Analog Electronics Circuit

Course Code	**BEEE3021**

BJT Review

***Source & References**:*

The materials presented in this lecture has been taken from various books and internet websites. This instruction materials is for instructional purposes only.

Referred book: R. Boylestad, Electronic Devices and Circuit Theory, 11th edition, Prentice Hall.

What is an Amplifier?

An amplifier is not something that just increases the voltage or the current,

but it amplifies

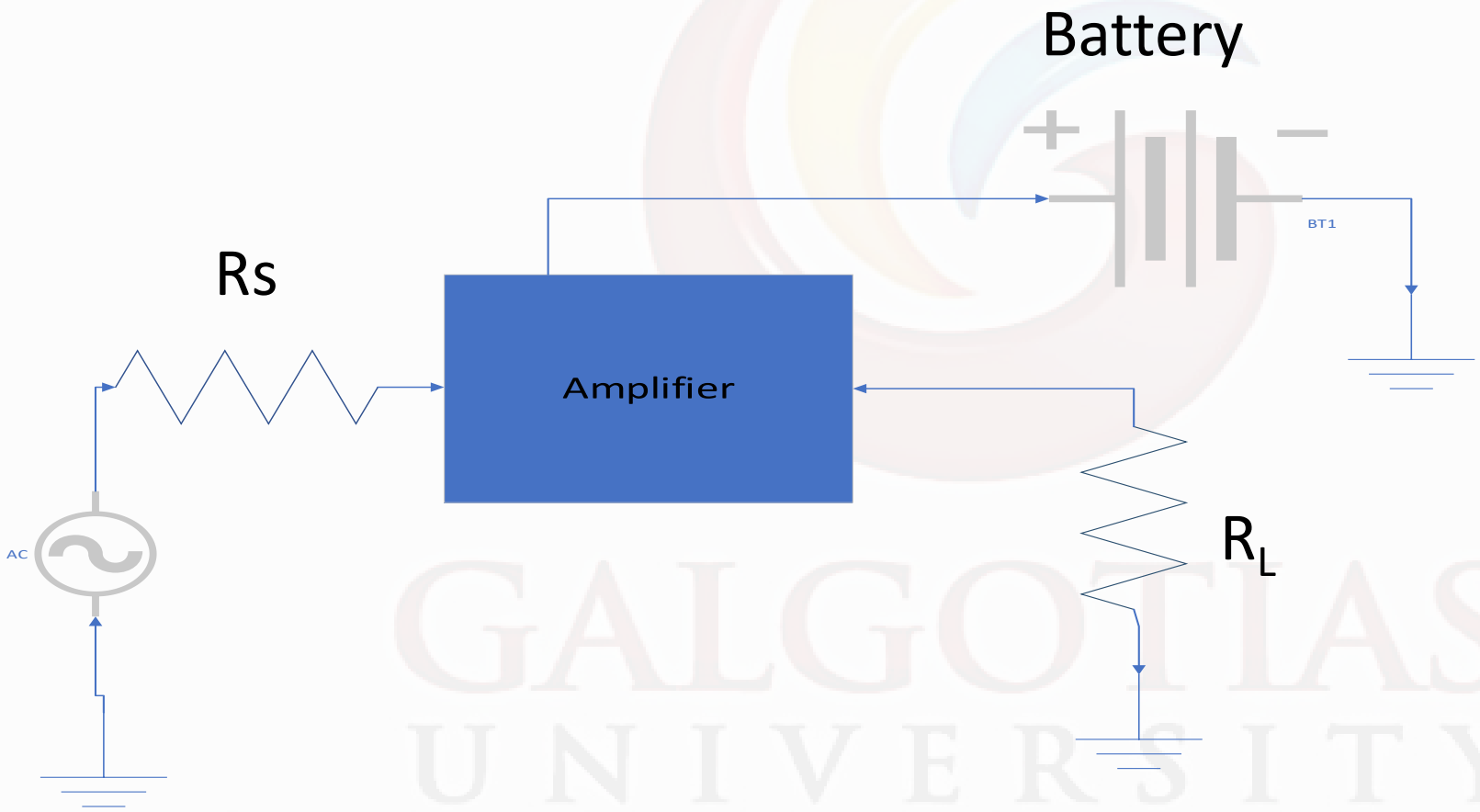
Power

The law of conservation of energy

From where the amplifier gets energy to amplify?

