SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB204 – LINEAR AND DIGITAL CIRCUITS

II YEAR/ III SEMESTER

UNIT 1 – **FUNDAMENTALS OF OPAMP**

TOPIC 3 – AC and DC characteristics of Op-amp

Guess?????

Why DC Characteristics?

- An ideal op- amp draws no current from the source and its response is also independent of temperature
- An real op-amp does not work this way
- Current is taken from the source into the op-amp inputs
- Also the inputs respond differently to current and voltage due to mismatch in transistors
- A real op-amp also shifts its operation with temperature
- In this case, these non- ideal dc characteristics that add error components to the dc output voltage

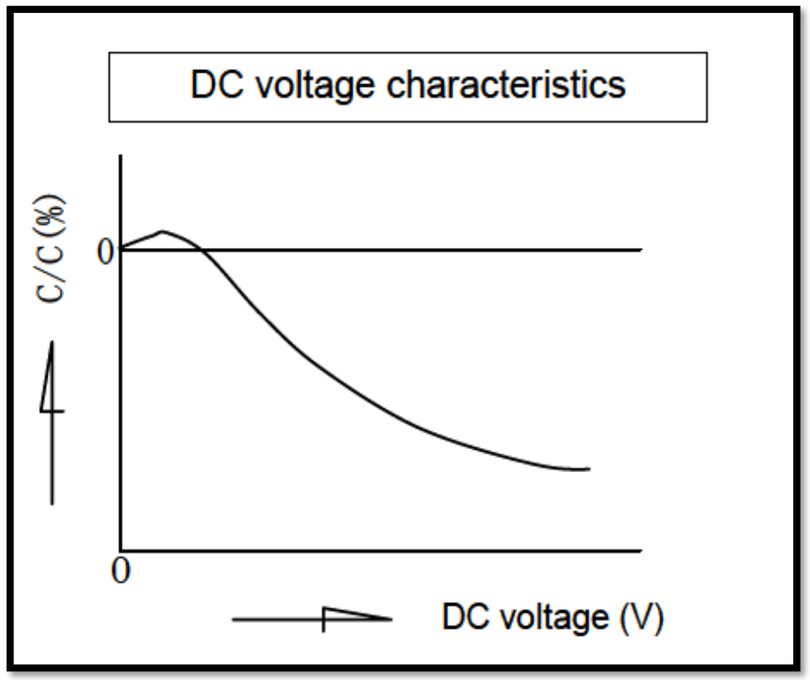
DC Characteristics

1. Input bias current

2. Input offset current

3. Input offset voltage

4. Thermal drift



Input bias current

- The average value of the two currents flowing into the op-amp input terminals is called Input Bias current (Ib)
- The two input currents are identical due to mismatch in transistors
- Let Ib1 be the current flowing into non inverting terminal and Ib2 be the current into the other
- Then the Input Bias current (Ib) is given by,

$$I_B = \frac{I_{b1} + I_{b2}}{2}$$

Input offset current

•The input stage of the op-amp is dual input differential amplifier

•Hence the input currents of op-amp are the base currents of the transistors used in the input stage

•Due to transistor mismatch these currents differ

•The algebraic difference between the currents flowing into the two input terminals of the op-amp is called input offset current and denoted as Iios.

It is given by,

$$I_{ios} = |I_{b1} - I_{b2}|$$

Input Offset Voltage

•Input **offset voltage** is the differential **voltage** which is required to apply between the two terminals of the **op-amp** such that the **output** of the **op-amp** will become zero when no input is applied to the **op-amp**

• **Output offset voltage** is the multiplication of DC gain and the input **offset voltage**

Thermal Drift

- **Thermal drift** is the changes in the normal operational behaviour of a device due to changes in ambient temperature
- **Drift** caused by internal heating of equipment during normal operation or by changes in external ambient temperature

- There are very few circuit techniques that can be used to minimize the effect of drift

- Careful printed circuit board layout must be equal be used to keep op-amps away from source of heat

- Forced air cooling may be used to stabilize the ambient temperature

Activity

In class activity

Can You Solve This?
Viral "IQ" Test

1 + 4 = 5
2 + 5 = 12
3 + 6 = 21
8 + 11 = ?

Mind Your Decisions

Why AC Characteristics ?

