

TSTE05 Elektronik & mätteknik

Föreläsning 16

Differentialförstärkarsteg, mm

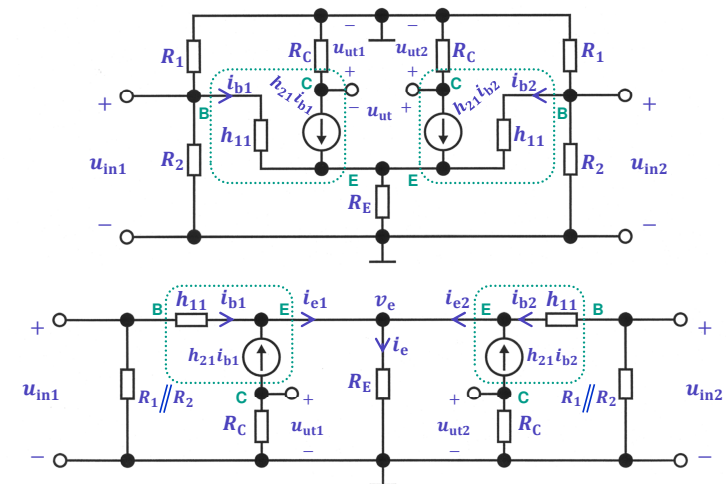
Föreläsningen börjar 15:20

Mikael Olofsson

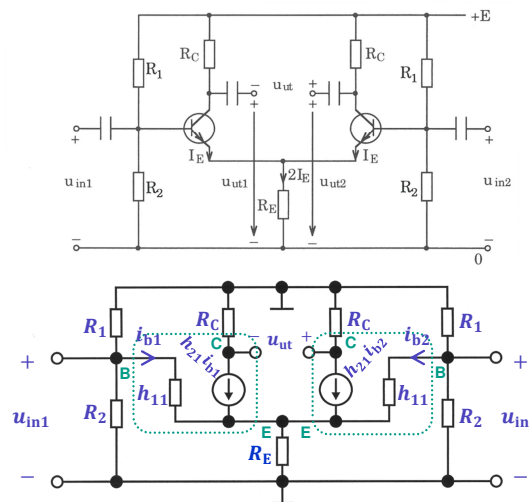
Institutionen för Systemteknik (ISY)

