz double layer?

A difference in potential is produced by the double layer produced due to charge developed on the metal that attracts the ions or charged particles of the solution which are very close of each other.

13. What is the role of salt bridge in galvanic cell?

Salt bridge: It consists of a U-tube containing a saturated solution of KCl or $(NH_4)_2NO_3$ in agar – agar gel. It connects the two half cells.

Functions

i. Eliminates liquid junction potential.

ii. Provides a path for the flow of electrons between two half cells.

14. What is concentration cell?

It is a cell wherein the electrical energy is derived due to the concentration gradience which leads to the transfer of electrons from a high concentration half cell to the lower one.

15. What are the applications of concentration cells?

(i) Determination of solubility of sparingly soluble salts.

(ii) Determination of valancy of ion of the electrolyteused.

16. What is potentiometric titration? Mention its various types.

Potentiometric titrations are special type of volumetric analysis in which the end point of the titration is obtained by potential measurement.

Types:

(i) Redox titration

(ii) Acid – base titration

(iii) Precipitation titration

17. What is conductometric titration?

It is a special type of volumetric analysis in which the end point of the titration is obtained by conductance measurements.

What is ion-selective electrodes?

18. Why acetic acid is weak electrolyte and HCl is strong electrolyte?

Acetic acid does not dissociate much whereas sulphuric acid dissociate nearly completely.

19. What are the advantages of conductometric titrations?

- It gives accurate end point.
- No need of indicator.
- Even very dilution and weak acids can be analyzed.

20. List out the applications of Amperometric titration.

(i) Amperometric titration (a) quantitative in nature (b) used to determine the end point.

(ii) Determination of water by using Karl fisher reagent.

(iii) Amperometric detector can detect very low concentration of reducible ions and they can eailly determine.

(iv) Quantification of ion or mixture of ions.

21. What is sensor? Give an example.

A sensor is a device that detects events or changes in quantities and provides a corresponding output. The output is usually an electrical or an optical signal.

Example: A thermocouple converts temperature to an output voltage.

22. What is mean by Physical sensors.

A physical sensor is a device that provides information about a physical property of the system. Ex : pressure sensors, temperature sensors etc.

23. Define Chemical sensors.

A chemical sensor is a device that transforms chemical information, ranging from the concentration of a specific sample component to total composition analysis, into an analytically useful signal. Ex: COD, methane , ions etc

24. List out the classification of chemical sensor.

- Optical sensors
- Electrochemical sensors
- Electrical sensors
- Mass sensitive sensors
- Magnetic sensors
- Thermometric sensors
- Others – radiation detecting sensors

25. Define electrochemical sensors.

Electrochemical sensors are one of the broadest and important types of sensors for the quantitative analysis of inorganic ions in electrolyte form making use of different kinds of electrodes.

Example: Glucose sensor

26. What are the applications of electrochemical sensors?

- Electrochemical sensors can monitor blood samples and other body fluids for its ionic chemical content concentrations.
- Special electrodes such as Teflon created electrodes are made use for the measurements of dissolved oxygen (DO).
- The industrial application of electrochemical sensors include the monitoring of various pollutants present in the environment and checking the ionic concentrations of various industrial products including chemicals, pharmaceutic drugs, pesticides, insecticides, fertilizers etc.

27. What is meant by Potentiometric sensors.

A potentiometric sensor is a type of chemical sensor that may be used to determine the analytical concentration of some components of the analyte gas or solution. These sensors measure the electrical potential of an electrode when no current is present.

28. Define Gas sensors.

A gas sensor is a device which detects the presence of various gases within an area, usually as part of a safety system.

29. Write any four Applications of Gas Sensor.

- Process control industries
- Environmental monitoring
- Fire detection Alcohol breath tests
- Detection of harmful gases in mines
- Home safety

30. Define optical sensor.

- Optical sensors have the ability to detect light, typically at a specific range of the electromagnetic spectra (ultraviolet, visible, and infrared).
- The sensor detects wavelength, frequency, or polarization of light and converts it into electric signal due to photoelectric effect.
- Optical sensors can be represented in general terms as a wavelength-selectable light source, the sensor material itself interacting with analytes, and a light detector.

