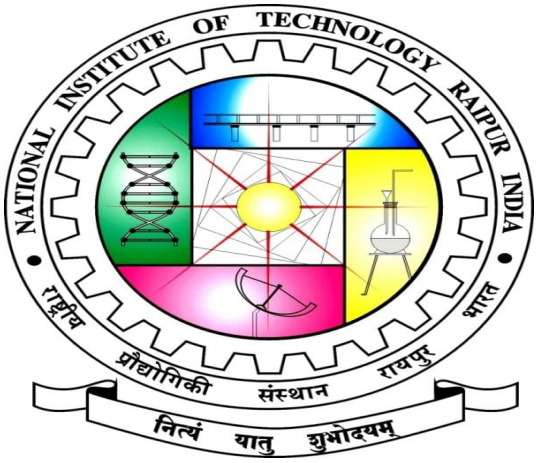
ASSIGNMENT-1

BIO MEDICAL ENGINEERING

National Institute of Technology Raipur(C.G)



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Section :-"A"(BME)

Topic :- Bio Medical Equipments

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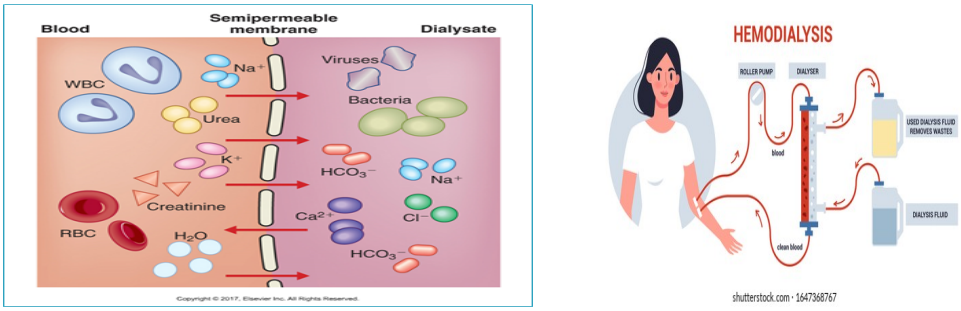
1 HEMODIALYSIS MACHINE

Hemodialysis is the process of purifying the blood of a person whose kidneys are not working normally and to perform this process the hemodialysis machine is used.This machine execute the dialysis process outside the body.In hospitals or in clinics this machines are monitored by specilized staff madeup of nurses and technicians. **Willem Kolff's** was the first to construct the working dialyzer in 1943 which was used for acute renal failure, which was further modified by Swedish professor **Nils Alwall** in stainless steel canister,to which negative pressure could be applied,by this way he made the first practical application of hemodialysis.

1.1 Mechanism



(a) Inside dialyser (b) Process

Figure 1: mechanism

Hemodialysis removes waste from the blood by circu-

lating the blood outside the body through an external filter called dialyser which contains semipermeable membrane.The counter current flow of blood and dialysate increases the concentration gradient,facilitate the removal of more urea, ions and creatinine from blood.The replacement of dialysate ensure that the concentration of unwanted solutes remains low in the dialysate side of the membrane.

1.2 Medical Use

Hemodialysis is the choice of renal replacement therapy for those patients who need dialysis acutely and the patients who are at the stage 5 of CKD it is mandatory untill the kideny transplant is done.

1.3 Recent innovation

KidneyX is a public-private company invented **bio artifical kidney** which performs similar functions of kidney. Bio artifical kidney promises to free kidney disease patients from dialysis machines and transplant waiting lists.

