Electronics II

Lecture 03
BJT re Equivalent Model

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Previous Lecture

- Amplifying Action in AC Domain.
- BJT Transistor Modeling.
- Important Amplifier Parameters using Two Port System
  - Input Impedance.
  - Output Impedance.

Session Overview

Topic	BJT *re* Equivalent Model
Concepts	Voltage Gain, Current Gain, Phase relationship re Equivalent Model for ▪ Common Base Configuration. ▪ Common Emitter Configuration. ▪Common Collector Configuration.
Recommended Reading	Sections 7.4 & 7.5 of [1]
Keywords	re, BJT, Common Base, Common Emitter, Common Collector, Equivalent Model.

Voltage Gain, A_v

- Small signal ac voltage gain is given as

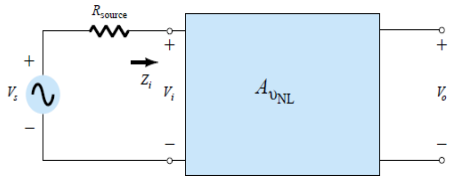
  $A_v = V_o/V_i$.

- If load is not connected to the output, then this voltage gain is called *"no load voltage gain"* and calculated as

  $A_{VNL} = V_o/V_i \mid_{R_L = \text{infinite}}$

- Normally for transistor amplifiers no load voltage gain is greater than the loaded voltage gain.

- V_i =
- V_i/V_s =
- $A_{vs} = V_o/V_s$ =
- A_{vs} =
- Typical Magnitude of voltage gain ?



Robert L. Boylestad, *Electronic Devices and Circuit Theory*, 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.

Voltage Gain, A_v

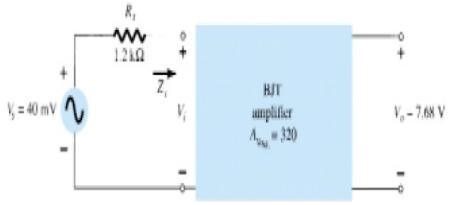
- Example 7.3 (Boylestad):
- For the given BJT amplifier, determine

a. V_i =

b. I_i =

c. Z_i =

d. A_{vs} =



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Current Gain, A_i

- The small signal ac current gain is defined as

  $A_i = I_o/I_i$

- For BJT amplifiers, typical range of Ai exceed from 1 to 100.

- For the given network

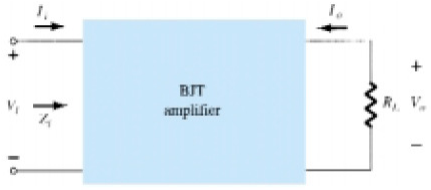
  $I_i = V_i/Z_i$

  $I_o = - V_o/R_L$

- $A_i = I_o/I_i = - (V_o/R_L)/ (V_i/Z_i)$

  $A_i = - (V_oZ_i)/ (V_iR_L)$

  $A_i = -(A_vZ_i)/R_L$



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Phase Relationship

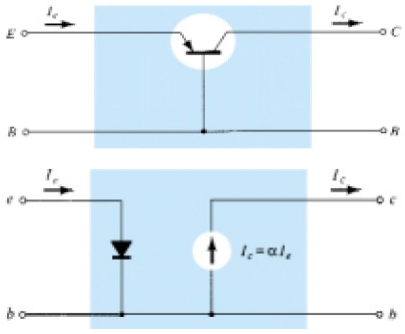
- For a typical transistor amplifier at frequencies at which the effects of reactive elements can be ignored, the input and output signals are either 180 degrees out of phase or in phase.

r_e, Transistor Model

- This model employs a diode and controlled current source to represent the behavior of a transistor.
- Current controlled current source is the one in which the parameters of the current source are controlled by a current.
- The r_e transistor model will be investigated for the following three configurations of the BJT amplifiers.
  - Common Base Configuration.
  - Common Emitter Configuration.
  - Common Collector Configuration.

Common Base Configuration

- A pnp transistor is employed to derive the re model for common base configuration.
- It is depicted in a way to replicate the two port network.
- The forward biased pn junction is replaced by a diode.
- A current source is connected in order to represent the collector current I_C.
- AC resistance of diode can be determined by
- $r_{ac} = 26mV/I_D$. $r_e = 26mV/I_E$



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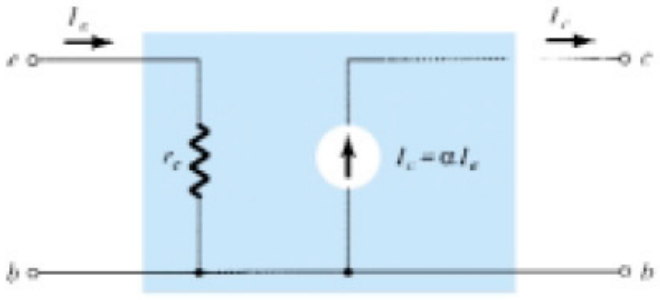
Common Base Configuration



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References

[1] Robert L. Boylestad, *Electronic Devices and Circuit Theory,* 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.