Ämnesområdet Elektroniska kretsar och system

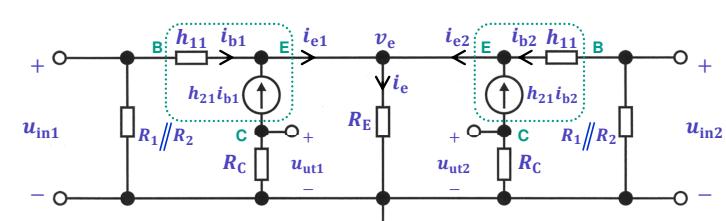
Omritat småsignalschema



Differentialförstärkarens småsignalschema



Superposition igen



Uppdelning av insignaler

$$u_{in1} = u'_{in1} + u''_{in1}$$

$$u_{in2} = u'_{in2} + u''_{in2}$$

Superposition med två fall

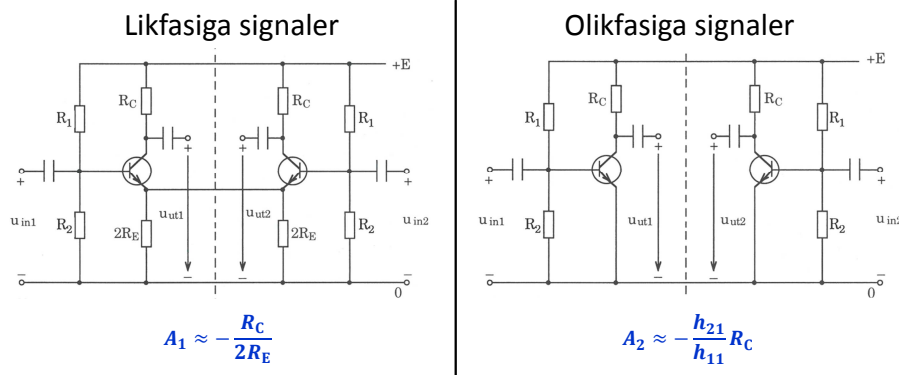
Fall 1: Likfasiga signaler

$$u'_{in1} = u'_{in2} = \frac{u_{in1} + u_{in2}}{2}$$

Fall 2: Olikfasiga signaler

$$u''_{in1} = -u''_{in2} = \frac{u_{in1} - u_{in2}}{2}$$

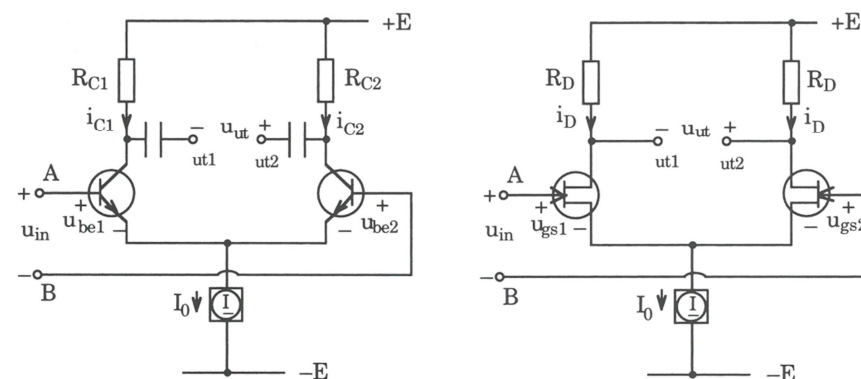
Ekvivalenta scheman



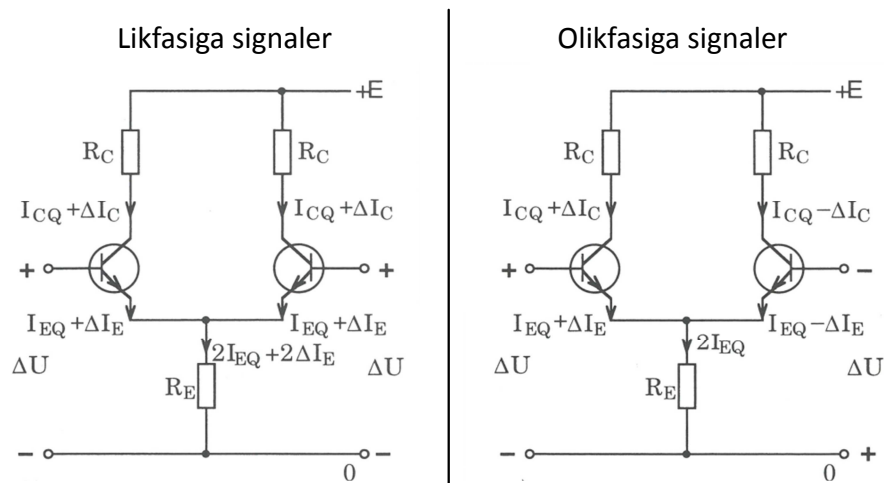
Common-Mode Rejection Ratio

$$CMRR = \frac{A_2}{A_1} \approx 2 \frac{h_{21}}{h_{11}} R_E$$

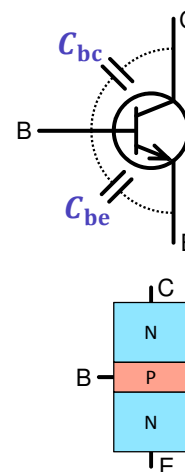
Strömgenerator – oändligt R_E – oändligt CMRR



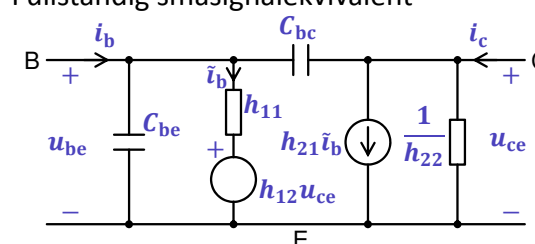
Likfasiga och olikfasiga insignaler



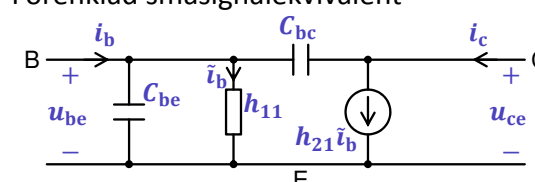
Parasitiska kapacitanser (strökapacitanser)



