Ajay kumar Garg Engineering College, Ghaziabad
Department of Applied Sciences and Humanities
Sessional Test - II

Semester - I
Course: B Tech
Subcode: RAS-102
Session: 2017-18
Marks: Engg. Chemistry

Section - A (5x2 = 10)

A.
1. Define degree of polymerisation and functionality.

A1. Degree of Polymerisation: The number of monomer combine to form polymer during polymerisation reaction is known as degree of polymerisation.

$$n\,CH_2=CH_2 \longrightarrow \left[CH_2-CH_2\right]_n$$

n = Degree of polymerisation.

Functionality: The number of valence sites or bonding site available during polymerisation of monomer is known as functionality. The monomer which have functionality in it are capable to form polymer.

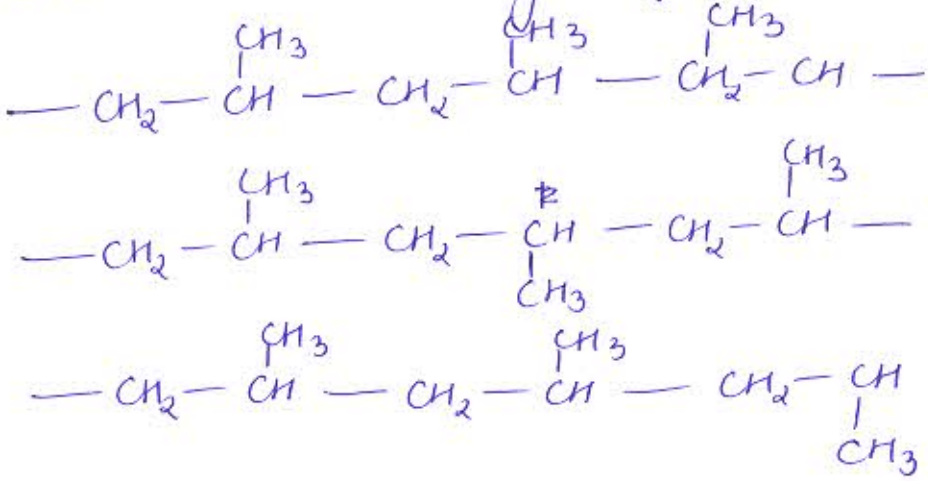
$$n\,CH_2=CH_2 \longrightarrow \underbrace{-CH_2-CH_2-}_{\text{free valence site}} \longrightarrow \left[CH_2-CH_2\right]_n$$

2. What is the role of Zeiglar - Natta catylyst in polymerisation reactions. Draw all the Possible structure of polypropylene.

A.2 In the presence of Zeiglar - Natta Catalyst the free radical polymerisation changes in to

Co-ordination addition polymerisation due to which Stereo-regular polymers are formed, which are better in performance and properties. No Ataetic polymer will formed.

Structure of Polypropylene



3. Define electrode potential and E.M.f of cell.

3. Electrode Potential : The tendency of an electrode to loose or gain ēs when it is in contact with its own ion in solution is called electrode potential.

$$E = E^{\circ} - \frac{.0591}{n} \log_{10} \frac{1}{[M^{+n}]}$$

E.M.F of Cell : The difference between the reduction electrode potential of two electrodes constituting an electro-chemical cell is known as E.M.F of cell. for galvanic cell: $E_{cell} = (E^{\circ}_{Cu^{++}/Cu} - E^{\circ}_{Zn^{++}/Zn}) - \frac{.0591}{2} \log_{10} \frac{[Zn^{++}]}{[Cu^{++}]}$

4. What is POP? How it is prepared?

4. Plaster of Paris (POP) is a mixture of hemihydrate of calcium sulphate and gypsum. It is prepared by heating fairly pure gypsum to a temperature of about 120–160°C.

$$CaSO_4 \cdot 2H_2O \rightleftharpoons CaSO_4 \cdot 2H_2O \xrightleftharpoons{120^{\circ}} CaSO_4 \cdot \tfrac{1}{2} H_2O$$

(Gypsum) — Orthorhombic dihydrate — (POP)

5. How Greases can be prepared? Give its applications.

5. Grease is a semi-solid lubricant obtained on mechanical dispersion of a soap in hot petroleum oil.

Soap + petroleum lubricating oil (hot) $\xrightarrow[\text{with or without filter}]{\text{Stirring}}$ Grease

Uses:
1. In rail axle boxes.
2. In bearings and gears.
3. In machines preparing paper, textiles, edible articles.