It’s from the Battery or power supply(dc) connected to it.

Amplifier Design

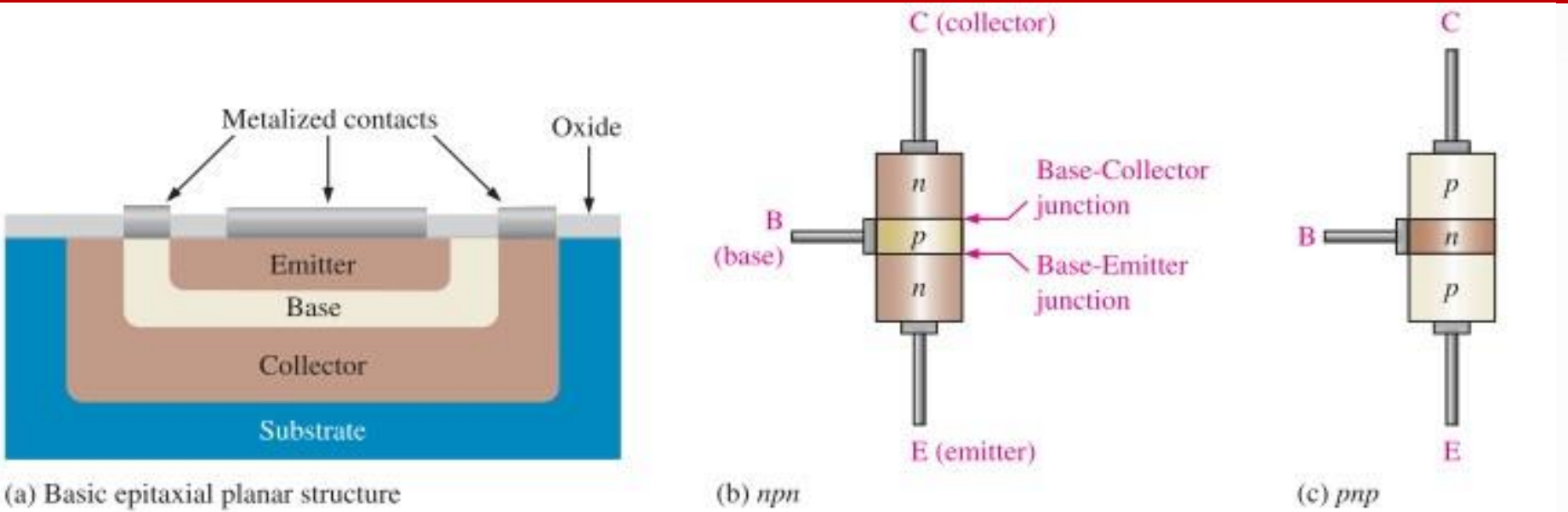


Components Needed to design an Amplifier?

