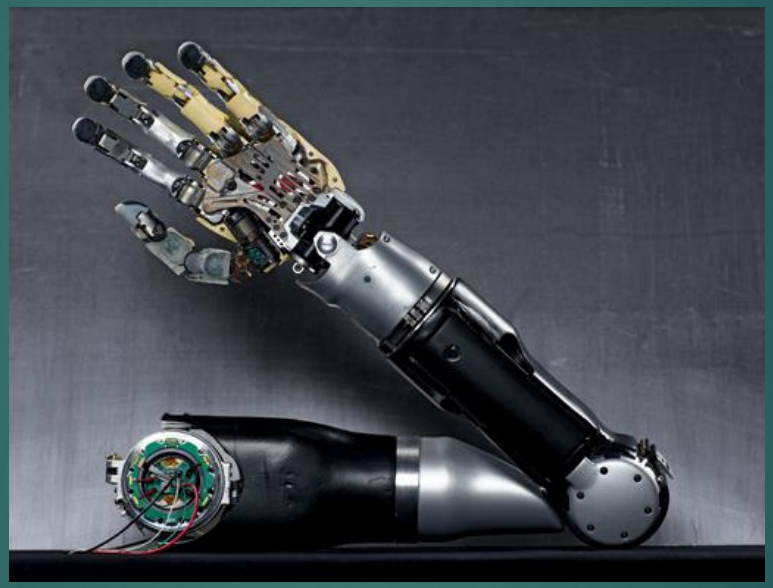
BIONICS



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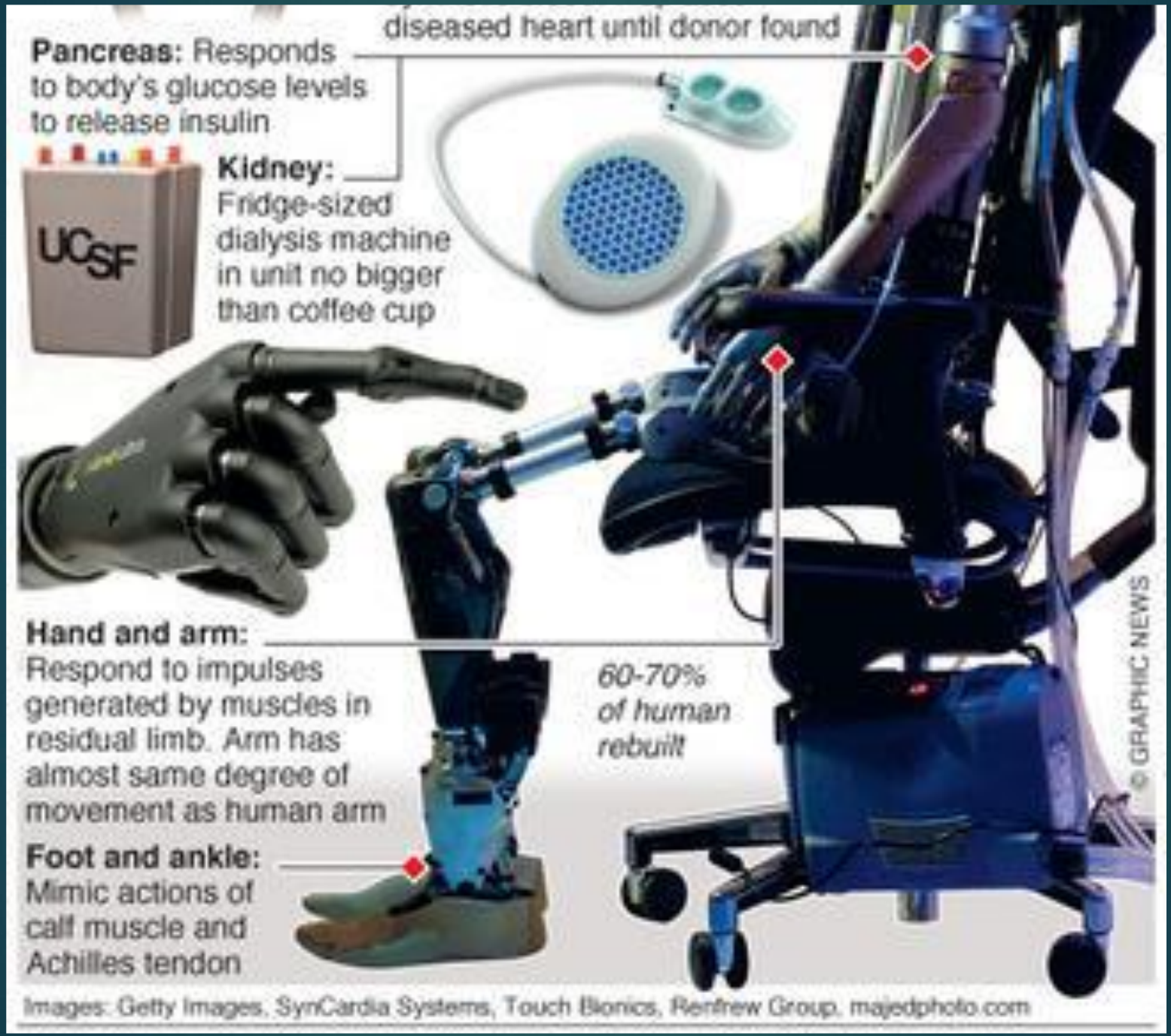
INTRODUCTION