31. What is the principle of fluorescent molecular sensor?

When a fluorophore contains an electron-donating group (often an amino group) conjugated to an electron-withdrawing group, it undergoes intramolecular charge transfer from the donor to the acceptor upon excitation by light.

32. List out the applications of fluorescence based sensors.

Detection of chemical and biochemical analytes,

- Cations: H^+, Li^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, Zn^{2+}, Pb^{2+}, Al^{3+}, Cd^{2+}, etc.
- Anions: halide ions, citrates, carboxylates, phosphates, ATP, etc.
- Neutral molecules: sugars, e.g. glucose, etc.
- Gases: O_2, CO_2, NO, etc.

33. How does a thermal sensor work?

- Temperature sensors work by providing readings via electrical signals. Sensors are composed of two metals that generate an electrical voltage or resistance when a temperature change occurs by measuring the voltage across the diode terminals. When the voltage increases, the temperature also increases.
- The most basic way to measure temperature is using a thermometer; this measures how hot or cold something is. With advances in technology, we now have access to a variety of temperature sensors that are much more accurate.

34. List out the applications of thermal sensor.

- Temperature sensors are used for measuring inlet air temperature, exhaust gas, engine temperature, and oil temperature.
- It can be used to monitor the temperature of solids, liquids or gases over an extremely wide temperature range.
- Temperature sensors are utilized in the monitoring of patients, in medical devices, in thermodilution, in humidifiers, gas analysis, cardiac catheters, ventilator flow tubes, and dialysis fluid temperature.

35. Define biosignals.

A biosignal is any signal in living beings that can be continually measured and monitored. The term biosignal is often used to refer to bioelectrical signals, but it may refer to both electrical and non-electrical signals.

36. What are chemical biosignals.

Signals providing information about concentration of various chemical agents in the body.

- Level of glucose (diabetes)
- Blood oxygen level (asthma, obstructive pulmonary disease, heart and kidney failure)
- Gases in blood and breathing airflow (anesthetic gases, carbon dioxide etc.)
- pH

37. What is blood oxygen sensor?

Pulse oximetry is a test used to measure the **oxygen** level (**oxygen** saturation) of the **blood**.

38. How does an oximeter work?

Pulse oximeter probes have light emitting diodes which shine two types of red light through the tissue.

Step – 1: The device is plugged to a person's finger.

Step – 2: Small beams of light pass through the blood in the finger; the sensor on the other side of the tissue picks up the light that is transferred through the tissues.

Step – 3: The oximeter measures oxygen by evaluating changes of light absorption in oxygenated or deoxygenated blood.

Step – 4: The result is displayed in the monitor.

Part- B

1. Describe the construction and working of standard hydrogen electrode (SHE). Mention its limitations.
2. Describe the calomel electrode with neat diagram and explain how it is useful for the determination of single electrode potential of metals?
3. What is glass electrode? Describe the glass electrode with a neat diagram and explain how it is useful for the determination of pH of the unknown solution.
4. Explain the principle involved in the different types of potentiometric titration.
5. Write a short note on ion-selective electrodes.
6. Distinguish a galvanic cell and a concentration cell. Illustrate with examples.
7. What are concentration cells? Drive an expression for the EMF of a concentration cell.
8. What are conductometric titrations? Explain the principle of acid – base titrations.
9. Explain in detail about Amperometric titration and its types.
10. What is the principle of potentiometric sensor? Explain in detail about analysis of glucose in blood and analysis of urea using potentiometric sensor method.
11. Explain in detail about the Detection of Hg^{2+} using fluorescence sensor method.
12. What is meant by thermal sensor? Explain the construction, working and application of digital thermometer.
13. Discuss in detail about the working principle of reflectance photometry and amperometric glucose biosensors.
14. Explain in detail about urea determination in environmental samples.
15. Explain the following: (i) Carbon dioxide (CO_2) sensor (ii) Oxygen sensor (O_2) & (iii) Ammonia sensors (NH_3).
16. Explain the principle, construction, working and application of Pulse oximeter.

