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COMSATS

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Electronics II

Lecture 09
Multistage Amplifiers
Part 01

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The theme of this presentation is an inspiration from the one used in S2 Department of Chalmers University of Technology, Gothenburg, Sweden.

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Previous Lecture

- FET Small Signal Analysis

    - AC Equivalent Circuit and related Parameters .
    - Small Signal Analysis of JFET Fixed Bias Configuration.

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Session Overview

| Topic	Multistage Amplifiers
Concepts	Cascade Connection, Cascode Connection.
Recommended Reading	Sections 12.1,12.2, 12.3 of [1].
Keywords	Cascade, Cascode.

Multistage/ Compound Configurations

- For various practical purposes, the single stage amplifiers are not sufficient.

- Multistage/ compound configurations are employed to enhance the functionality and suitability for different purposes.

- Most important of these configurations are considered for study here. These include

- Cascade Connection
  – Amp. Stages in series.

- Cascode Connection
  – Amp. Stages on top of each other.

- Darlington Pair.
  – Multiple stages connected to operate as a single transistor.

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Cascade Connection

- It's a series connection where the output of one stage acts as an input to the next stage.
- Phase relationship of input & output?

- The total voltage gain of cascade connection is the product of the individual stage gains i.e. $A_v = A_{v1}*A_{v2}$
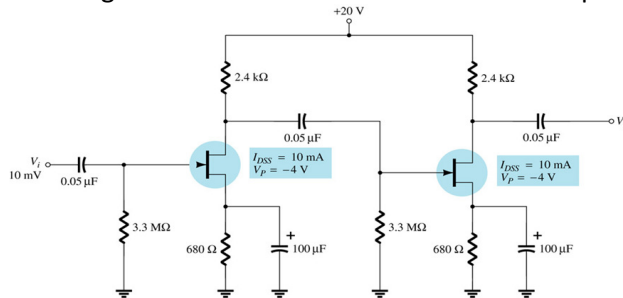- $Z_i = R_{G1}$ $Z_o = R_{D2}$
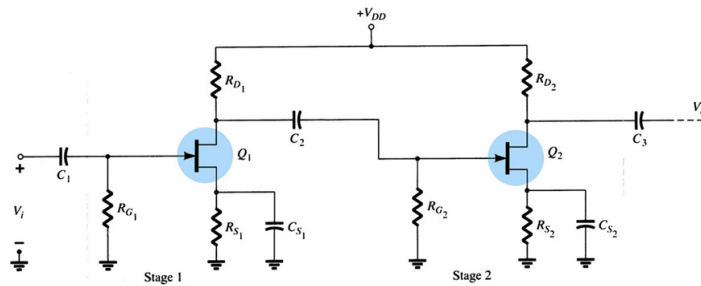
Robert L. Boylestad, *Electronic Devices and Circuit Theory*, 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.

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Cascade Connection

- *Example 12.1 (Boylestad):*

  Calculate DC Bias, voltage gain, input impedance, output impedance and output voltage for the given cascaded amplifier. Also calculate the load voltage if a 10kΩ load is connected to the output.
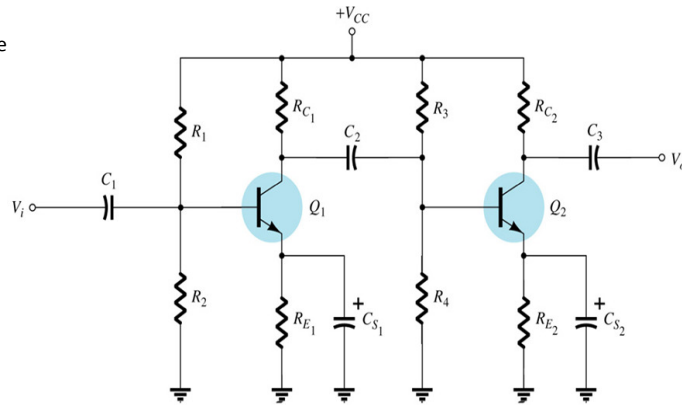

Robert L. Boylestad, *Electronic Devices and Circuit Theory*, 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.

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BJT Cascade Amplifier

- $A_v = -(R_C \,||\, R_L)/r_e$

- $Z_i = R_1 \,||\, R_2 \,||\, \beta r_e$
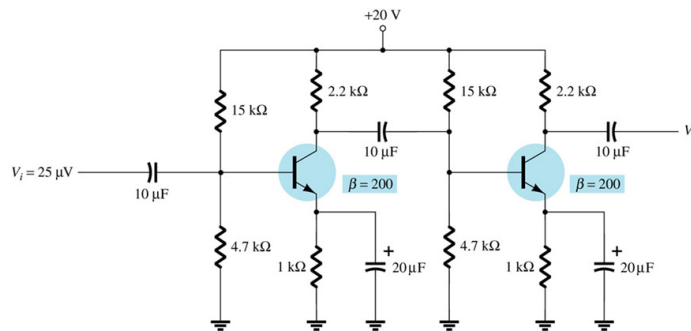
- $Z_o = R_C \,||\, r_o.$