The word "Bionics" comprises of two words –
'Bi' means 'life' and 'onics' means 'electronics'.

BIONICS:

The study of mechanical system that function like Living organisms or parts of living organism.

In other words, It is the application of biological Methods and systems found in nature to the study and design of engineering system and modern technology.


diseased heart until donor found
Pancreas: Responds to body's glucose levels to release insulin
Kidney: Fridge-sized dialysis machine in unit no bigger than coffee cup
UCSF
Hand and arm: Respond to impulses generated by muscles in residual limb. Arm has almost same degree of movement as human arm
60-70% of human rebuilt
Foot and ankle: Mimic actions of calf muscle and Achilles tendon
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History

1958 : The first artificial pacemaker by Wilson Greatbatch

1971 : Bausch & Lomb develop the world's first soft contact lens.

1978 : The multi-channel cochlear implant, which allows the recipient to hear by mimicking the function of the cochlea, is first used.

1983 : A person born blind implanted with bionic eye by Joao Lobo Antunes

2000 : An artificial silicon retina is implanted into a human eye. The artificial retina is made from silicon microchips which contain thousands of tiny light-converting units.

2001 : Amputee Jesse Sullivan receives a fully robotic arm developed by the Rehabilitation Institute of Chicago. The arm has a nerve muscle graft which allows him to use his own thoughts to move the artificial limb.

2002 : Argus I, Bionic Eye, clinically tested on 6 patients

2002 : Project Cyborg - Array of 100 Electrodes implanted to nervous system of Kevin Warwick. The signal produced was transmitted, and felicitated a prosthetic arm to mimic Warwick's hand movements. Later Warwick's nervous system was connected to internet.

2004 : The Rheo Knee, Hugh Herr, Bionic Knee for walking, running.

2006 : Argus II, Bionic Eye, approved for commercial use in Europe.

What is ‘Bionics’?

- Bionics - as the name suggests is the interplay of ‘BIOlogy’ and ‘electrONICS’. By dictionary, bionics means “comprising or made up of artificial body parts that enhance or substitute for a natural biological capability”[1]. Generally, a mechatronic prosthetic system is interfaced to the biological body to overcome the disability.
- It is seen in most of the cases that even if the body part is not working well (say the ear, eye or body part is amputated), the part of brain responsible for controlling it, works fine. So, if one is amputated, his brain’s motor cortex works fine. Bionics exploits this idea. As ideology, it believes that the signals from the brain could be extracted, deciphered and then implemented by mechatronic prosthetic system . Even more, it believes sending back the feedback/stimulus to brain, say by the prosthetic system.

CLASSIFICATION OF BIONICS

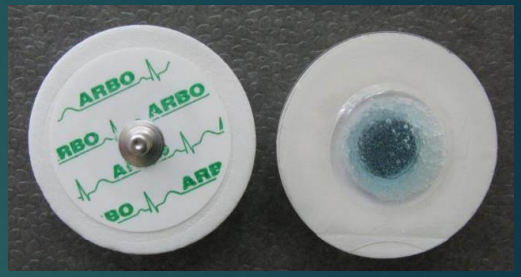
- **Active Bionics** – The bionic part of a body that performs multiple functions.

