

Bio-Materials:-

Biomaterials are materials (synthetic, natural, solid and sometimes liquid) that are used in medical devices (or) in contact with biological system.

- Metals
- Ceramic
- Polymers
- Composites
- Semiconductors

Introduction:-

Biomaterials are employed in components implanted into the human body for replacement of diseased (or) damaged body parts. The process of replacing damaged organ (or) blood vessels or tissues in part (or) as whole has improved the scope of human life.

Bio Materials can be divided into three main types

1. Biostable Biomaterials
2. Bio active - Biomaterials
3. Biodegradable - Bio materials

1. Bioneer Biomaterials:-

The materials that once placed in human body has minimal interaction with its surrounding tissue are known as bioneer biomaterials.

- Stainless Steel
- titanium alumina
- Ultra molecular weight Polyethylene.

2. Bio active -Biomaterials:-

the materials which on being placed within human body. Interaction with the surrounding bone, soft tissue etc. are called bioactive biomaterials

- Glass
- Ceramics.

3. Biodegradable - Biomaterials:-

The materials which after being placed within human body start to dissolve and slowly replaced by advancing tissue (such as bone) are called bioreversible-biomaterials.

- (Tricalcium phosphate) $\text{Ca}_3(\text{PO}_4)_2$
- Co-polymers

Note : Calcium oxide, Calcium carbonate, gypsum

Biomaterials properties :-

Biocompatible →

Able to perform within appropriate host response without having toxic or injurious effects on biological system.

Adequate Mechanical Performance :-

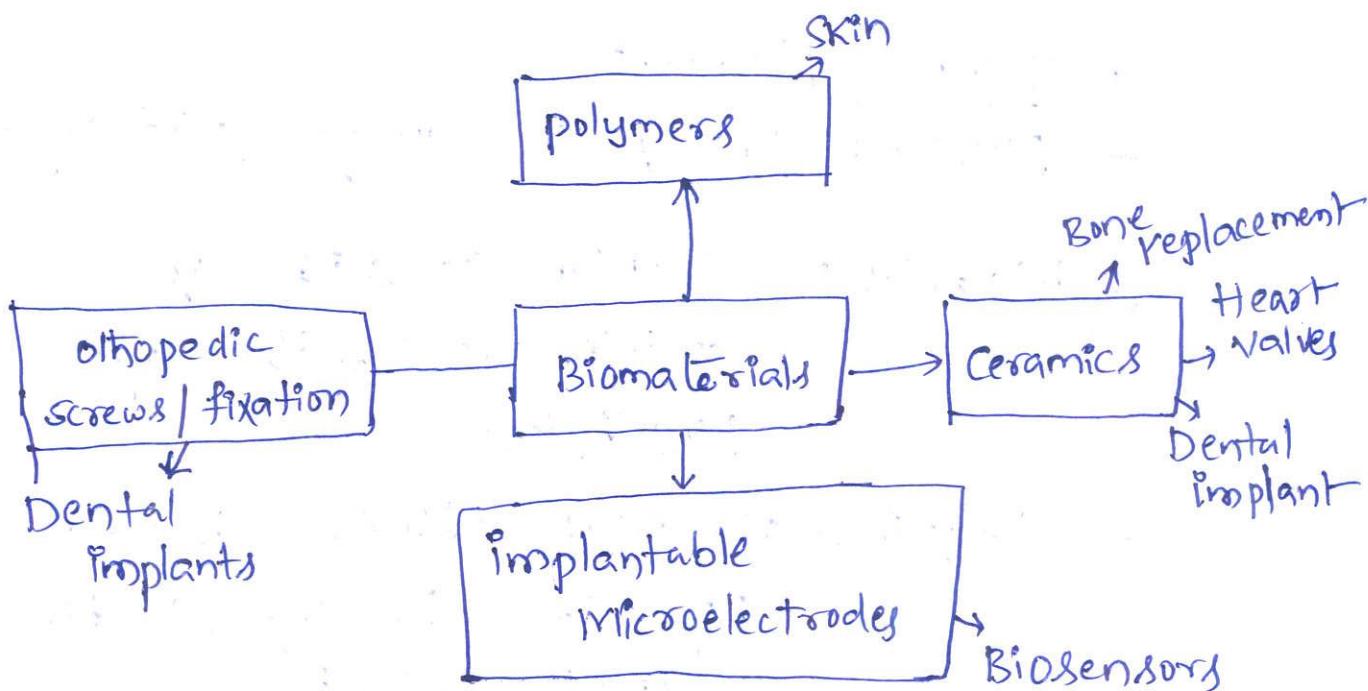
Has appropriate mechanical performance suitable for its application

Application design :-

Structure design and Selection of Materials are compatible with area of application

Repeatable Fabrication :-

Relatively inexpensive, reproducible, easy to fabricate and process for large-scale production.



Materials classification:-

Composite:- Combination of two materials with different physical and chemical properties that will produce different properties from its original parent.

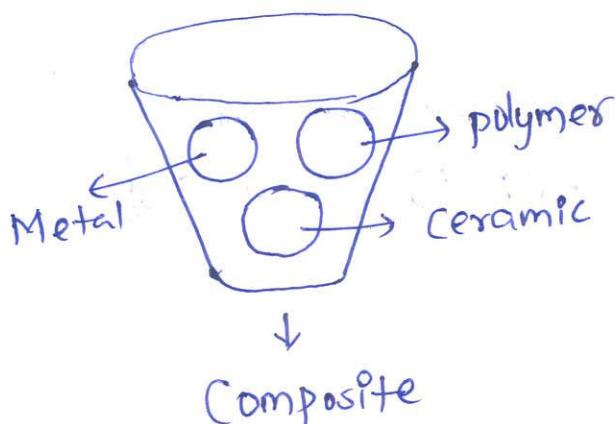
Metal + polymer

Metal + ceramic

Polymer + ceramic

Polymer + polymer

Ceramic + Ceramic



Metal + Metal → Commonly Known as Alloy

Application of Biomaterials:-

* Joint Replacement

→ purpose: To replace damaged joint organs

→ Materials:- Titanium (Ti) & its alloys

Stainless Steel & its alloys

Polyethylene

→ Required property:- Able to withstand high load bearing, bioactive light-weight

Bone Scaffold & Cement

→ Purpose: To graft and fill missing bone and to guide osseointegration on implant.

→ Materials:- Calcium phosphate (CaP),

→ Required property: Biodegradable, bioactive

Boneplate

→ Purpose: To hold and to assist remodeling of two broken/fractured bones

→ Materials:- \rightarrow Ti & its alloys

\rightarrow SS & its alloys

\rightarrow Cobalt-Chromium (Co-Cr) & its alloys

→ Required property: Able to withstand Load bearing.

* Dental Implant

Purpose:- To hold artificial tooth in replacing dysfunction/damaged tooth

Materials:- \rightarrow Ti & its alloys

\rightarrow SS & its alloys

\rightarrow alumina & its alloys

Required property:- Able to withstand high load.

Cardiovascular System :- (stent)

Purpose : To remove blood clot inside the blood vessel and to support weak blood vessel

Materials :- \rightarrow SS & its alloys

\rightarrow Co-Cr & its alloys

Cardiovascular System :- (Heart valve)

Purpose :- To replace damaged heart valve

Material :- \rightarrow SS & its alloys

\rightarrow Carbon

* Artificial heart

Purpose :- To replace damaged heart

Material :- polyurethane

* Artificial Kidney

Purpose :- To replace damaged kidney

Materials :- Cellulose

* Artificial Skin

Material :- silicon - collagen composite