12/07/2017

Electronics II — ET 2004

LO1 (AE) – Analyse, Construct & Design AE ccts. [25 h]
* Transistor Amps (BJT, FET)
* OP Amps
* Power Electronics (Thyristor ccts)
* Power Amps
* Power Supplies (Linear & switch mode)

LO2 – Analyse, Construct & Design DE ccts. [10 h]
* Data Converters
* Programmable Logic Devices (CPLDs)
* Micro Controllers

LO3 – Develop skills Digital System Designs [10 h]
* Digital Systems Design Concepts
* Verilog HDL
* Basic Digital Simulations using verilog.

(DE)

Transistor Amps (Ref: Chap #5 (BJT), Chap #8 (FET) of Boylestad)

Transistors
- BJT ✓
- FET – Cover Briefly (Chap #8 of Boylestad)

Amplifiers – Basic and most Common AE Application.
- Discrete Transistor Amps.
  (Use BJTs, FETs, Rs, Cs, Ls, etc... to build amp ccts.)

- IC Amplifiers

  # IC OP Amp is the most common device used to make IC Amps.

- An amplifier gives an o/p more in value than its i/p

  Can be

  V–V Amp

  C–C Amp

  V CV Converter C

  (I–V Converter)

  C VC Converter V

  (V–I Converter)

- In a Power Amp, O/p power is more than the i/p power

  # Discrete Power Amps

  # IC Power Amps (Power OP Amps)

- Amps are also classified based on their use.

  Ex: Audio Amps

  Video Amps

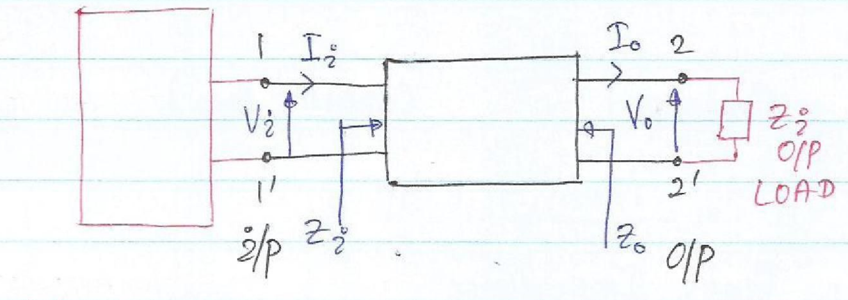
  RF Amps

  μW Amps

  LW Amps

  Instrumentation Amps.

Representation of an Amp. or Amp. Equivalent Circuits



i/P Signal Source

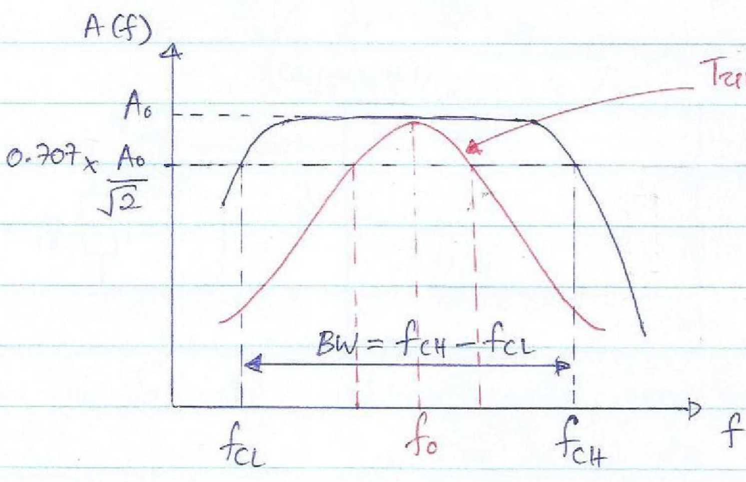
Amplifiers Amplification (Gain); $A = \dfrac{O/P\ Quantity}{I/P\ Quantity}$

" I/P Impedance ; $Z_i = \dfrac{V_i}{I_i}$

" O/P " ; $Z_o = \dfrac{V_{o,\,oc}}{I_{o,\,sc}} = \dfrac{\text{Open cct O/P Voltage}}{\text{Short cct O/P voltage}}$

" Frequency Response and Bandwith (B or BW) $= \dfrac{V_o |_{Z_L} = \infty}{I_o |_{Z_L} = 0}$

" Gain Bandwith Product (GBP = A x BW)



Tune Amp (Narrow Band Amp)

A – Mid Band Gain

f_{CL} – Lower Cut-off freq.

f_{CH} – Upper Cut-off freq.

NO UNITS

$A_V = \frac{V_o}{V_i}$ = Voltage Amplification (Voltage Gain) — high for a Voltage Amp

$A_I = \frac{I_o}{I_i}$ = Current " (Current Gain) — high for a Current Amp

Ω $A_Z = \frac{V_o}{I_i}$ = Trans Impedance ——— high for a IV Conv.

$\frac{1}{\Omega} = S$ seemans $A_Y = \frac{I_o}{V_i}$ = Trans Admittance ——— high for a VI Conv.