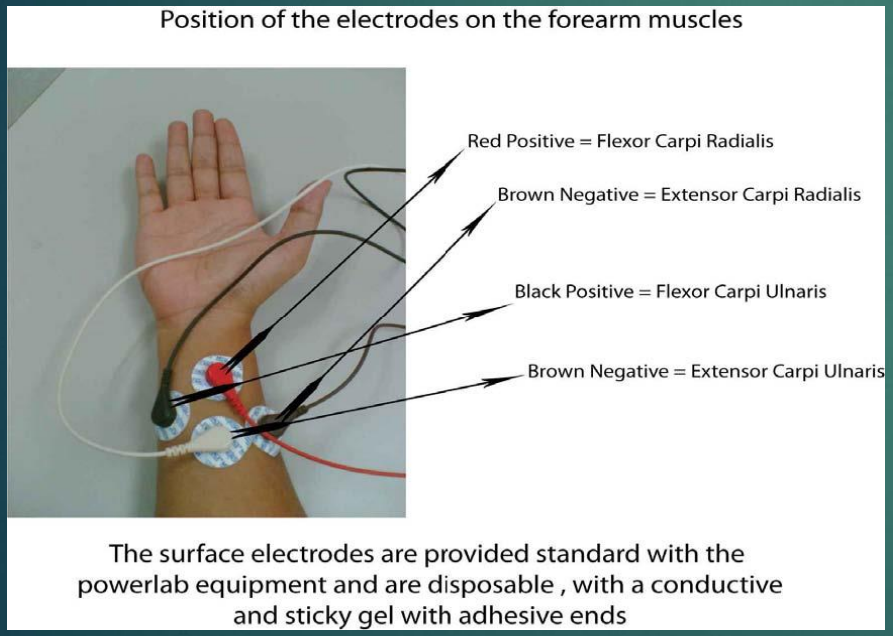
- **Passive Bionics** – The bionic part of a body that performs single functions.

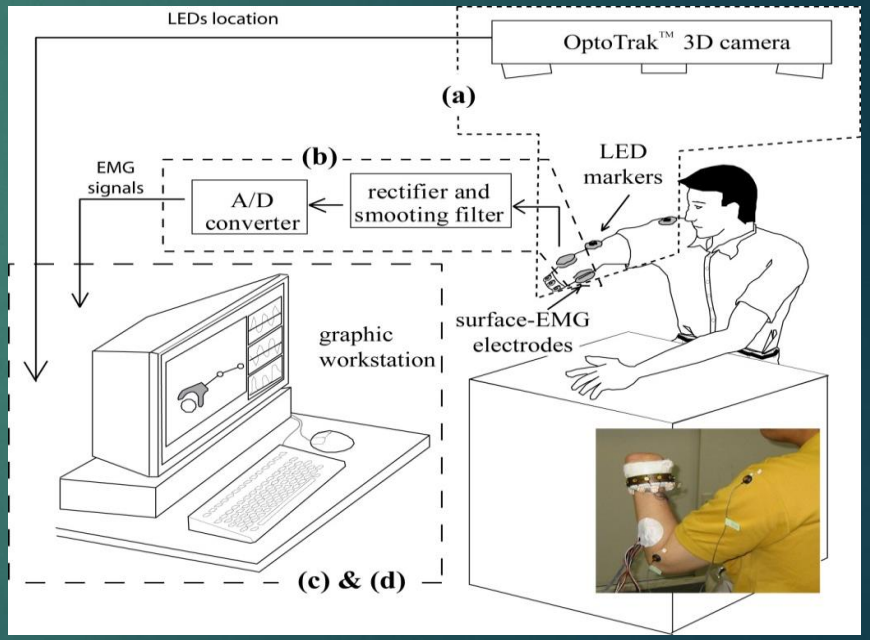
Basically, these parts are used as replacement in transplantation.

HOW DOES BIONICS INCORPORATE IT ? contd..

Using surface electrodes, EMG, EEG sensors that could read the signals from nerve. They are generally stickered to human body muscle (hand/leg/thighs). In some cases they could be injected inside the body. In Project Cyborg 100 electrodes were implanted in the nervous system.

