Unit - 5

Q1. What is Antilock Breaking System →

- Anti-lock Braking System, also known as anti-skid braking system (ABS) is an automobile safety system which prevents the locking of wheels during braking and avoids uncontrolled skidding

- Modern ABS allows steering during braking which gives more control over the vehicle in case of sudden braking.

- The main benefit is that it decreases the stopping distance on dry and slippery surfaces. Without ABS, even a professional driver can fail to prevent the skidding of the vehicle on dry and slippery surfaces

Main components of ABS →

It has 4 main components →

1. Speed sensors
2. valves
3. pump
4. Controller

1. Speed sensors →

- It is used to calculate the acceleration and deceleration of the wheel.

- It consists of a toothed wheel and an electromagnetic coil or magnet and a Hall effect sensor to generate signal.

- When the wheels of the vehicle rotates, it induces magnetic field around the sensor.
  Fluctuation in this magnetic field generates voltage.

- This generated voltage signals to the controller. With the help of the voltage, the controller reads the acceleration and deceleration of the wheel.

2. Valves →

- Each brake line which is controlled by ABS has a valve. In some of the systems, the valve works on 3 positions →

1) In position one - the valve remains open,
   - pressure from master cylinder passed through it to the breake.

2) In position two - the valve blocks the line and seperates the break from master cylinder.
   - this prevents further rise of pressure to the ~~break~~ brakes.
   - Valve operates in the second position when the driver applies the brake ~~harder~~ harder.

3) In position three - some of the pressure from the breake is released by the valve

- The dogging of the valve is the major problem in ABS. When the valve is dogged, it becomes difficult to open, close or change position.

When the valve is in inoperable condition, it prevents the system from modulating the valves and controlling the pressure to the brakes.

3. Pump →

- Pump is used to restore the pressure to the ~~breake~~ brakes after the valve releases the pressure.
- When the controller detects wheel slip, it signals to release the valve. After the valve releases the pressure supplied from the driver, it restores the desired amount of pressure to the braking system.
- The controller modulates the pump so as to provide desired amount of pressure and reduce slippage of wheel.

4. Controller →

- Controller used in the ABS is of ECU type. (Electronic Control Unit)

- It recieves information from each individual wheel's speed sensor, and if the wheel loses traction with the ground, signal is sent to the controller, the controller then limits the brake force and activates the ABS modulator.

- The activated ABS modulator actuates the braking valves on and off and varies the pressure to brakes.

Working of ABS →

- The controller (ECU - Electronic Control Unit) reads the signal from each wheel's speed sensor.

- As the brakes are suddenly applied by the driver, this makes the wheel decelerate at a faster rate and may cause the wheel to lock

- As the ECU reads the signal which indicates rapid decrease in the speed of the wheel, it sends signal to the valve which makes it close and the pressure to the brake pad is reduced, which prevents the wheel from locking

- The wheel again starts to accelerate, again the signal is sent to the controller, this time it opens the valve, increasing the pressure to the brake pad, and brakes are applied. This again reduces the speed of the wheel and tries to make it stop.

- This process of applying and releasing brakes happens 15 times per second, when a driver suddenly applies the brake harder.

- Due to this, locking of wheel is prevented and skidding of vehicle is eliminated.

- During braking with ABS system, the driver can steer the vehicle and this reduces the risk of vehicle collision.

Q2. Artificial Pancreas (AP)

- The introduction of artificial pancreas proved to be a boon for diabetic patients.

- This medical device has the potential to improve the conditions of people with Type 1 diabetes (T1D).

- Diabetes mellitus is a serious chronic condition characterized by high glucose levels in the blood, and it is caused due to the inappropriate functioning of the pancreas
The pancreas is located behind the stomach.
When we eat food, our body converts it into energy through glucose. Thus, after a meal when blood glucose levels increase, beta cells of the pancreas release insulin which simulates fat cells to remove excess glucose from the blood and store it in the liver in the form of glycogen, thereby maintaining blood glucose levels in the desirable range of 70 mg/dL to 180 mg/dL.