Section-B

6. What is Grignard reagent? Give its preparation and application as synthetic reagent with the help of Chemical reagent?

6. Preparation: It is prepared by treating alkyl halide with magnesium in the presence of dry ether.

$$RX + Mg \xrightarrow[Et_2O]{X = I, Cl, Br} RMgX$$

Applications:

a) Synthesis of alkanes:

$$CH_3MgBr + HOH \longrightarrow CH_4 + Mg\begin{matrix}OH\\Br\end{matrix}$$

b) Synthesis of higher alkanes:

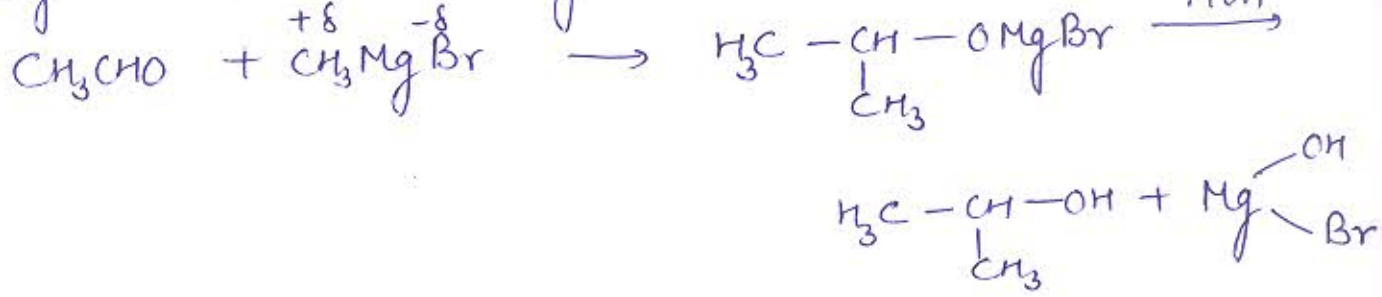
$$CH_3MgBr + CH_3Br \longrightarrow CH_3-CH_3 + MgBr_2$$

c) Synthesis of primary alcohols:

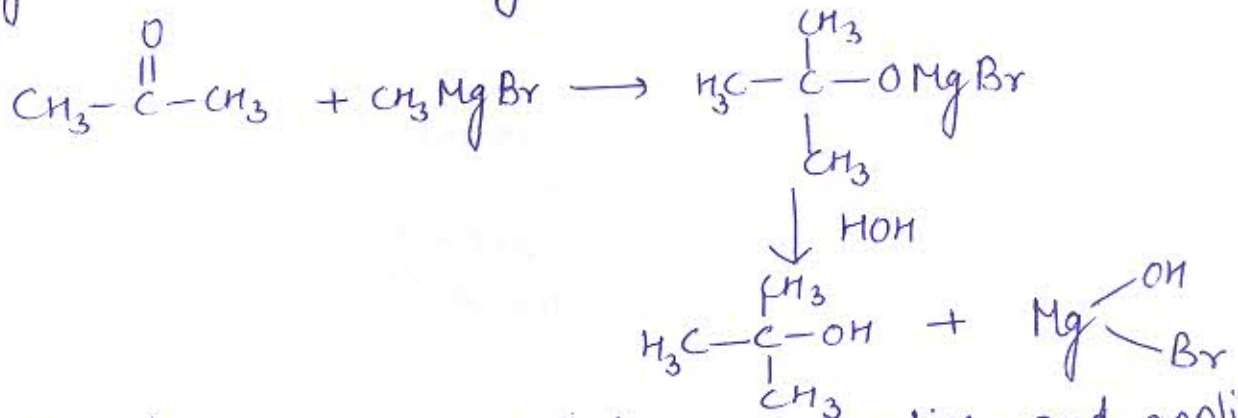
$$HCHO + CH_3MgBr \longrightarrow CH_3CH_2OMgBr \xrightarrow{HOH}$$