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

BJT Cascade Amplifier

- *Example 12.2 (Boylestad):*

  Calculate voltage gain, input impedance, output impedance and output voltage for the given cascaded BJT amplifier. Also calculate the load voltage if a 10kΩ load is connected to the output.
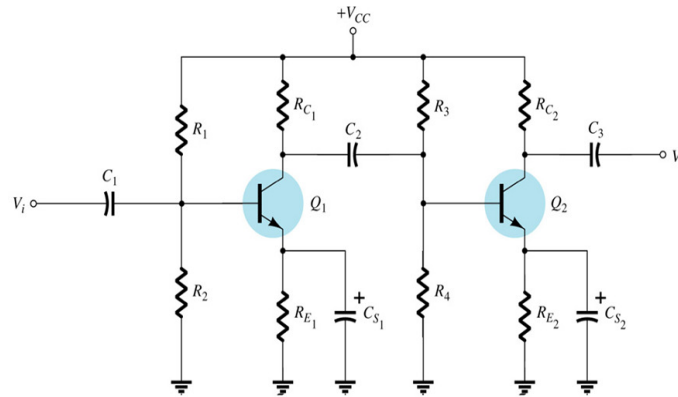

Robert L. Boylestad, *Electronic Devices and Circuit Theory,* 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.

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BJT Cascade Amplifier

- *Task:* Calculate Z_o of stage 01 and Z_{in} of stage 02 for the given configuration.
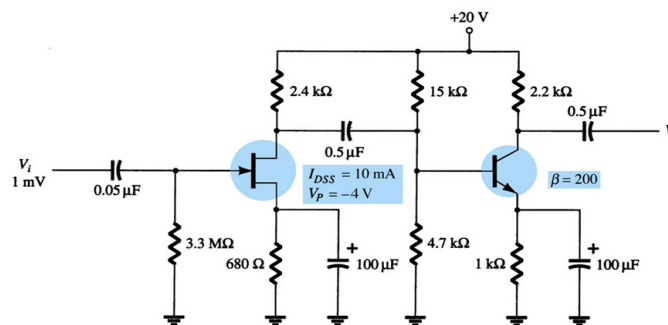

Robert L. Boylestad, *Electronic Devices and Circuit Theory,* 8th Edition, Pearson Education Inc, ISBN: 81-7808-590-9.
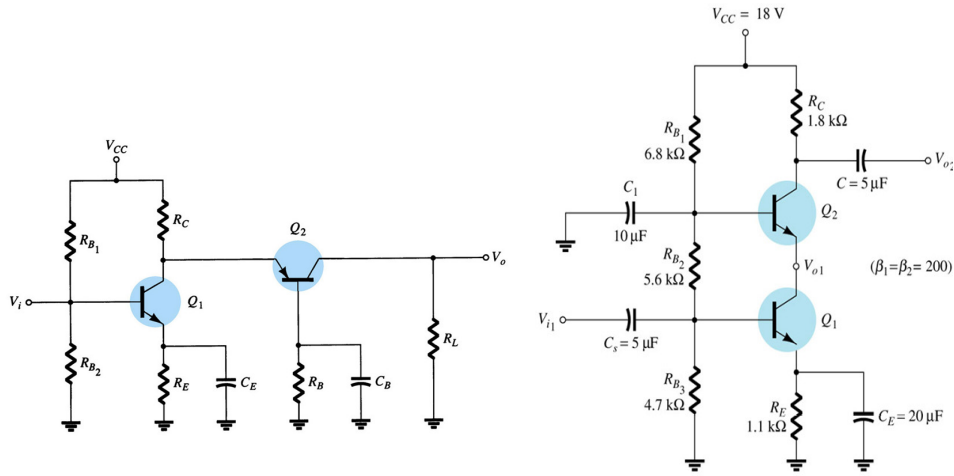
FET-BJT Cascade Amplifier

- *Example 12.3 (Boylestad):*

  Calculate input impedance, output impedance, voltage gain and output voltage for the given cascade amplifier using the DC bias conditions calculated in Example 12.1 & 12.2.

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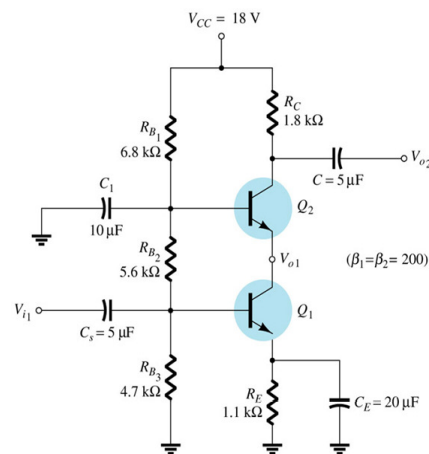
Cascode Connection

Cascode Connection

- *Example 12.4(Boylestad):* Calculate the voltage gain for the given cascode amplifier.

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References

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