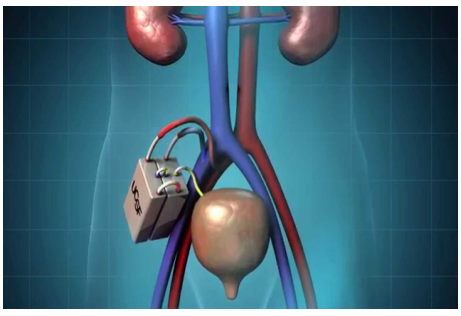
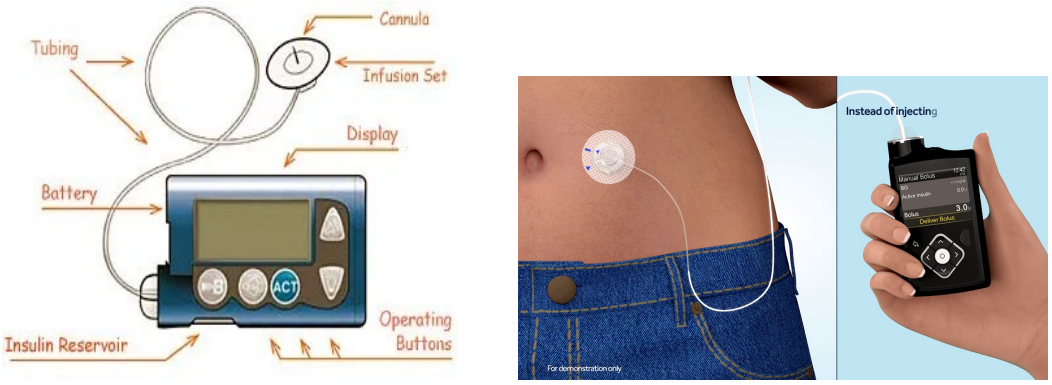


Figure 2: BioArtifical Kidney

2 INSULIN PUMP

An insulin pump is a medical device used for the managment of insulin in the treatment of diabetes mellitus, also known as continuous subcutaneous insulin therapy.In 1974 the first insulin pump was created and was named **the Biostator**. The first pump was so large that it was worn as a backpack. It can monitor the blood glucose levels.Today insulin pumps are so small that they can fit in a pocket or a purse.

2.1 Mechanism



(a) Insulin pump parts (b) Attachment

Figure 3

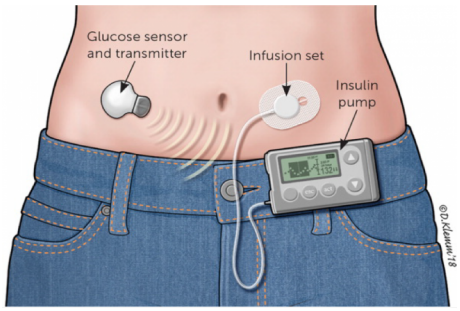
Insulin pump works by delivering a basal, or set, rate of insulin through a tube called cannula. The cannula is inserted just under the top layer of your skin. Your doctor

will fix the amount of insulin you need each day.It has the insulin reservoir to store the insulin and a screen so that you can see your glucose levels.Insulin pumps can also deliver an insulin bolus. This is the extra dose of insulin beside your basal rate.The patient need to administer the bolus dose.They don't adjust on their own according to your glucose levels.

2.2 Medical Use

Insulin pumps are used by those who are suffering from type 1 and many people with type 2 diabetes need to take insulin to manage thier glucose levels.

2.3 Recent innovation

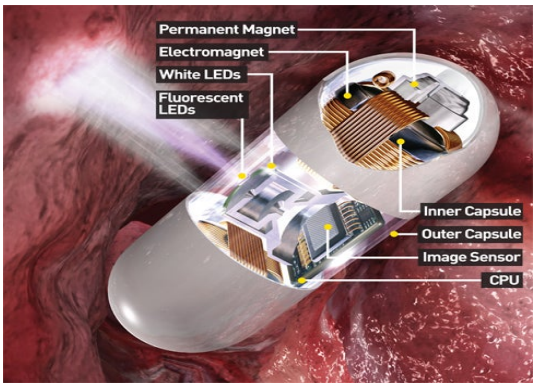


FDA(Food and drug administration) approved the **Artifical pancreas** or closed loop system on september 2016 which helps for the people suffering from type 1 diabetes manage their glucose level.It conatins a sensor which measures blood glucose level and sends data to the device,a insulin pump to deliver insulin and a computer in the device which calculates the amount of the insulin to deliver.This technology requires minimal human input.