When the concentration of glucose in the blood gets low, the alpha cells of pancreas secrete a hormone called glucagon which causes catabolising of glycogen stored in the liver.

- Artificial pancreas is a man-made scientific technology developed in order to match the working of the pancreas. It is designed to change glucose levels in the bloodstream in a similar way as human pancreas would during the day and overnight.

- Maintaining balanced glucose level is important for the function of brain, kidney and liver.
Therefore it is necessary for T1D patients to maintain these levels when the body cannot produce insulin.

- An AP system consists of 3 devices →
  → insulin delivery pump
  → a continuous glucose monitoring system (CGM)
  → a computer controlled algorithm in order to allow real time communication between the two.

- AP is sometimes called a closed-loop ~~system~~ device, as the patient is not in the decision making loop.
AP is called an automatic system for glucose control.

- After monitoring the blood glucose levels, the AP system manipulates the insulin delivery ~~rates~~ pump rates by a closed-loop controller that recieves information from the sensor so as to reduce the instance of low blood glucose due to over administration of insulin (hypoglycemia) and high blood glucose due to failure to administer enough insulin (hyperglycemia)

- hypoglycemia is a short term risk involving drowsiness, shakiness and even loss of consciousness.

- hyperglycemia is a long term risk that results in blindness (diabetic retinopathy), numbness (diabetic neuropathy) and kidney failure (diabetic nephropathy).

3 main types of AP →

1. Closed-loop AP →

- An insulin pump communicates wirelessly with a CGM inserted under the skin.
- The CGM measures blood glucose concentration and sends the result to a small computer where the control algorithm calculates the correct dosage of insulin.

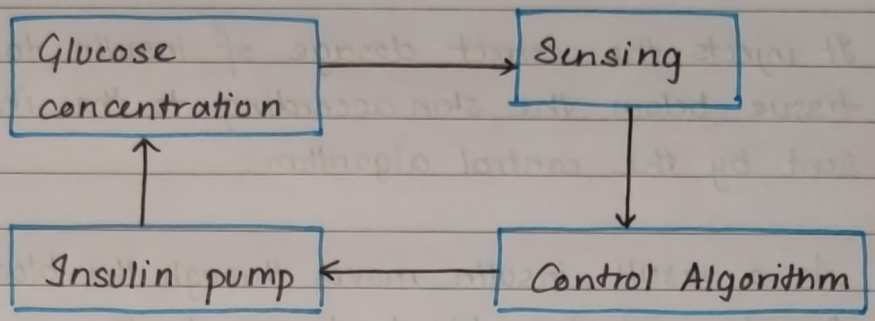
2. Bionic pancreas →

- It consists of two pumps that deliver insulin and glucagon respectively, and automatically controls blood glucose levels.
- The pump is wirelessly connected to the iPhone that enables realtime communication between devices and calculates the required insulin or glucagon dosages.

3. Implanted AP →

- It contains a gel that acts according to the changes in glucose level.
- The gel administers higher dose of insulin if glucose concentration increases and decreases the dose during low glucose concentration.
- It can be refilled with insulin consistently

AP system comprises of →



- CGM →

→ The CGM takes ongoing blood glucose readings through a little sensor inserted under the skin (subcutaneously) which continuously monitors the concentration of glucose in the blood.

→ A small transmitter sends the data to the reciever. CGM provides continuous display of estimates of both blood glucose levels as well as the direction and rate of changes of these estimates

→ to get the correct predictions, the patient needs to recalibrate the CGM periodically.

- Control Algorithm →

→ The computer model, ~~algs~~ or the controls algorithm embedded in ~~the~~ an external processor, also called the controller, performs a series of calculations on the recieved information from CGM.

→ The controller manipulates the insulin infusion rate based on these calculations.

- **Insulin pump →**

→ It injects the correct dosage of insulin to the fatty tissue below the skin according to the instructions sent by the control algorithm.