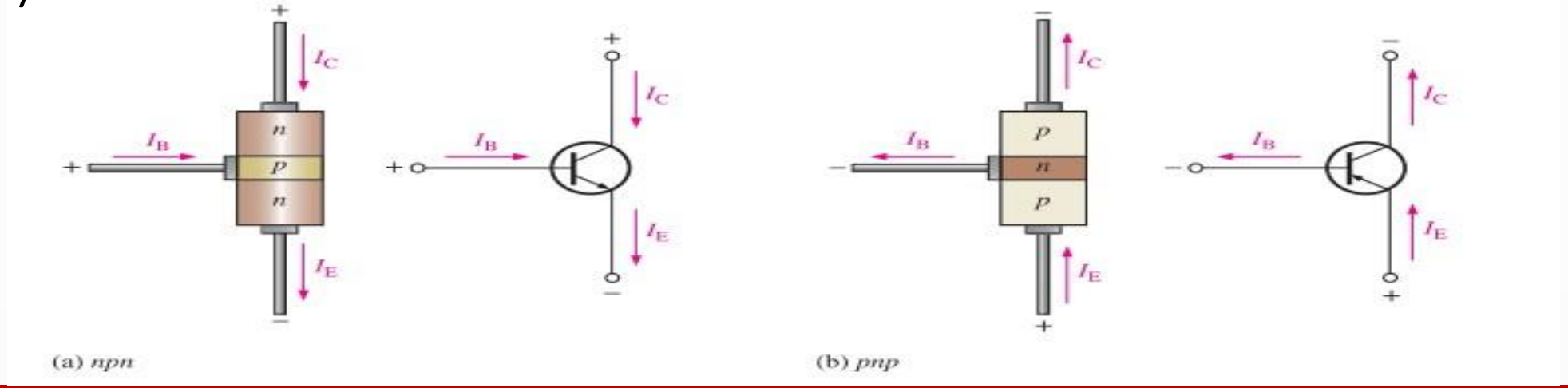
	Linear	Non-Linear
Passive	R, L, C, Transformer	Diodes, LED
Active	V, I CCCS, CCVS VCVS, VCCS	BJT, FET MOSFET MESFET CMOS FinFET

Transistor Construction

- Basic BJT Constructions



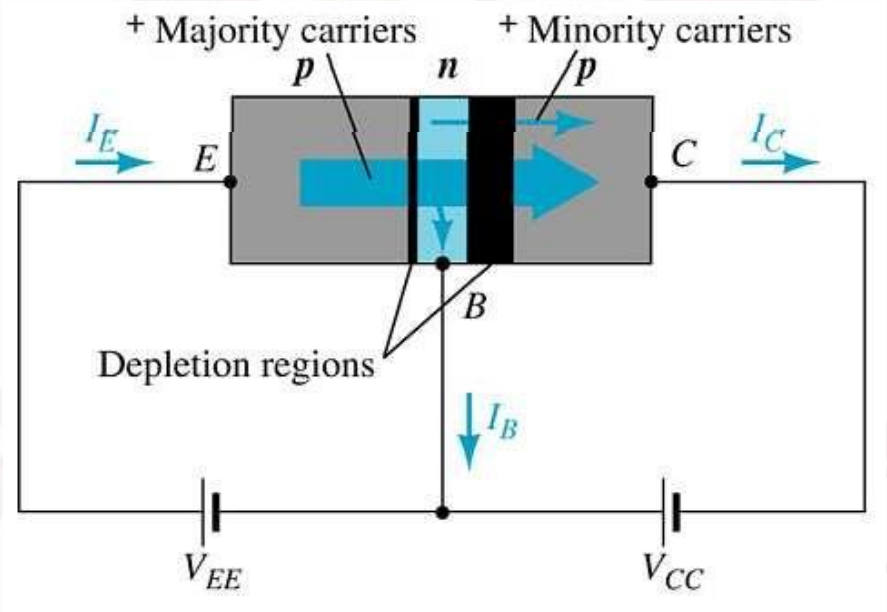
- Basic BJT symbols and Currents



Transistor Operation

With the external sources, V_{EE} and V_{CC}, connected as shown:

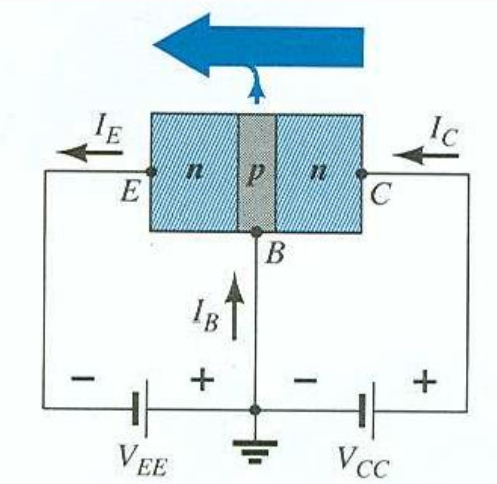
- **The emitter-base junction is forward biased**
- **The base-collector junction is reverse biased**