$$CH_3CH_2OH + Mg\begin{matrix}OH\\Br\end{matrix}$$

d) Synthesis of secondary alcohol



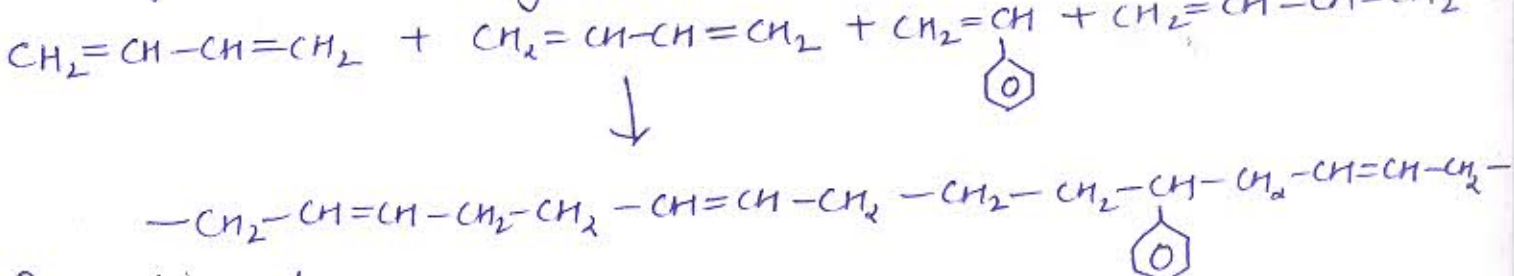
e) Synthesis of tertiary alcohol



7. Write down the preparation, properties and applications of (i) BUNA-S ii) Terylene.

(i) BUNA-S or SBR (Styrene Rubber)

Preparation: By the co-polymerisation of butadiene (75%) and styrene (25%) in an emulsion system at 50°C using cumene hydroperoxide as catalyst.



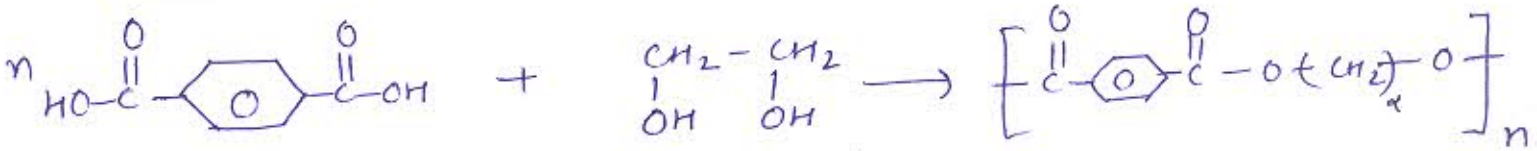
Properties:

a. High abrasion resistance
b. High load bearing capacity
c. Resilience
d. Can be vulcanised like raw rubber.

Applications: a) Motor tyre b) Shoe soles
c) Insulation of wire cables
d) Gaskets e) Adhesives

5. ii) Terylene (Polyethylene terephthalate) PET / Dacron:

Preparation: By reacting terephthalic acid with dihydroxy alcohols.



terephthalic acid Ethylene glycol PET

Properties:

a. Has good resistance to hydrocarbon solvents & moisture.
b. Has good mechanical properties like high tensile strength, impact strength.
c. Good fiber forming material, & fibers having outstanding crease resistance, low moisture absorption & are more durable.

Applications:

a) Magnetic recording tape.
b) Bottles are used for coca-cola, fruit juice & sauces.
c) Wide-necked jars for coffee.
d) Used for blending with wool - resist shrinkage & attack by moths.

Q.8) Write a note on conducting polymers with its classification.

8. Conducting Polymer: A polymer which can conduct electricity is termed as conducting Polymer.

They are broadly classified as:

(a) Intrinsically conducting Polymer: Polymers have extensive conjugation in the backbone which is responsible for conductance.

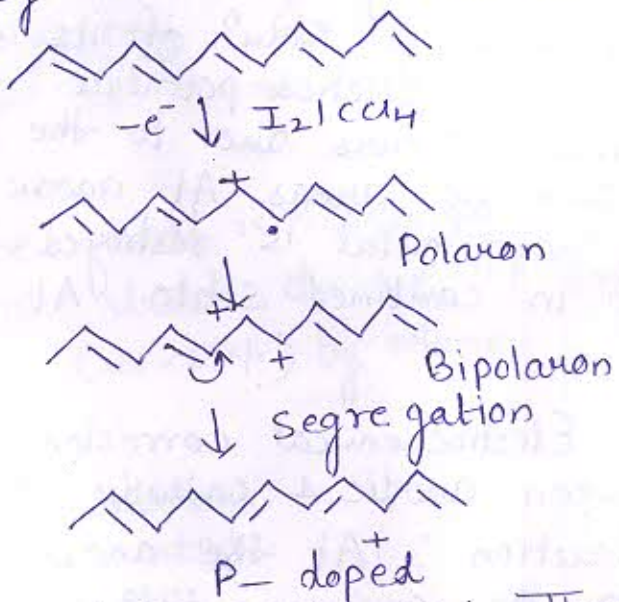
(i) Conducting polymers having conjugated π e$^-$s: in the backbone.