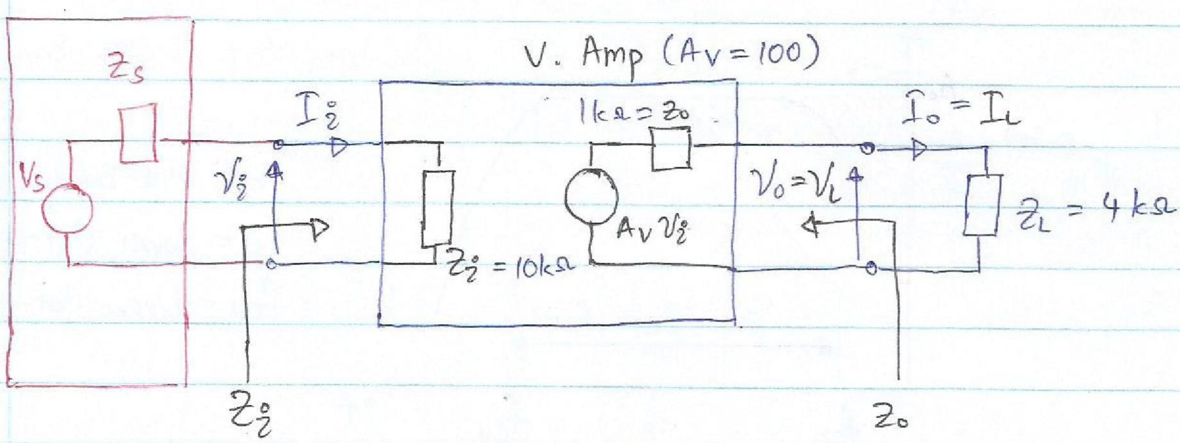
$A_P = \frac{P_o}{P_i}$ = Power Amplification
Power Gain

[Q1] Go through (Browse) a datasheet of a

* BJT Transistor
* FET Transistor
* Diode

and study their frequency emmitation.

V Amp is the most common type.



V. Amp connected to a Voltage Source and a Load.

$$\text{No Load V. Gain} = \left.\frac{V_o}{V_i}\right|_{I_o=0}$$

$$= \left.\frac{V_o}{V_i}\right|_{Z_L=\infty}$$

$$= \frac{A_v V_i}{V_i} = \underline{\underline{A_v}} = 100$$

$$A_{v}dB = 40\,dB$$

$$\text{Loaded Voltage Gain} = \left.\frac{V_o}{V_i}\right|_{I_o \neq 0}$$

$$= \left.\frac{V_o}{V_i}\right|_{Z_L \neq \infty}$$

$$A_{VL} = \frac{Z_L}{Z_L + Z_o} \times A_v \quad = \frac{4}{5} \times 100 = \underline{\underline{80}}$$

$= 10 \log 80$

$80 = 8 \times 10$

$= 2^3 \times 10$

$\log_{10} 2 \simeq 0.3$

$$\underline{\underline{A_{VL} < A_v}}$$

$$A_{VS} = \frac{V_o}{V_s} = \frac{V_o}{V_i} \times \frac{V_i}{V_s} = A_{VL} \times \left(\frac{Z_i}{Z_i + Z_s}\right)$$

Overall V. Gain

$$\therefore A_{VS} = A_v\left(\frac{Z_i}{Z_i + Z_s}\right)\left(\frac{Z_L}{Z_L + Z_o}\right) = \left(\frac{10}{0.1} \simeq 0.99\right) 80$$

$$= \underline{79.2}$$

When Z_s getting ↑ Overall V. gain ↓ [When others are constant]

Note :- deciBell (dB) Notation is widely used to express gain.

A_v or A_i in dB

$= A_{VdB}$ or A_{IdB}

$= 20 \log_{10} |A_V|$ or $20 \log_{10} |A_I|$

$$A_p \text{ in } dB = A_{pdB} = 10 \log_{10} A_p.$$

$$A_p = \frac{V_o I_o}{V_i I_i} = A_{VL} \cdot A_{IL}$$

$$= \frac{V_o^2 / R_L}{V_i^2 / R_i} = \left(\frac{V_o}{V_i}\right)^2 \cdot \frac{R_i}{R_L} = (A_{VL})^2 \cdot \frac{R_i}{R_L}$$

$$A_p = 6400 \times \frac{10}{4} = \underline{16,000}$$

$$\therefore A_{pdB} = 10 \log_{10} 16,000$$

$$= \underline{\underline{42}}$$

$10 [4 \log_{10} 2 + 3 \log_{10} 10]$

$10 [(4 \times 0.3) + 3]$

$10 [1.2 + 3]$

$10 [4.2] = \underline{42}.$

For ideal Voltage Amp ;

$Z_i = \infty \Longrightarrow I_i = 0$

$Z_o = 0$

$BW = \infty$

$A_{VS} = A_{VL} = A_V$

[Q] Go through the text and carry out a similar analysis to the above voltage amplifier for,

(i) Current Amp

(ii) Trans. Impedance Amp (IV Conv)

(iii) Trans. Admittance Amp (VI Conv)