UNIT III
ELECTROCHEMICAL ENERGY SYSTEMS

PART A

1.What are the important requirements of a battery?

- It should have more storage capacity.
- It should be light and compact.
- It should provide power for longer time period.
- It should be capable of recharged.
- It should give constant voltage
- It should be resistance to self-discharge.
- It should be cheaper

2.What is a primary battery? Give an example.

These are cells in which the electrode reactions cannot be reversed by passing an external current. The reactions are possible only once and the battery will be dead after use. Hence it is non -rechargeable battery.

Eg: Daniel cell, Leclanche cell, Mercury cell.

3.Mention the differences between primary battery and secondary battery.

Primary Batteries	**Secondary batteries**
Primary batteries are used only once	Secondary batteries can be used for several cycles.
Irreversible battery	Reversible battery
They are cheap.	They are expensive.
Initial cost is low.	Initial cost is very high.
Disposable.	Periodic recharging and regular maintenance is required.

4.Why does a dry cell become dead after a long time, even it has not been used?

Acidic NH_4Cl slowly corrodes the zinc container of the dry cell, even when the cell is not in use. Hence, dry cell becomes dead after a long time, even it is not used

5.What are secondary cells?

These are cells in which the electrode reactions can be reversed by passing an external current. Thus a secondary battery may be used through a large number of cycles of charging and discharging. Hence it is a rechargeable battery.

Eg: Lead acid battery, Ni-Cd battery.

6. State the reaction when a lead storage battery is recharged.

$$PbO_{(s)} + 4H^+ + SO_4^{2-} + 2e^- \longrightarrow PbSO_{4(s)} + 2H_2O$$

7. What are the applications of lead acid storage cell?

- Lead storage cell is mainly used in automobiles like cars, buses and trucks.
- It is used in gas engine ignition, telephone exchanges, hospitals and power stations.
- It is also used in Uninterrupted Power Supply (UPS), as a power system which provides current constantly without a break.

8. Write the cell representation of NICAD battery.

It is represented as:

$Cd / Cd(OH)_2$ // $KOH / NiO_2 / Ni$

9. Give the advantages and disadvantages of NICAD battery?

Advantages

- It has longer life than lead storage cell.
- Available in a wide range of sizes, high number of charge/discharge cycles.
- Possess good load performance and allows recharging even at low temperatures.
- It is compact and lighter and used in high current applications.
- It is smaller and lighter.
- Like a dry cell, it can be packed and sealed.
- It is the lowest cost battery in terms of cost per cycle.

Disadvantages

- It is very expensive.
- Cadmium is highly toxic.
- Relatively low energy density, low capacity when compared to other rechargeable systems.
- Has relatively high self-discharge and need to be recharged after storage.

8. List out the advantages of Li battery.

- It generates a high voltage upto 3.0volt.
- Since Li is a light-weight metal, only 7g of lithium produces 1 mole of electrons.
- Since Li has the most negative E^0 value, it generates a higher voltage than the other types of cells.
- It can be made in different shapes and sizes.
- There is no risk of leakage from the battery, since all its constituents are solid.
- It possess high energy density.

9. What is Energy density?

It is the amount of energy stored in a given system or region of space per unit volume.

10. What is power density?

Is the power of the battery per unit weight that represents the speed at which the energy can be delivered to the load.

Power density = Energy density / Time

11.What is capacity retention?

Capacity retention is derived from the number of cycles that the cell undergoes charge-discharge processes. Although factors like electrolyte stability, temperature, etc, influence the capacity of degradation, phase stability of the electrode is the prime component in determining the cycle life of a cell/ battery.

12. Mention the advantages of fuel cells.

- It has high efficiency.
- It is portable and easy to maintain.
- It does not produce any harmful exhaust.
- Water produced from hydrogen-oxygen fuel cells can be used for drinking purpose.
- It can be used as a source in space flights.
- No noise and thermal pollution.