π e$^-$s increases their conductivity to a large extent.

Overlapping of conjugated π $\bar{e}$s over the entire backbone results in the formation of valence bands as well as conduction bands. The valence & conduction bands are separated by significant band gap. Thus, electrical conductance can occur only after thermal or Photolytic activation of $\bar{e}$s.

ii) Doped conducting polymer: Intrinsically conducting Polymers have low conductivity but can easily be oxidised or reduced as they have low ionization Potential & high e^- affinities. Their conductivity can be increased by creating +ve or -ve charge on Polymer backbone by oxidn or redn known as Doping.

P- doping :



b) Extrinsically conducting polymers: They owe their conductivity to externally added ingredients in them.

Two types:

(i) Conductive element filled: Polymer acts as the binder to hold the conductive element (c-black, metallic fibers) together in solid entity.

(ii) Blended conducting polymers: They are obtained by blending a conventional polymer with a conducting polymer. These polymers possess better electrical, mechanical properties.

i) In neutral or alkaline medium

$$2H_2O + O_2 + 4e^- \longrightarrow 4OH^-$$

ii) In presence of dissolved oxygen in acid medium

$$4H^+ + O_2 + 4e^- \longrightarrow 2H_2O$$

Rusting of Iron

$$Fe(s) \longrightarrow Fe^{++} + 2e^-$$

$$Fe^{++} + 2OH^- \longrightarrow Fe(OH)_2$$

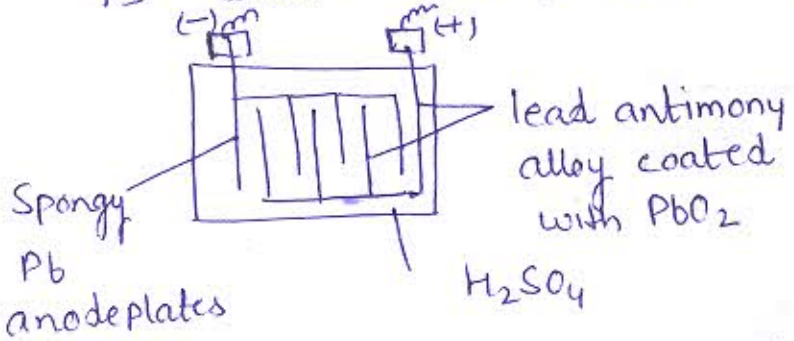
$$Fe(OH)_2 + O_2 + 2H_2O \longrightarrow 2Fe_2O_3 \cdot 3H_2O$$

(Rust)

Q.10 What is Lead storage cell. Explain its construction and working.

10. Lead acid storage cell: A storage cell or battery can operate both as voltaic cell and as an electrical cell.

Construction: The anode is spongy metallic lead plates, cathode is lead dioxide plates. Electrolyte is dilute H_2SO_4 (20-21%) by volume.



Discharging: As electrochemical cell

Anode – Oxidn

$$Pb \longrightarrow Pb^{+2} + 2e^-$$

$$Pb + SO_4^{--} \longrightarrow PbSO_4$$

$$Pb + SO_4^{--} \longrightarrow PbSO_4\downarrow + 2e^-$$

Cathode – Redn

$$PbO_2 + 4H^+ + 2e^- \longrightarrow Pb^{+2} + 2H_2O$$

$$Pb^{+2} + SO_4^{--} \longrightarrow PbSO_4\downarrow$$

$$PbO_2 + 4H^+ + 2e^- + SO_4^{--} \longrightarrow PbSO_4\downarrow + 2H_2O$$

Net Reaction:

$$Pb + PbO_2 + 4H^+ + SO_4^{--} \longrightarrow 2PbSO_4\downarrow + 2H_2O + \text{Energy}$$

9 Output EMF — 2.0 volts at conc? of 21.4% H_2SO_4 (by volume) at 25°C

Charging : During discharging $PbSO_4$ is precipitated at both the electrodes. When $PbSO_4$ completely covers both anode & cathode the cell stops functioning as a voltaic cell.

