# PD233: Design of Biomedical Devices and Systems

(Lecture-13 Medical Implants and Prosthesis)

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Course Website:
http://cpdm.iisc.ac.in/utsaah/courses/

# Medical Implant

- Medical implants are devices or tissues that are placed inside or on the surface of the body.
- Many implants are prosthetics, intended to replace missing body parts.
- Other implants deliver medication, monitor body functions, or provide support to organs and tissues.

FDA.org

# Examples:

Orthopaedic implants

- Knee
- Hip
- Shoulder

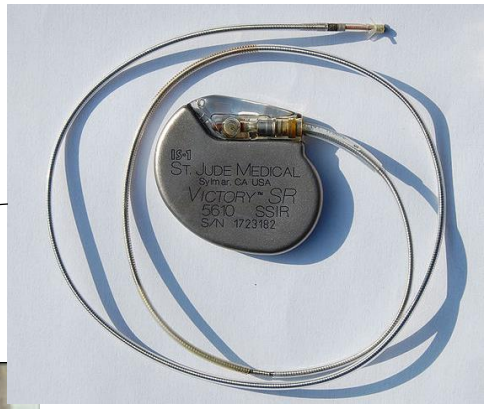
Ophthalmologic

- Intraocular lens
- Contact lens
- Retinal Surgery Implant
- Prosthesis after Enucleation

Imagesources: wikimedia.org

# Examples:

Cardiovascular implants
- Vascular graft
- Heart valves
- Pacemakers




Reconstructive
- Breast prostheses
- Nose
- Dental

Via Dr. Vibha Shetty

Imagesources: wikimedia.org

# Factors effecting implant performance

Performance over the life of the implants need to be studied

Wear Micromotion

Fit

Fixation

Stiffness

# Biomaterial Choices for Implants

- Biomaterial : Any substance (other than a drug) or combination of substances, synthetic or natural in origin, which can be used at any period of time as a whole or in part of a system which treats, augments or place any tissue, organ or function of the body.

  -Boretos and Eden, 1984

Depending on duration of use:

Non absorbable materials for permanent implants

Absorbable materials for tissue scaffolds

Primary types of materials

-Metallic (titanium, stainless steel)

-Ceramics (ceramics, calcium phosphate, hydroxy apatite)

-Covalent (polymers, biological macromolecules)

# Metallic Biomaterials

## Stainless steel

Fe-Cr-Ni-Mo-C...

+Strength

+ease of manf.

+availability

-potential of corrosion

-high elasticity modulus

## Cobalt Chromium

Co-Cr-Mo-Ni…

+Strength

+Rel. wear resistance

-high modulus of elasticity

## Titanium Alloy

Ti-Al-V-Fe

+Strength

+low elasticity modulus

+Corrosion resistance

-low wear resistance

# Ceramics

- Compounds of metal and non-metallic elements
  - Alumina (Aluminium oxide)
  - Zirconia (Zirconium oxide)
  - Chromium Oxide
  - Titatium Oxide
- Dense/Hard starch resistant
- Can be polished to ultra smooth surface

# Oxinium

- New metal alloy (Zirconium and niobium) developed for implants that has a ceramic surface produced by a special oxidation process.

+scratch resistance

+low modulus

Combines  advantages of metal alloys and ceramic materials

# Polymer materials

UHMWPE

PMMA

Are used non-absorbing biomaterials

# Absorbable biomaterials (synthetic)

- **Polylactic acid  and Polyglycolic acid**
- **Polycarbonates**
- **Polydioxanones**
- **Polyphosphazenes**
- **Poly(anhydridesPoly(anhydrides))**
- **Poly(orthoPoly(orthoesters)esters)**
- …

# Absorbable biomaterials (natural)

- **Collagen**
- **Collagen-GAG copolymer**
- **Albumin**
- **Fibrin**
- **Hyaluronic acid**
- **CelluloseCellulose**