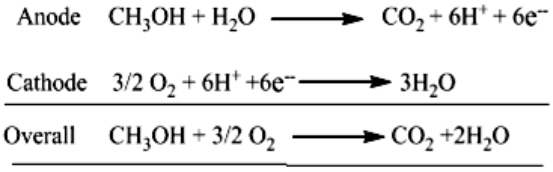
13.State the limitations of fuel cells?

- The corrosiveness of the electrolytes used.
- It needs to be stored in high tanks.
- It is difficult to predict the life time of fuel cells accurately.
- High cost of pure hydrogen and the catalyst needed for the electrode reactions
- (Ex. Pt, Pd, Ag etc.,)
- Problem of handling gaseous fuels at low temperature or high pressure.

14.Write the characteristics of fuel cells.

- They do not store chemical energy
- Reactants are to be supplied constantly while products are removed constantly. In this respect, a fuel cell resembles an engine more than does a battery.
- The efficiency of a fuel cell is about twice that of a conventional power plant.
- Fuel cell generators are free of noise, vibration, heat transfer, thermal pollution.
- They do not run down like batteries as the reactions take place under nearly reversible conditions and the efficiency is higher in producing more useful work.

15. Write down the reactions occur in Methanol Oxygen fuel cell.



16. What are the requirements for SOFC electrolyte?

- Ions conductive -oxygen ion transport.

- Chemically stable (at high temperatures as well as in reducing and oxidizing environments).
- Gas tight/free of porosity.
- Uniformly thin layer.

17. Write down the reactions of Solid Oxygen Fuel Cell.

Anode $H_2 + O^{2-} \longrightarrow H_2O + 2e^-$

Cathode $1/2\ O_2 + 2e^- \longrightarrow O^{2-}$

$H_2 - 1/2\ O_2 \longrightarrow H_2O$ + Electrical energy + heat

18.What are the drawbacks of biofuel cells?

- Its current output was generally very low 10^{-3} to 10^{-6} A
- Raw materials like vegetable and fruit extracts, petroleum extracts and human waste should be available in plenty.

19.Give two examples for electrochemically active bacteria.

- Shewanellaputrefaciens**,**
- Aeromonashydrophila

PART B

1. Discuss the principles and working of Hydrogen Oxygen fuel cell.
2. Explain the construction and working of methanol oxygen fuel cell.
3. What is SOFC? Explain its working. What are its advantages?
4. Describe the principles involved in Proton Exchange Membrane fuel cell.
5. Write an informative note on Biochemical fuel cells.
6. Construct and explain primary battery (Dry cell) with neat diagram.
7. Explain the principle, working of lead acid battery.
8. Discuss the construction and working of NICAD battery.
9. What are lithium batteries? Explain the construction and working of lithium ion batteries. Mention its advantages over other types of batteries.
10. Write a note on Lithium battery.
11. Discuss in detail about nickel hydride battery.

Unit IV

POLYMERS IN ELECTRONICS

Part – A

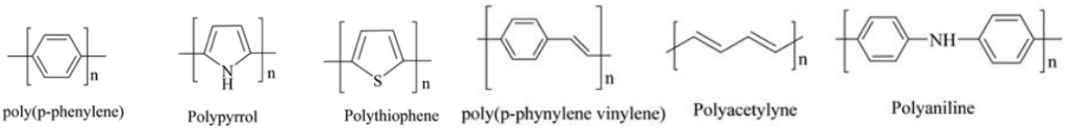
1. Define conducting polymer.

A polymer which can conduct electricity is termed as conducting polymer.

2. What are the conditions for conducting polymers?

A key requirement in the synthesis of conducting polymers is that the conjugated nature of the monomer should be conserved during the synthesis process. Conducting polymers are synthesized from their respective monomers using electrochemical, chemical oxidation, or interfacial polymerization processes.