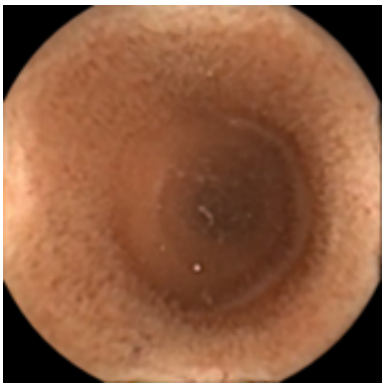
3 CAMERA PILL

Capsule endoscopy is a procedure used to record internal images of the gastrointestinal tract(GI) to be used in medical diagnosis.The capsule or pill camera is similar in shape to a standard pharmaceutical capsule, although a little larger, and the first capsule endoscope device named"M2A"was introduced in 2000 by an Israeli company known as Given Imaging.

3.1 Mechanism



(a) Capsule parts



(b) Image of the intestines acquired by camera pill

Figure 4

It contains tiny image sensor and an array of LEDs powered by a battery. After a patient swallows the capsule, it passes along the GI tract taking number of image

per second which are transmitted wirelessly to receiver connected to a portable recording device carried by the patient.The electromagnet help to maneuver the device through signals recieved from outside the patient body.

3.2 Medical Use

Capsule endoscopy is used to inspect parts of the GI tract that unable be seen with other types of endoscopy. It is useful when disease is suspected in the small intestine, and can sometimes it is used to find the site of GI bleeding or the cause of unexplained abdominal pain, searching for polyps, ulcers and tumors in small intestine, and diagnosis of inflammatory bowel diseases.

3.3 Recent innovation

On 15th November2021 Medtronic reported that FDA approved for its **PillCam™ SB3** system for remote endoscopy procedures. The PillCam™ SB3 at home program ensure both timely and precise result for patients from the comfort of their homes.After the eight-hour procedure, the PillCam SB3 capsule transmits nearly 50,000 images.These images are securely transferred to the cloud which are accessed by GI physician who reviews the images to make diagnosis.

4 ARTIFICAL HEART VALVE

An artificial heart valve is one-way valve implanted into a person's heart to replace a heart valve which is not functioning properly.The first valve invented by **Charles Hufnagel** was a "sutureless valve" in 1952, implanted an heterotopic valvular heart prosthesis in the descending aorta of a patient with aortic valve regurgitation.

4.1 Mechanism

4.1.1 Mechanical heart valve

The metal ring holds, by means of two metal supports, when the heart beats the dics opens and let the blood to flow through, then closes again to avoid blood flowing backwards. .This valve could last for more than 20years but the drawback of these valve is that the patients should use anticoagulants to avoid blood cloating.

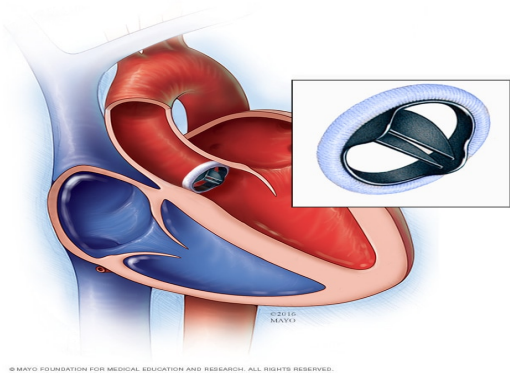


Figure 5

4.1.2 Bioprosthetic valve

Bioprosthetic valves are made from animal tissue attached to a metal or polymer support whose mechanism is similar to mechanical valve.This

Figure 6

valve is less likely than mechanical valves to cause blood clot but this valve are suspected to structural damage.

4.1.3 Tissue engineered valve

Tissue engineered heart valves (TEHV) offer a new and advancing proposed treatment of creating a living heart valve for people who are in need of either a full or partial heart valve replacement.This valve would be a living organ, able to respond to growth and works as native aortic valve.

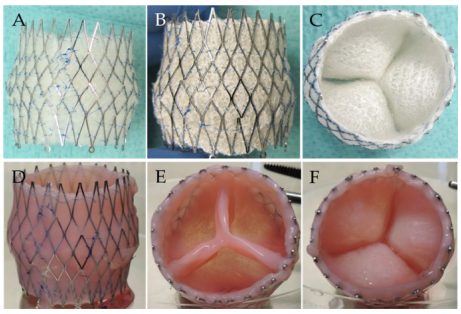


Figure 7

4.2 Medical Use

Artificial heart valves are used to replace heart valves that have become damaged with age or by certain diseases.