Currents in a Transistor

Emitter current is the sum of the collector and base currents:

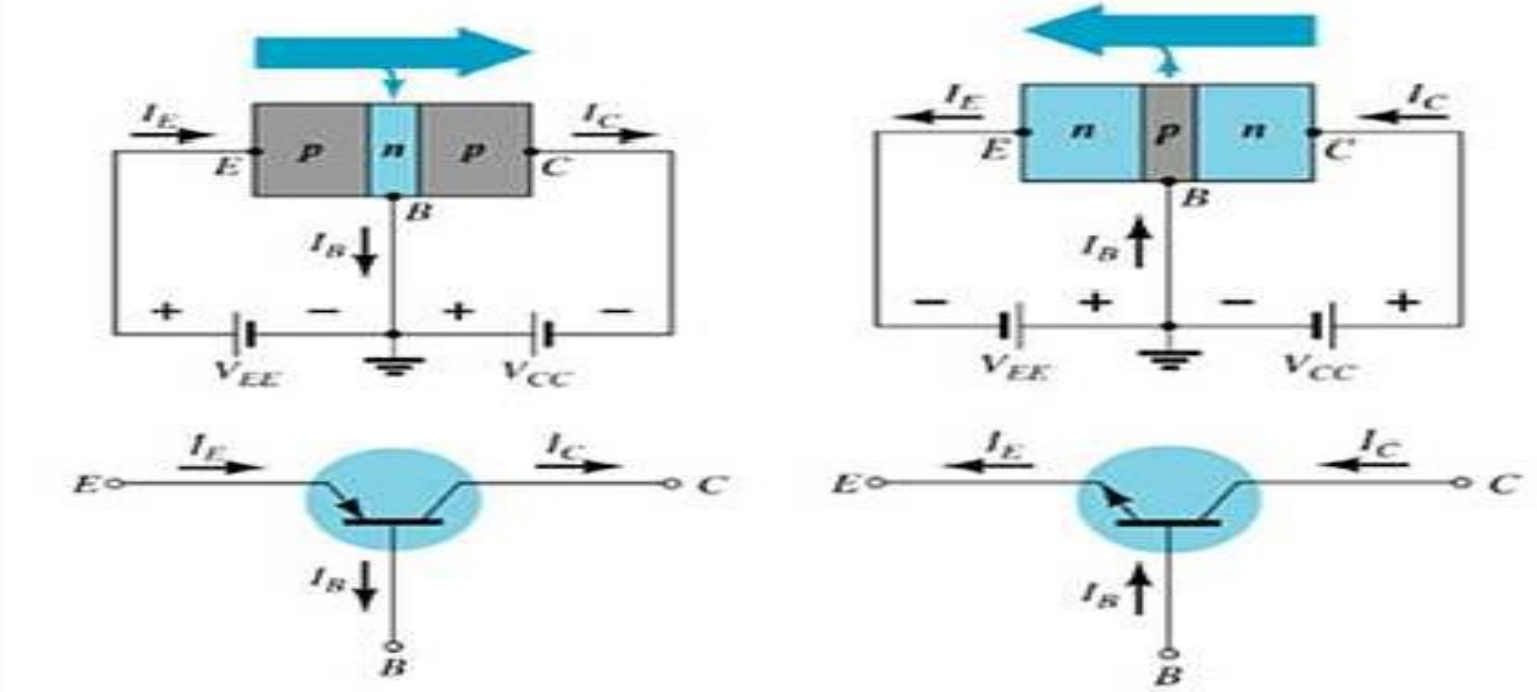
$$I_E = I_C + I_B$$



The collector current is comprised of two currents:

$$I_C = I_{C_{majority}} + I_{CO_{minority}}$$

Common-Base Configuration

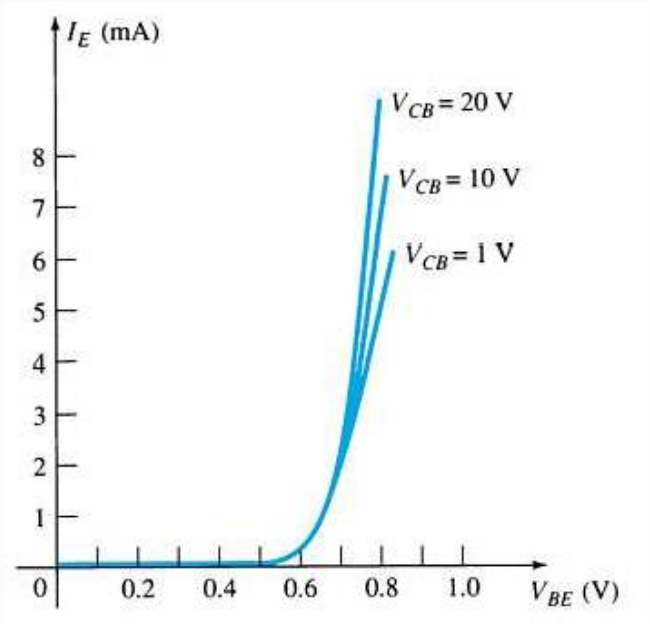


The base is common to both input (emitter–base) and output (collector–base) of the transistor.

Common-Base Amplifier

Input Characteristics

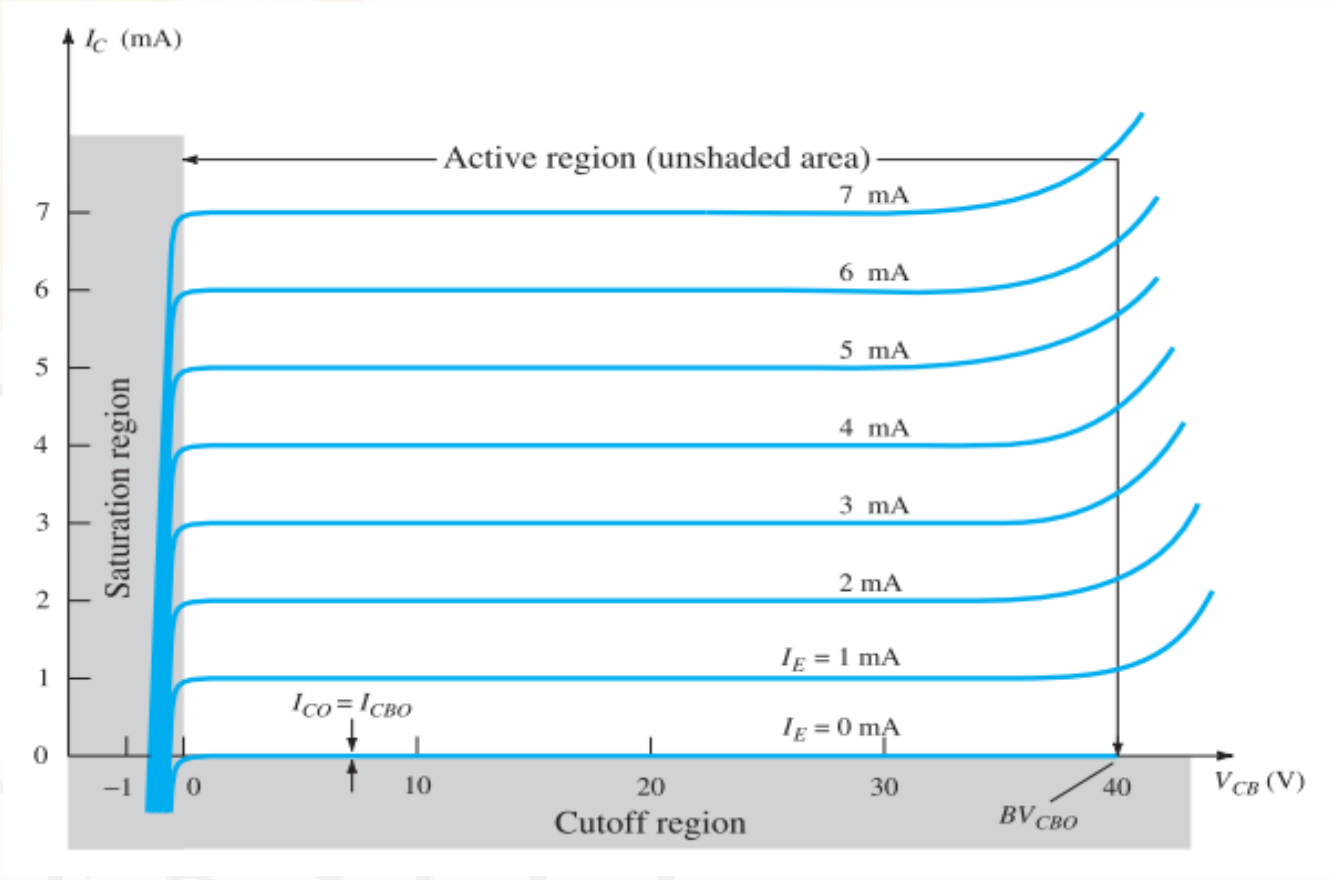
This curve shows the relationship between of input current (I_E) to input voltage (V_{BE}) for three output voltage (V_{CB}) levels.