3. Mention the examples for conducting polymers.



4. How conductivity of a polymer can be increased by doping method?

The conductivity of a conductive polymer is due to the charge formed by the dopant, as the doping level increases, more charges are formed in the polymer and, thus, results in a greater conductivity.The conductivity of certain organic polymers can be raised to metallic levels by chemical or electrochemical p-doping' (oxidation) or n-doping' (reduction).

5. What are the uses of conducting polymers?

They are used in the manufacturing of chemical sensors, electro-magnetic shielding, antistatic coatings, corrosion inhibitors, etc. They are also used in compact electronic devices such as polymer-based transitions, light-emitted diode (LEDs), and lasers.

6. What are the limitations of conductive polymers?

Conductive polymers have limitations such as a poor mechanical characteristic or poor flexibility, low process-ability and poor biocompatibility.

7. List out the application of PANI.

- Printed circuit board manufacturing
- Antistatic and ESD coating
- Microelectronics
- Photovoltaic cells
- Display devices
- Polymer light emitting diodes

8. What is a photonic polymer?

Polymer materials that change their reflection colour as function of environmental stimuli such as temperature, humidity and light, are attractive for various applications .

9. Draw the structure of polypyrrole and give their applications

Applications

- It has been used to fabricate hybrid nanocomposites with inorganic components for biosensor and biomedical applications.
- Polypyrrole was used to coat silica and reverse phase silica to yield a material capable of anion exchange and exhibiting hydrophobic interactions.
- Used in the microwave fabrication of multiwalled carbon nanotubes.

10. What is the principle of photonic crystals?

Photonic crystals are periodic dielectric structures that are designed to form the energy band structure for photons, which either allows or forbids the propagation of electromagnetic waves of certain frequency ranges, making them ideal for light-harvesting applications.

11. Define photo resist.

A photoresist (also known simply as a resist) is a light-sensitive material used in several processes, such as photolithography and photoengraving, to form a patterned coating on a surface. This process is crucial in the electronics industry.

12. What is positive and negative photoresist?

Positive photoresists are able to maintain their size and pattern as the photoresist developer solvent doesn't permeate the areas that have not been exposed to the UV light. With negative resists, both the UV exposed and unexposed areas are permeated by the solvent, which can lead to pattern distortions.

13. What is the principle of photolithography?

Photolithography is a patterning process in which a photosensitive polymer is selectively exposed to light through a mask, leaving a latent image in the polymer that can be selectively dissolved to provide patterned access to an underlying substrate.

14. What is the process of photolithography semiconductor?

Photolithography is the process used to fabricate semiconductor devices. It is a process by which a pattern is transferred from a photomask to the surface of a wafer. It is the most time-consuming and the most complicated process.

15. What is a liquid crystal?

Liquid crystal is the state of any substance whose properties are found between that of the original solid and that of the liquid; that is, it may have some properties of the solid, and some properties may be present in the liquid. Liquid crystals are used in LCD (liquid crystal display).

16. How does a liquid crystal differ from that of a solid and an isotropic liquid?

A true liquid is isotropic , that means its properties are uniform in all directions— the result of its molecules being in constant random motion. Crystalline solids, in contrast, are anisotropic ; optical- and other properties such as thermal and electrical conductivity vary with direction.

17. How are liquid crystals classified?

Liquid crystals can be classified into two main categories: thermotropic liquid crystals, and lyotropic liquid crystals. These two types of liquid crystals are distinguished by the mechanisms that drive their self-organization, but they are also similar in many ways.

18. What is meant by Thermotropic liquid crystals?

Thermotropic liquid crystals (LC) are anisotropic liquids that possess a mesophase (a phase with crystal and liquid properties) within a certain temperature range.

19. What are lyotropic liquid crystals?

Lyotropic liquid crystals result from the self-assembly process of amphiphilic molecules, such as lipids, into water, being organized in different mesophases.

20. What are smectic liquid crystals?

The phase which looks like the most to a crystalline solid and for which molecules are ordered in equidistant layers. It shows a long-range positional order (at least in one direction) and also an orientational order in each layer.