4.3 Recent innovation

A new **polymeric heart valve** with a life span potentially longer than current artificial valves that would also prevent the need for the millions of patients with diseased heart valves to require life-long blood thinning tablets has been developed by scientists at the universities of Bristol and Cambridge.

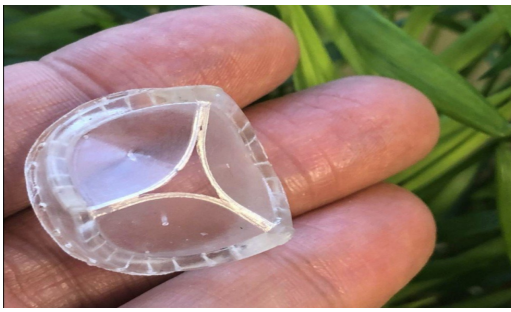


Figure 8

5 EXTERNAL PACEMAKER

An External Cardiac Pacemaker that is also known as Artificial Pacemaker is an electrodes-based medical device that is used to restore heart's normal rhythm to maintain adequate heart rate.In 1950, Canadian electrical engineer **John Hoppsbuilt** made the first external pacemaker based upon observations by cardio-thoracic surgeons Wilfred Gordon Bigelow and John Callaghan at Toronto General Hospital although the device was first tested on a dog at the University of Toronto's Banting Institute.

5.1 Mechanism

It conatins a small, metal battery-operated computer that is typically implanted into soft tissue beneath the skin in the chest.Wires (leads) that are implanted in your heart and connected to the computer.The pacemaker continuously monitors your heartbeat and delivers electrical energy (as programmed by your physician) to pace your heart if it's beating too slowly.Your pacemaker also stores information about

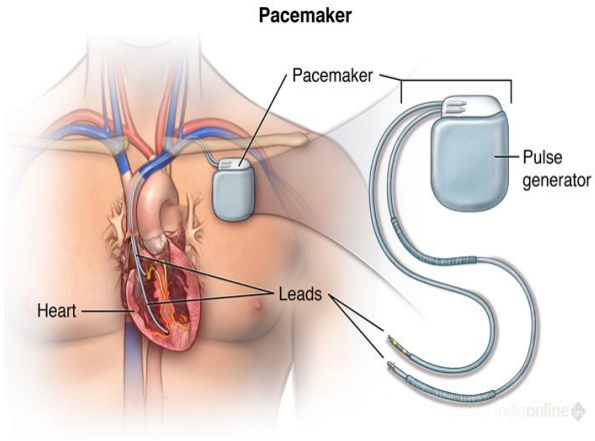


Figure 9

your heart. This allows your doctor to better evaluate the therapy and adjust your pacemaker settings, if necessary.

5.2 Medical Use

Pacemakers are used to treat heart rhythm disorders or Atrioventricular block (AV block)and related conditions such as: Slow heart rhythm (bradycardia) ,Fainting spells (syncope) heart failure.

5.3 Recent innovation

Medtronic **Micra AV** is world's smallest pacemaker whose size nearly equal to the vitamin capsule, also called leadless pacemaker because it is directly implanted into the patients heart via vein in the leg.This implantaion method unlike conventinal pacemaker don't create a scar or bump under the skin.It has several internal atrial sensing algorithms which detect cardiac movementand also senses when the blood is flowing through right ventricle.

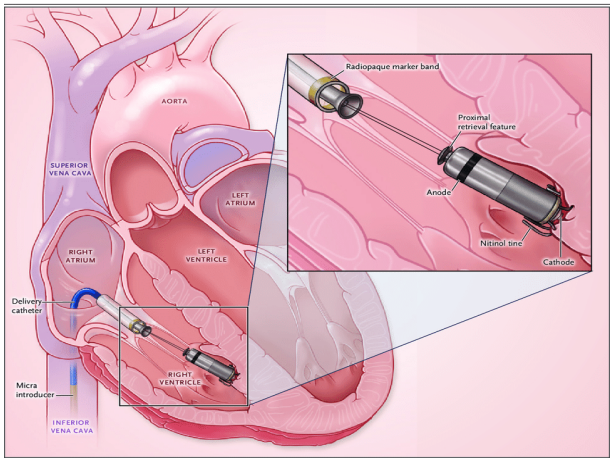


Figure 10