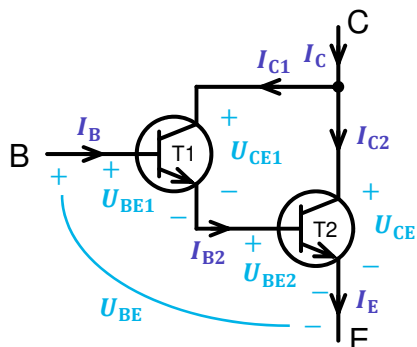
Fullständig småsignalekvivalent



Förenklad småsignalekvivalent



Darlingtonkoppling – DC-analys



Spänningar:

$$U_{BE} = U_{BE1} + U_{BE2} \approx 1,4 \text{ V}$$

$$U_{CE} = U_{CE1} + U_{BE2}$$

Strömmar:

$$I_{C2} = B_2 I_{B2} \quad I_{C1} = B_1 I_B$$

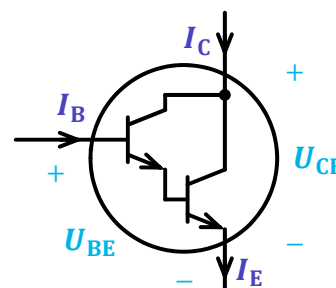
$$I_{B2} = I_B + I_{C1} = (1 + B_1) I_B$$

$$I_E = I_{B2} + I_{C2} = (1 + B_2) I_{B2} = (1 + B_2)(1 + B_1) I_B$$

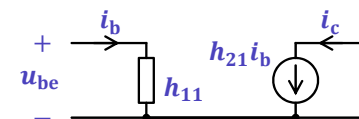
$$I_C = I_{C1} + I_{C2} = (B_1 + B_2(1 + B_1)) I_B$$

Strömförstärkningsfaktor: $B = B_1 + B_2(1 + B_1)$

Darlingtonkoppling – Tolkning som en transistor



Förenklad småsignalekvivalent



Inimpedans:

$$h_{11} = h_{11,1} + h_{11,2}(1 + h_{21,1})$$

Strömförstärkningsfaktor:

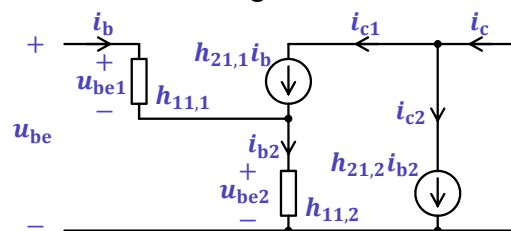
$$h_{21} = h_{21,1} + h_{21,2}(1 + h_{21,1})$$

Strömförstärkningsfaktor:

$$B = B_1 + B_2(1 + B_1)$$

Darlingtonkoppling – ESSS

Förenklad småsignalekvivalent



$$i_{c1} = h_{21,1} i_b$$

$$i_{b2} = i_b + i_{c1} = (1 + h_{21,1}) i_b$$

$$i_{c2} = h_{21,2} i_{b2}$$

$$i_c = i_{c1} + i_{c2} = h_{21,1} i_b + h_{21,2} i_{b2} = (h_{21,1} + h_{21,2}(1 + h_{21,1})) i_b$$

Strömförstärkningsfaktor: $h_{21} = h_{21,1} + h_{21,2}(1 + h_{21,1})$

$$u_{be} = u_{be1} + u_{be2} = h_{11,1} i_b + h_{11,2} i_{b2} = (h_{11,1} + h_{11,2}(1 + h_{21,1})) i_b$$

Inimpedans: $h_{11} = h_{11,1} + h_{11,2}(1 + h_{21,1})$

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