**DEV BHOOMI UTTARAKHAND UNIVERSITY**

**ASSIGNMENT ON OP-AMP(OPERATIONAL AMPLIFIER)**

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**Operational Amplifiers**

**Introduction-** An Op-amp is a very high gain differential amplifier with high input impedance and low output impedance.

(Or)

An Op-amp is a direct is a direct-coupled high-gain amplifier usually consisting of one (or) more differential amplifiers and usually followed by a level translator and an output stage.

**Block Diagram of a Typical Op-amp:-**

The Block diagram of an Op-amp is shown below-

Input-inverting

Output

Stage

Level-shifting

Stage

Intermediate

Stage

Input

Stage

Input output

Inverting input

Dual-input Dual-input unbalanced Emitter follower Complementary

Balanced output output differential with constant symmetry Push-pull

Differential amplifier current source amplifier

**Characteristics of an ideal op-amp:**

An ideal op-amp exhibits the following characteristics –

1. Infinite voltage gain

2. Infinite input impedance

3. Zero output impedance

4. Zero input offset voltage

5. Zero input offset current

6. Infinite CMRR

7. Infinite slew rate

8. Infinite bandwidth

**Concept of Virtual ground –**

+

VA **-**

VO

VB

+

Let VA and VB be the voltage at the input terminals. We know that

VO = Av (VA - VB)

The AV is the differential voltage gain and its ideal value is infinity

AV = ∞ = VO / VA -VB

VA -VB = 0

This concept is called as Virtual Ground.

**Op-amp Parameters (or) Characteristics:-**

1. **Differential gain (or) differential mode gain (Ad) -** It is the factor by which the difference between the input signals is amplified by the Op-amp.

Ad = Vo / Vd = Vo/V1-V2

1. **Common mode gain (ACM) -**It is the factor by which the common mode input voltage is amplified by the Op-amp.

Acr=Vo/Vcr=Vo/ (V1+V2)/2

1. **Common mode rejection ratio (CMRR) –** It is the factor which explains the ability of an op-amp to reject the common mode signal.

CMRR=Ad/Acr

1. **Differential input resistance (or) Input resistance (or) input Impedance (Ri) –** It is the equivalent resistance measured at either the inverting (or) non-inverting input terminal with the other terminal connected to ground. It is denoted by Ro.

Ideally: Ri =

Practically: Ri = 2mΩ (for µA741)

1. **Output resistance (or) output impedance –** It is the equivalent resistance measured between the output terminal of the op-amp and the ground. It is denoted by ‘Ro’.

Ideally: Ro =

Practically: Ro = 75Ω (for µA741)

1. **Bandwidth (BW) -** It is the range of frequency over which the gain of op-amp is almost constant. It is denoted by BW.

Ideally: BW=

Practically: BW= 1mµΩ (for µA741)

**Op-Amp Applications:-**

1. **Voltage Follower-**An op-amp circuit in which the ouput voltage follows the input voltage is called voltage follower (output voltage is equal to the input voltage).
2. **Inverting amplifier-** An op-amp circuit in which the output voltage is out of phase (180 degree) with respect to the input voltage is called inverting amplifier.
3. **Non-inverting amplifier-**An op-amp circuit in which the output voltage is in phase with the input voltage is called non-inverting amplifier.
4. **Summer (adder) (or) Summing amplifier-** An op-amp circuit in which the output voltage is sum of the input voltage is called summer.
5. **Sub tractor (or) Difference amplifier-**An op-amp circuit, in which the output voltage is the difference (subtraction) of two input voltages is called Subtractor.
6. **Differentiator-** An op-amp circuit in which the output voltage is the differentiation (derivative) of the input voltage is called differentiator.
7. **Integrator-** An op-amp circuit in which the output voltage is the integration of the input voltage is called integrator.

Thank

You