→ As a result, insulin moves through the blood stream, thereby reducing blood glucose levels.

- **Patients →**

→ The patients are a significant part of the AP system.

→ The amount of glucose in the blood frequently changes ~~according to~~ as it gets affected by the food taken by the patient, intensity of physical activity, and other substances.

Q3. Green Buildings

- A 'green building' is defined as one which uses less energy, water and natural resources, creates less waste and a healthy environment for the people living inside, as compared to a conventional building.

- Green buildings can help considerably reduce the consumption of electricity.

- In general, a green building is the practice of increasing the efficiency of utilization of resources (energy, water etc.) while reducing it's impacts on human health and environment during the building's life cycle.

- It is better achieved through →
  1) Better selection of site
  2) Innovation in design process
  3) Efficient use of water
  4) Accurate choice of materials and efficient construction.

- CHARACTERISTICS OF GREEN BUILDINGS →

  - Location and transport
  - Sustainable sites
  - Efficient use of water
  - Energy and atmosphere
  - Materials and resources
  - Indoor environmental quality
  - Design ~~ino~~ innovation
  - Regional priority.

- Five green systems being utilized in building engineering include -
  - → radiant floors
  - → gray water recycling
  - → solar power
  - → geothermal systems
  - → energy efficient window systems

- These systems working together can help the owner achieve their energy and water conservation goals, and can also help reduce utility bills.

- Automated Lighting →

→ The ways ~~in~~ which we use today to light houses, offices and most indoor areas is not efficient as a lot of energy is consumed unnecessarily during daytime.

→ In most cases lighting system relies on people to control switching the lights on and off.

→ In the proposed smart lighting system, lights switch on automatically when somebody is in the room, and switch off when there is no occupancy.

→ In addition, adjustment of brightness of the lights can be done via personal computer or any other smart device.

→ In this method, the illumination level, for the area where it must be controlled for energy conservation, is measured by a sensor considering the amount of background light coming from outside.

→ Automatically the brightness level is controlled to reach the preset level determined for that room.

→ This method provides user comfort, avoids human forcedness to switch the lights on and off, and enables energy conservation.

→ Arduino controller is used to build the controller.

→ It helps reduce energy consumption as it takes into account the occupancy of the room as well as the external daylight coming into the room.
The maintenance cost is reduced since the lifetime of the light bulb is better utilized
It also leads to lesser pollution by reducing carbon footprint.

- AC control - power distribution grid →

→ Smart devices reduce the idle running of energy consuming systems

→ These devices are connected to a larger network, they send anonymised consumption data of each unit to the distribution utility

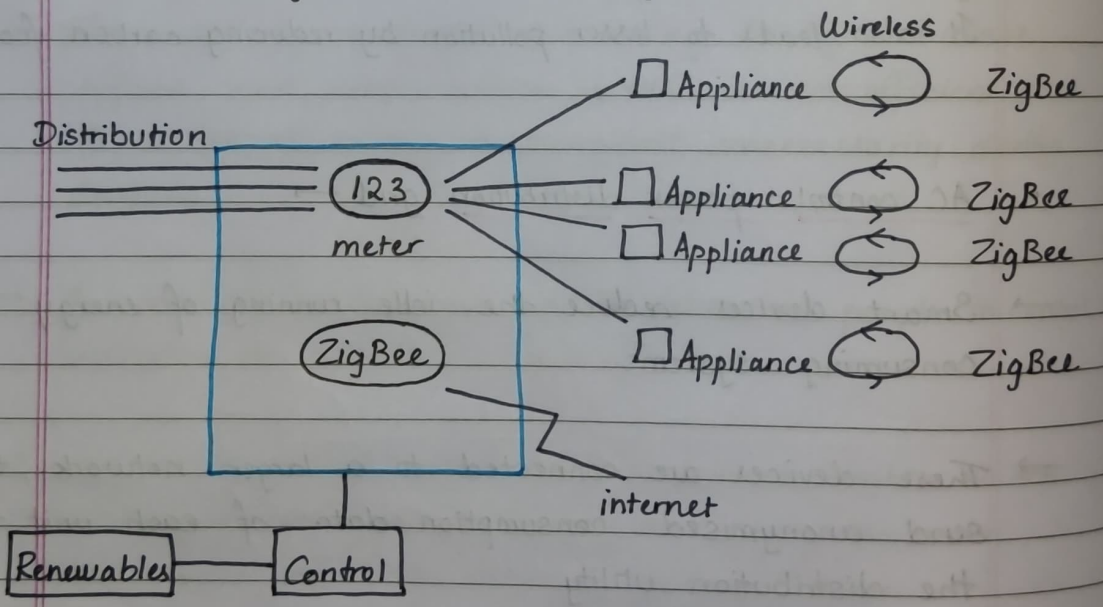
→ This aids the utility to enhance grid efficiency and to reduce grid-related operations and maintenance.