- Purpose of this circuit is to amplify a small **AC** input signal, such as an audio or radio frequency signal

- A small **AC** voltage is applied to the input, through a coupling capacitor

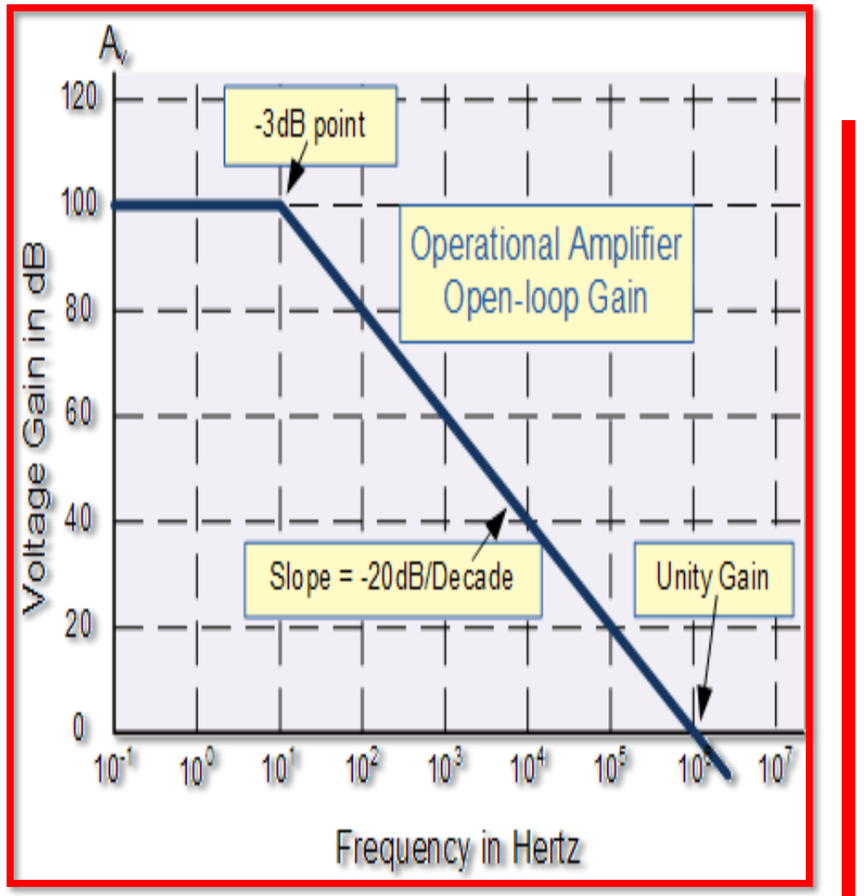
- Hence, such a circuit is useful only as an **AC amplifier**

- To amplify DC signals separate operational **amplifier** circuit is used

- For small signal sinusoidal applications the AC characteristics are
    1. Frequency response.
    2. Slew rate.

Frequency response

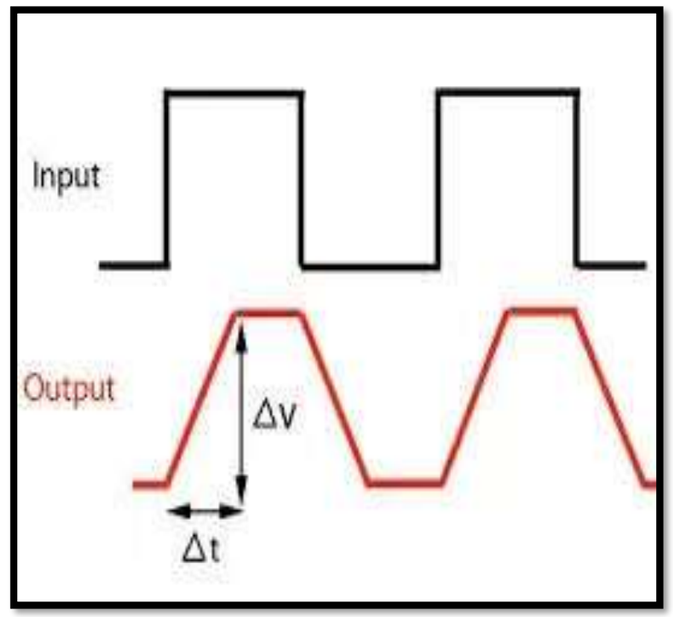
- An ideal op-amp has infinite band width
- Its open loop gain is 90dB with d.c.signal and this gain should remain the same through audio and radio frequency
- But practically op-amp gain decreases at high frequency
- This is due to a capacitive component in the equivalent circuit of op-amp.



Slew rate

- The slew rate is defined as the maximum rate of change of output voltage caused by a step input voltage., Specified in V/μs

  eg : 1V/micro sec. slew rate denotes the output rises or falls by 1 volts in 1 micro seconds



- The rate at which the voltage across the capacitor dVc/dt is given by

  dVc/dt = I/C , Slew rate SR dVc/dt|max= Imax/ C

- For IC741, Imax= 15 micro amps, C= 30 Pico farad

  Slew rate = 0.5V/ micro sec

Assessment

Think, Pair, Share

What's the issue / question / topic?	What do I think about it?	What does my partner think?	What will we share?

THANK YOU