

Class - 21

Learning: OPAMP (Operational Amplifier):

OP-AMP is a high gain electronic voltage amplifiers with differential inputs and usually a single-ended output.

Ideal OP-AMP:

1) The output does whatever is necessary to make the voltage difference between the inputs zero.

$$V_+ = V_-$$

2) The input current into both terminals is zero.

$$I_+ = I_- = 0$$

3) Infinite open-loop gain.

Class - 22

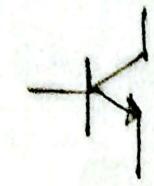
Learning: Transistor (BJT) as a switch.

BJT = Bipolar junction Transistor.

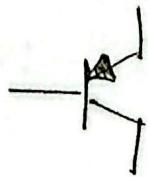
Semiconductor: 3 terminals →

- Base (B)
- collector (C)
- Emitter (E)

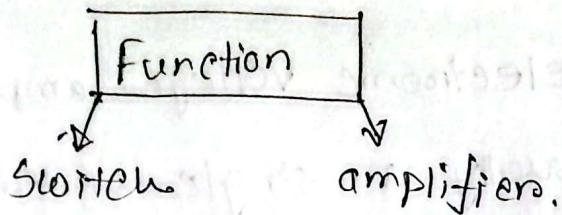
Two types: ① NPN (most commonly used in switching).
② PNP



(NPN)



(PNP)



Using a BJT as a switch:

BJT operates in 2 modes

1) Cut-off Region (Off)

- Ⓐ No base current \rightarrow NO collector current.
- Ⓑ acts like open switch.

2) Saturation Region (On)

- Ⓐ Base current flows \rightarrow Collector current flows.

- Ⓑ acts like closed switch.

$$I_B = -\frac{I_C}{\beta}$$

β = current gain.

Class - 23

Learning: Transistor (MOSFET) as a switch

MOSFET → metal oxide semiconductor field-Effect

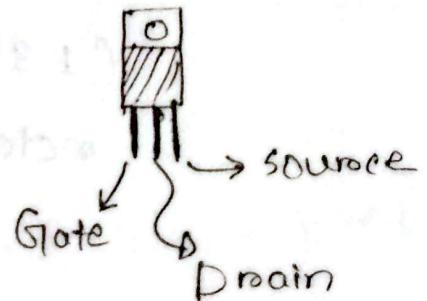
Transistor

→ voltage control transistor with 3 terminals:

- Gate (G)
- Drain (D)
- Source (S)

Two types:

- 1) N-channel (used for switching)
- 2) P-channel.



Class-24

Learning: Stepper motor and how to use

A brushless, synchronous motor that moves in precise steps rather than rotating continuously.

Q) How does a stepper motor work?

1) Multiple coils arranged in phases.

2) By energizing these coils in a specific sequence the motor "steps" from one position to the next.

3) Each step moves the shaft by a fixed angle.

(1.8° per step for ~~step for~~ many common motors)

Class 25

Learning: servos and how to use them.

A servo motor is a closed-loop motor

includes:

- 1) A DC motor
- 2) a gearbox
- 3) A position sensor
- 4) A control circuit.

④ servos are usually controlled by PWM signals.

Learning: 555 timer IC.

④ 555 timer is an 8-pin integrated circuit used for timing, oscillation and pulse generation.

Application:

i) Delays

ii) Oscillators

iii) Timers.

V) Pulse width modulation.

VI) LED, flashers.

VII) Tone generators.

Class-27

Learning: ADC (Analog to Digital converter)

↳ takes continuous analog signal \rightarrow converts it into digital value (binary value).

Resolution: More bits = finer detail.

Sampling Rate: Must be high enough to accurately capture signals.

Types:

(1) Successive Approximation Register (SAR) ADC

(2) Flash ADC.

(3) Delta-Sigma.

Arduino: Uses 10-bit SAR ADC, needs 0-5V by default.

Class-30

Learning: Microcontrollers (Arduino) Timers.

Timers	Bit Size	Associated Pins	Functions
Time 0	8 bit	Pins 5,6	millis(), delay() PWM
Time 1	16 bit	Pins 9,10	PWM, precise timing
Time 2	8-bit	Pins 3, 11	PWM, audio, IR