21. What are nematic liquid crystals?

In nematic liquid crystals, the molecules tend to be oriented parallel but their positions are random.

22. What are cholesteric liquid crystals?

Cholesteric liquid crystals (CLCs) represent the intermediate state between the crystalline phase, which is formed at low temperatures, and the liquid phase, which is formed at a sufficiently high temperature.

A cholesteric liquid-crystal display is a display containing a liquid crystal with a helical structure and which is therefore chiral. Cholesteric liquid crystals are also known as chiral nematic liquid crystals.

23. List out the applications of liquid crystals.

Liquid crystal displays are common in calculators, digital watches, oscillaographic systems, television displays using L.C. screens has also been developed. Cholesteric liquid crystals have also been used for novelty items such as toys and decorative materials.

24. Differentiate between LCD and OLED.

OLED	LCD
Its full form is Organic light-emitting diode	Its full form is liquid crystal display
It uses organic materials like carbon to manufacture screens.	It screen made with the liquid crystal.
It's every pixel that produces light radiations.	In this device background light such as lamp is used to provide light.
To show different colors its pixels blink and then off independently.	While in LCD pixels are not on and off independently, they use light at the backend and pixels panels to block white light and make

	different colors.
Its brightness is large	Its brightness is low.
when the brightness of colors on the screen is less it consumes less power.	It uses large amount of energy.
When the color is white it consumes high energy.	It uses a small amount of power.
Usage of organic material decreases operating life.	Its life span is high.

25. Write down the applications of LCD

- LCD finds its major applications in displaying the images in the screens of various electronic gadgets like television, calculator, computer monitor etc. These are also used in digital watches and mobile screens.
- These are also used in visualizing RF wave in transmission through waveguides and in medical applications like in liquid crystal thermometer etc.

26. Define OLED

- It is a thin film display technology that contains OLED, an organic material which emits lightwhen current is passed through it.

PART-B QUESTIONS

1. What are conducting polymers? Explicate polyaniline is a conducting Polymer.
2. Briefly explain the Conducting polymers.
3. Discuss the preparation, applications of Polyaniline and polypyrrole.
4. Write a short note on Photonic crystals.
5. Explain the following terms: (i) Photoresist (ii) Photolithography
6. Explain the Photolithography process with a photoresist briefly from wafer cleaning to developing. What is the main difference between positive and negative photoresist.
7. What are liquid crystals? Distinguish between smectic, nematic and cholesteric types with suitable example.
8. What are liquid crystals? Explain the molecular ordering in the following liquid crystal phases: (a) Nematic crystal phase (b) Chiral nematic phases (c)Smectic phase
9. Explain the following with examples: (i) Thermotropic liquid crystals (ii) Lyotropic liquid crystals.
10. What are liquid crystals? Distinguish between Thermotropic and lyotropic liquid crystals with examples.
11. Explain the working of liquid crystals in display systems?
12. Explain the construction, working and applications of LCD.
13. What are OLED displays? Explain the construction, working principle and applications of organic light emitting diode.

UNIT –V
NANO MATERIALS

PART -A

1. What is Nano chemistry (or) Nanoscience?

Nano chemistry is defined as the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales

2. What is Nano Technology?

The design, characterization and application of structures, devices and systems by controlled manipulation of materials at nano scales is known as Nano Technology

3. What are Nano particles?

Nano particles are particles, the size of which ranges from 1-50 nm.

4. Define nano wires.

Nano wires is a materials having an aspect ratio, length to width ratio greater than 20.
Nano wires are also referred to as quantum wires.

5. What are the characteristics of Nano wires?

- Nano wires are one dimensional material.
- Conductivity of a nano wire is less than that of the corresponding bulk materials.
- It exhibits distinct optical, chemical, thermal and electrical properties due to this large surface area.

6. What are nano rods?

Nano rod is a material having an aspect ratio in the range 1 to 20 with short dimension of the materials being 10-100 nm.

7. What are nano clusters?

Nano clusters constitute an intermediate state of matter between molecules and bulk materials .these are fine aggregates of atoms or molecule.