→ Almost all small scale renewable generators generate low voltage DC power.
To supply power to the AC mains network, costly and inefficient power invertor/convertor setups are used.

→ A possible solution that can omit the usage of these is to install a DC network linking DC devices to DC power supplies.

→ DC nano network for smart homes will comprise of →
- home area network with a smart meter
- Intelligent devices.

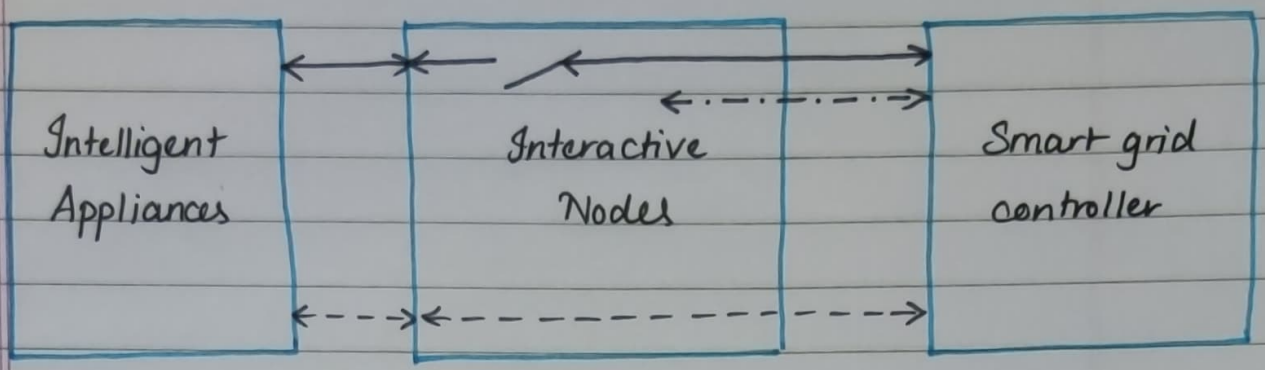
Efficient algorithms will be developed to manage loads during peak hours, to coordinate between Smart Meters and Intelligent devices, and to monitor the power flow. The total load of the building will be categorized and managed.



SMART GRID SYSTEM ARCHITECTURE.

A grid-connected system allows you to power your home or small business with renewable energy during those periods daily or seasonally, like when the sun is shining, water is running, or wind is blowing. Any excess electricity you produce is fed back to the grid.

SMART ELECTRICAL SYSTEM



Where ⟷ : electrical pathway
⟷ : data communication pathway
⟷ : system parameter pathway

→ It will have three elements, the intelligent appliances, interactive nodes and computerized control mechanism which must be able to communicate with eachother.

→ When the appliance is connected to the node, the switch will remain in the open position

→ The controller will detect that the appliance is connected and will send signal through communication pathway requesting it's identification data.

→ If the controller asses that the appliance can work properly at that node without adverse effects on the other nodes, it sends a signal to close the switch and allows the appliance to operate.