Recharging is done by passing an external EMF greater than 2 volts.

at previous anode now work as cathode

$$PbSO_4 + 2e^- \longrightarrow Pb + SO_4^{--}$$

at previous cathode now work as anode

$$PbSO_4 + 2H_2O \longrightarrow PbO_2 + SO_4^{--} + 4H^+ + 2e^-$$

Net Reaction : $2PbSO_4 + 2H_2O + Energy \longrightarrow Pb + PbO_2 + 4H^+ + 2SO_4^{--}$

$Pb \mid PbSO_4(s) \mid H_2SO_4(aq) \mid\mid PbSO_4(s), PbO_2(s) \mid Pb(s)$

Part - C

14. Explain (i)

Mechanism of Lubrication :

(a) Hydrodynamic / fluid film Lubrication : The sliding surfaces are separated from each other by a bulk lubricant film (~1000 A° thick) This film prevents direct surface to surface contact so that the small peaks & valleys do not interlock.

This reduces wear. This type of lubrication is used in light machines like watches, clocks, sewing machine, instruments. eg. hydrocarbon oils which are blended with selected long chain polymers in order to maintain viscosity of the oil.

(b) Boundary / Thin film lubrication : A thin layer of lubricant is absorbed on the metallic surfaces which avoids direct metal to metal contact. An boundary

lubrication, the distance between sliding surface is very small. The contact between the metal surface is possible due to very low speed, very high load, low viscosity of oil. for this type of lubrication molecules should have.

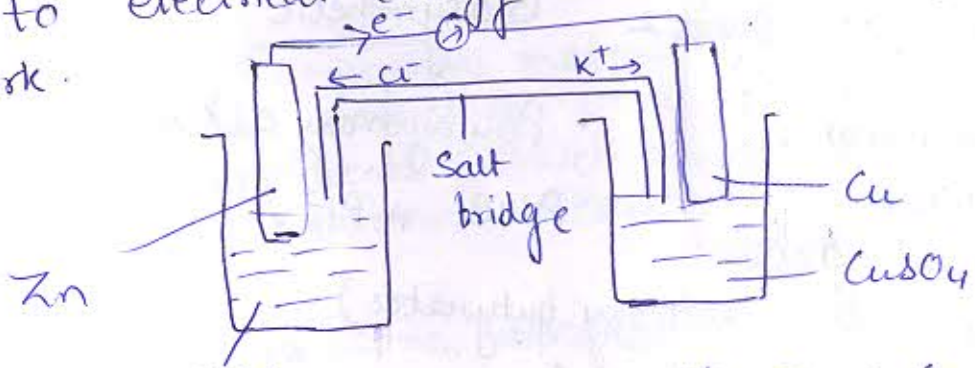
(i) High viscosity index
(ii) Lateral attraction between the chains
(iii) Resistance to heat.

eg. Graphite, MoS_2

(iii) Extreme pressure lubrication: It is done by incorporating extreme pressure additive in mineral oils for applications in which high temperature is attained due to very high speed.

eg. Chorinated esters, sulphurized oil.

(iv) Galvanic cell: It is a device in which chemical energy from a spontaneous redox ~~reduction~~ reaction is changed in to electrical energy that can be used to perform work.



$Zn \rightarrow Zn^{+2} + 2e^-$ $\quad Cu^{++} + 2e^- \rightarrow Cu$

Anodic reactions: $Zn \rightarrow Zn^{+2} + 2e^-$ (Oxidn. half cell Reaction)

Cathodic reactions: $Cu^{+2} + 2e^- \rightarrow Cu$ (Redn. Reaction)

$$Zn(s) + Cu^{+2}(aq) \rightarrow Zn^{+2}(aq) + Cu(s)$$

Salt bridge: Salt bridge is an inverted U-tube containing an aqueous soln of electrolyte KCl, NaCl, KNO_3 etc. Agar-Agar or gelatine

is used to make it semisolid. Salt bridge main, neutrality by migration of −ve ions towards anode and +ve ions towards cathode, so electrical circuit could be completed.

12 Write a short note on :

(i) Biodegredable polymers : The polymers that are biodegredable in nature. A degredable material in which degradation result from the action of micro-organisms and the material are converted to water, CO_2, methane.