8. What is magic number?

It is the number of atoms in the clusters of critical sizes with higher stability.

9. How are nanomaterials classified?

1.Zero-dimensional (0D) nanomaterials 2.One-dimensional (1D) nanomaterials.
3.Two-dimensional (2D) nanomaterials 4.Three-dimensional (3D) nanomaterials

10.Distinguish between bulk and nanoparticles

Nano particles	**Bulk particles**
1. Size is less than 100nm	Size is larger in micron size
2. Collection of few molecules	Collection thousands of molecules
3. Surface area is more	Surface area is less
4. Strength, hardness are more	Strength, hardness are less.

11. What are size dependent properties? Give examples.

On a nanometre scale, materials behave differently when compared to larger scales. Chemical and physical properties of a nanomaterial become size-dependent. Some of the major size dependent properties include

(i) Thermal properties – melting temperature
(ii) Optical properties – absorption and scattering of light
(iii) Chemical properties – reactivity, catalysis
(iv) Mechanical properties – mechanical strength
(v) Electronic properties – conductance behaviour

12. What are the advantages of sonochemical method?

- Decrease of reaction time and increase of yield
- More uniform, smaller and pure crystals with minimal agglomerations are formed
- No chemical reducing agent is necessary for reaction
    - Possible switching of reaction pathway
    - Use of less or avoidance of phase transfer catalyst

13. State the advantages of electrodeposition

- It is relatively cheap and fast and allows complex shapes.
- It can be performed at low temperatures which will minimize inter diffusion of materials in the case of a multilayered thin film preparation.
- The film thickness can be controlled by monitoring the amount of charge delivered
- The composition and defect chemistry can be controlled by the magnitude of the applied potential, which can be used to deposit non-equilibrium phases.

14. List out the advantages of ball milling method of nanoparticle synthesis

- Few mg to several kgs of nanoparticle can be synthesized in a short time.
- This technique can be operated at large scale.
- It is useful in preparation of elemental and metal oxide nano crystals like Co, Cr, Al-Fe, Ag-Fe and Fe.
- Variety of intermetallic compounds of Ni and Al can be formed.
- Ball milling method is useful in producing new type building materials, fire – proof materials, glass ceramics, etc.

15. What are carbon Nanotubes?

- Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure.
- Nanotubes have been constructed with length-to-diameter ratio of greater than 1,000,000.
- These cylindrical carbon molecules have unusual properties and wide range of applications.

16. How is carbon Nanotubes classified?

Carbon nanotubes are classified into two types,

1. Single-walled nanotubes 2. Multi-walled nanotubes.

17. Mention some important applications of CNTs.

- It is used in storage devices.
- It is used as a catalyst.
- It is used as protective shield.
- As a good reinforcing element in composites.

18. List out the advantages and disadvantages of solvothermal process

Advantages

- Products obtained are in crystalline form. So no purification required.
- Can be used for preparing nanomaterials of different morphology (powder, rod, wire, tube, single crystals and nanocrystals).
- Precise control over the size, shape distribution and crystallinity of nanoparticles by varying experimental conditions.

Disadvantages:

- Inability to monitor crystals in the process of their growth.
- The need to expensive autoclave.
- Safety issues during the reaction process.

PART-B

1. Distinguish between molecules, nanoparticles and bulk materials.
2. Discuss the solvothermal method of synthesis of nanomaterials.
3. Explain how nanomaterials are synthesized by the chemical vapour deposition.
4. Discuss the various size dependent properties of nanomaterials.
5. Explain how nanomaterials are synthesized by the electro deposition.
6. What are nanoporous materials? How are nanoporous materials synthesized by solgel method?
7. Write short notes on photochemical synthesis of nanomaterials.
8. Write note on i.Nanowire ii.nanoclusters.
9. Explain briefly the advantages and applications of sol-gel process.
10. Write an account of carbon nanotubes.
11. Explain the detailed about the size dependent properties of Nanomaterials.