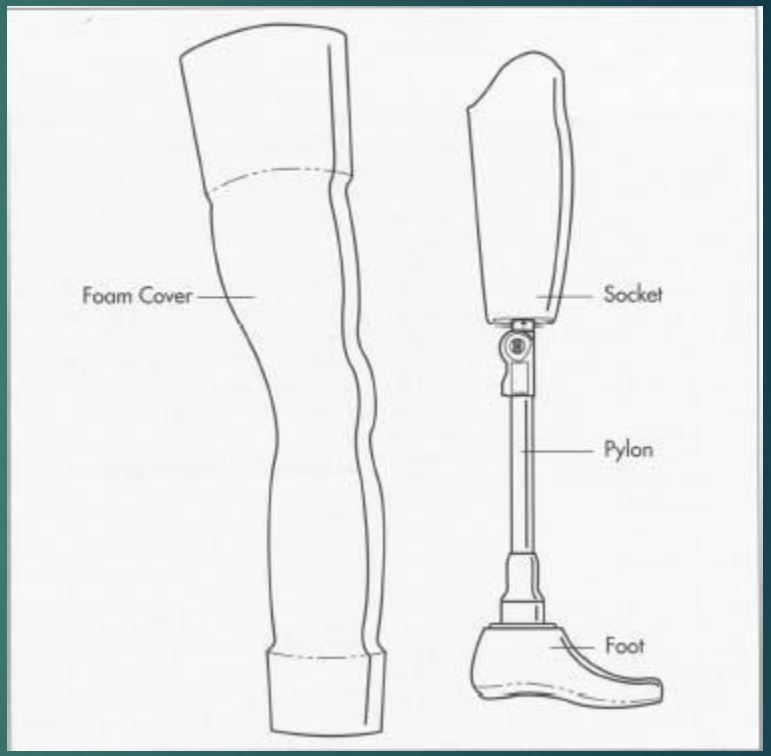






WORKING OF BIONIC LEG

- Pressure transducer is located in the feet.
- This sends the signals to the electrodes set in the stump.
- Then Nerves can receive and interpret the signals accordingly.
- Thus a person can walk on the new device as he can feel the ground and adjust his grait appropriately.



ADVANTAGES OF BIONIC PARTS

- Improve the quality of life for those with certain disability.
- It is minimally invasive, reducing health risks to patients.
- Fewer complications from healing wounds and quicker recovery time.
- Biomaterials and biomedical devices can be used to replace damaged and diseased body parts like artificial joints, pins, screws , valves or lenses.
- Bionic parts will be everlasting in material cycle, as a result, increases material efficiency and durability.

DISADVANTAGES OF BIONIC PARTS

- Religious groups and society believe bionics to be sinful.
- Bionic part may be operated at a lower level of effectiveness than that of blood- flesh equivalent.
- It is the expensive example of advanced technology and hence deepen the gap between quality of life of poor and rich people.(cost of bionic eye is $100,000 and bionic leg is $150,000)

MATERIALS USED IN MAKING OF BIONIC BODY PARTS

- Light weighted metals – Titanium , Aluminium and Steel.
- Plastic polymer laminates – Epoxy, Acrylic and Polyester.(The plastics begins as a liquid and mixes with a catalyst , the new mixture is applied to model and then saturated. It is light weighted in nature and provides strength.)
- Reinforcement Textiles – Nylon, Carbon Fibres, Kevlar. (Kevlar provides flexibility and carbon fibres provide strength to the part.)

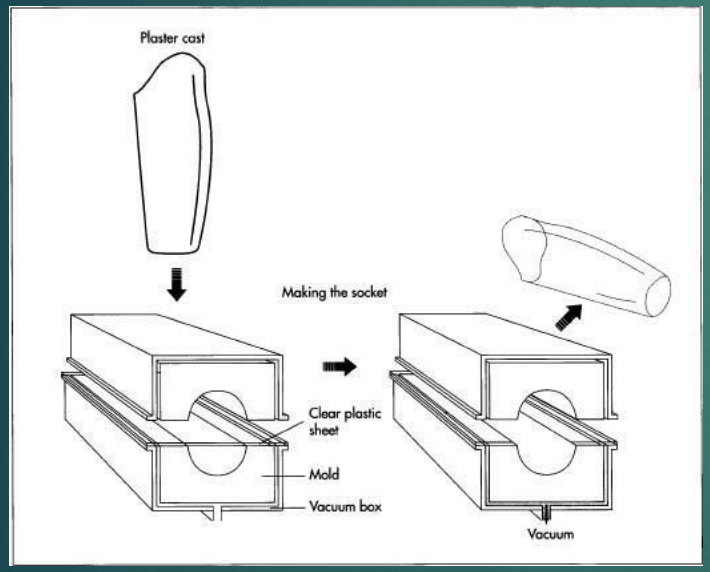
- Thermoplastic – Polypropylene , polyethylene. (they are used in making of structural components of parts. They are available in variety of sizes and color. They are flexible and crack-resistant.)

- Cosmetics Foams - Polyethylene and Polyurethane. (parts are often covered with a foam material to match the look of other part.)