Common-Base Amplifier

Output Characteristics

This graph demonstrates the output current (I_C) to an output voltage (V_{CB}) for various levels of input current (I_E).



Operating Regions

- **Active – Operating range of the amplifier.**
- **Cutoff – The amplifier is basically off. There is voltage, but little current.**
- **Saturation – The amplifier is full on. There is current, but little voltage.**

Approximations

Emitter and collector currents:

$$I_C \cong I_E$$

Base-emitter voltage:

$$V_{BE} = 0.7\ V \text{ (for Silicon)}$$

Alpha (α)

Alpha (α) is the ratio of I_C to I_E :

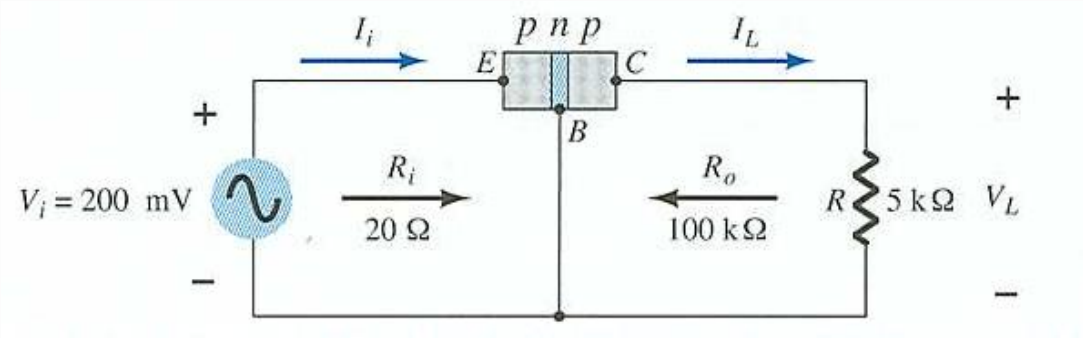
$$\alpha_{dc} = \frac{I_C}{I_E}$$

Ideally: $\alpha = 1$
In reality: α is between 0.9 and 0.998

Alpha (α) in the AC mode:

$$\alpha_{ac} = \frac{\Delta I_C}{\Delta I_E}$$

Transistor Amplification



Currents and Voltages:

$$I_E = I_i = \frac{V_i}{R_i} = \frac{200\text{mV}}{20\Omega} = 10\text{mA}$$

$$I_C \cong I_E$$

$$I_L \cong I_i = 10\,\text{mA}$$

$$V_L = I_L R = (10\ \text{ma})(5\ \text{k}\Omega) = 50\,\text{V}$$

Voltage Gain:

$$A_v = \frac{V_L}{V_i} = \frac{50\text{V}}{200\text{mV}} = 250$$

THANK YOU