Imp points : i) Naturally occuring polymers are biodegradable.

ii) Synthetic addition polymers with C as the only atom in the backbone do not biodegrade at mol wt > 500

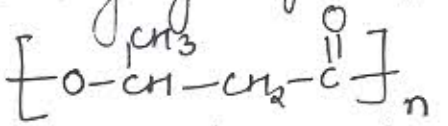
iii) M.wt lower are more degradable than higher.

iv) hydrophillic polymers degrade faster than hydrophobic.

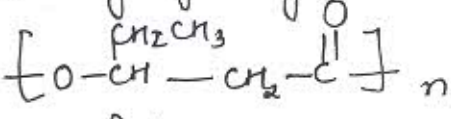
Classification

Natural (from plants & animals)	Biosynthetic	Synthetic
• Carbohydrates	• Polyhydroxy alkanoates	
• Cellulose	PHB & PHV	
• Nucleic acid		

PHB (Poly hydroxy butyrates)

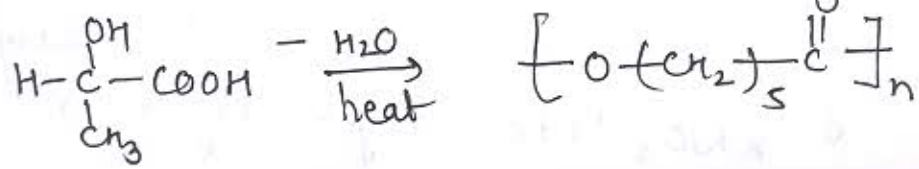


PHV (Poly hydroxy valerate)

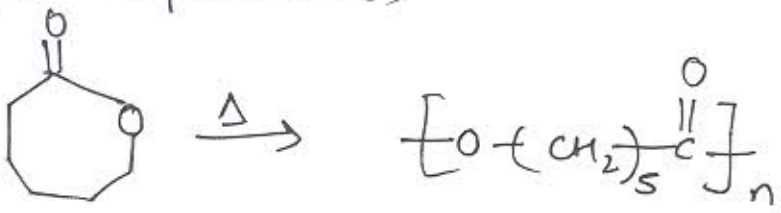


Synthetic Polymers :

i) Polylactic Acid (PLA) Green plastic Bioplastic



ii) Poly(ε-Caprolactone)



Water Soluble Biodegradable Polymers :→ Prepared by acrylic acid, maleic anhydride, methacrylic acid & diff. combination
→ Polyamino acids, aspartic acid, glutamic acid
→ Synthesized by modifying Starch & cellulose
Carboxymethyl Cellulose (CMC)
Hydroxyethyl Cellulose (HEC)

Applications : 1. Water soluble biodegradable polymers are used in detergent builders, Scale inhibitors, emulsifiers, paper sizing agent, skin lotion.
2. PLA is used in biomedical application – dialysis media, drug-delievery device, compost bag.
3. Poly(ε-caprolactone) is used in drug delivery system, adhession behaviour, GBR membrane.
4. PHA are class of linear polyesters which when treated with different monomers to give material of different properties.

(ii) Composites : Composites material may be defined as a material system consisting of a mixture of two or more macro-constituents, which are mutually insoluble, differing inform or composition and forming different phases.

Composite materials have some advantages over :
- high specific strength
- lower specific gravity
- higher specific stiffness
- Corrosion resistance and oxidⁿ resistance
- ability to with stand extreme tempʳ conditions

Applications : . In automobile industry, turbine engines, tank.
. In marine applications like propellers
. In components of rocket, aircraft.
. In safety equipments.

Constituents of composites:

A) Matrix phase: is the continuous body constituent, which encloses the composites, binds dispersed phase together, acts as a medium to transmit and distribute an externally applied load to the dispersed phase,

Matrix phase may be:
- Metal matrix composites MMC
- Ceramic matrix composites CMC
- Polymer matrix composites PMC

B) Dispersed Phase: is the structural consituent which determine the internal structure of composites.

eg. of dispersed phase.

1. Fibre: (a) Glassfibre
   (b) Carbon fibre eg. PAN
   (c) Aramid fibre eg. Kevlar
2. Particulates: Small pieces of metallic or non-metallic substances.
3. Flakes: Mica flakes
4. Whiskers: Thin strong filament.

Types of Composites

A) Fibre Reinforced
- a) Glass-fibre reinforced
- b) Carbon-fibre "
- c) Aramidfibre "
- d) Alumina fibre "

Particulates
- a) Oxide based
- b) Carbide based
- c) CrC & Comatrix

Layered
- a) Plywood