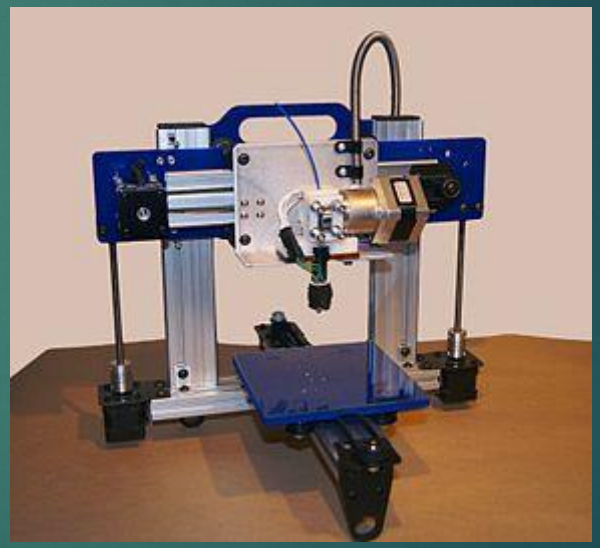
TECHNIQUES TO MANUFACTURE BIONIC BODY PARTS

- 3D Printing.
- Casting.
- Plastic Forming.
- Injection Moulding.
- Extrusion,

Casting



3D printer

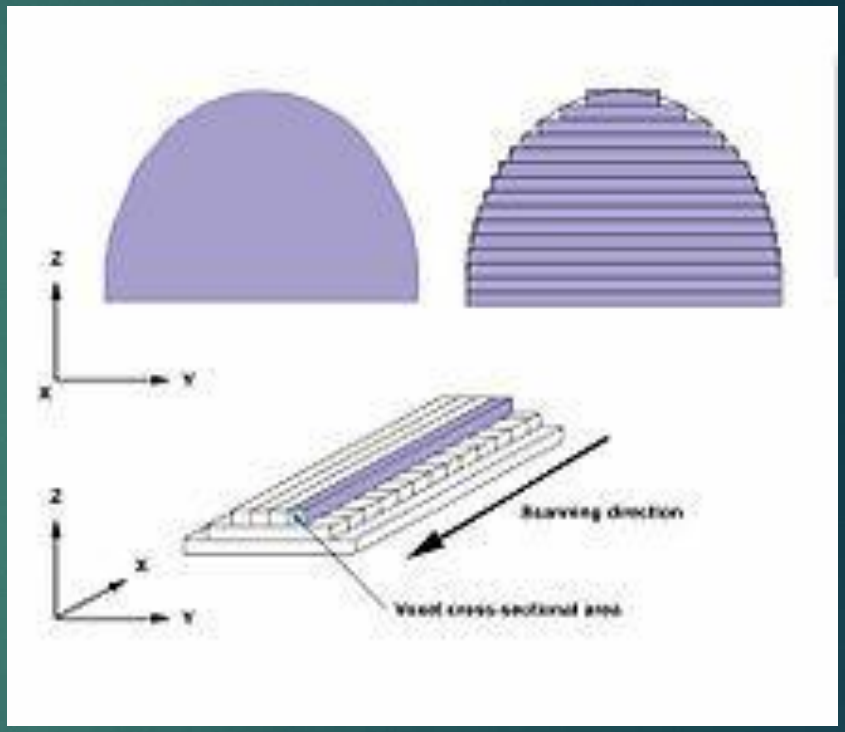


3D PRINTING

- 3D Printing is also known as additive manufacturing.
- A process of joining materials to make object from 3D model data usually layer upon layer.
- It can be used anywhere throughout the product life cycle from pre-production(rapid prototyping) to full-scale production(rapid manufacturing).

PRINCIPLE OF 3D PRINTING

- The machine reads the data from a CAD drawing and lays down successive layers of liquid, powder or sheet material and in this way builds up the model from a series of cross- section.
- These layers which corresponds to virtual cross-section from CAD model, are joined together or fused automatically to create final shape.
- The standard data interface between CAD software and machine are STL file and WRL file format.
- It is used to fabricate any shape or geometric feature.



CASTING-

- it is a manufacturing process by which a liquid material is poured into a mould which contains a hollow cavity of desired shape. And then allowed to solidify.
- The solidified part is known as casting.

PLASTIC FORMING-

- It is based on rubber machinery and metal die casting machine.
- With the help of compressed air, close to blow moulding cavity,plastic shape and size is provided and then make it cool.

INJECTION MOULDING-

- It is used for producing parts(highly précised) from both thermoplastic and thermosetting materials including glass, elastomer.
- Material is fed into heated barrel and forced into mold cavity where it cools and hardens the configuration of cavity.

EXTRUSION-

- It is used to create object of a fixed cross sectional profile.
- A material is pushed and drawn through a die of desired shape.

REFRENCES

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- www.discoverychannel.co.in
- www.wikipedia.com
- www.bionicinstitute.org.in