Elektronik I

BJT soru tekrarı – çalışma bölgeleri ve DC analiz örnekleri

Orijinal not: Bjt-soru-tekrar.pdf

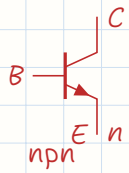
UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

NOTICE *This document was transcribed from handwritten lecture notes with the help of Claude (Anthropic). It is meant as a supplementary resource and may contain errors or omissions. Always check against the original notes and official course material.*

npn Junction

orj. s. 1

$$i_C = I_S e^{V_{BE}/V_T} \qquad (I_S \hookrightarrow \text{saturation current})$$

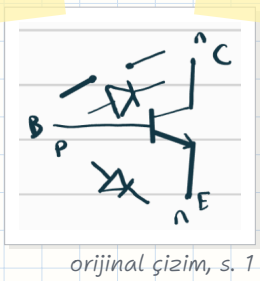


$$\boxed{i_B = \frac{i_C}{\beta}} \qquad \boxed{i_E = \frac{\beta+1}{\beta} i_C = \frac{1}{\alpha} i_C = (\beta+1) i_B}$$

$$i_C = \alpha i_E$$

	Active	Sat	Cutoff
EBJ	Forward bias	Forward bias	Reverse bias
CBJ	Reverse bias	Forward bias	Reverse bias

In npn



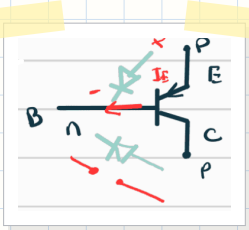
orijinal çizim, s. 1

Active: $V_{BE} \geq 0{,}7$, $V_{BC} \leq 0{,}4$ V

Cutoff: $V_{BE} < 0{,}7$, $V_{BC} \leq 0{,}4$ V

Saturation: $V_{BE} \geq 0{,}7$, $V_{BC} > 0{,}4$ V

In pnp



orijinal çizim, s. 1

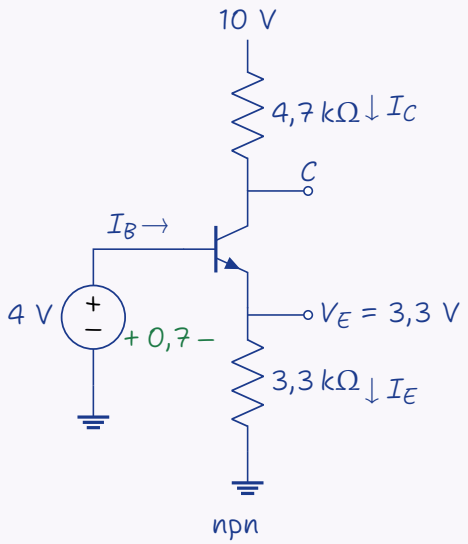
Active: $V_{EB} \geq 0{,}7$, $V_{CB} \leq 0{,}4$ V

Cutoff: $V_{EB} < 0{,}7$, $V_{CB} \leq 0{,}4$ V

Saturation: $V_{EB} > 0{,}7$ V, $V_{CB} > 0{,}4$ V

Örnek 1

Analyze the circuit below calculate all node voltages and branch currents. Assume that β is specific to be 100. $V_{BE} = 0{,}7$ V



Assume that transistor operate in active mode.

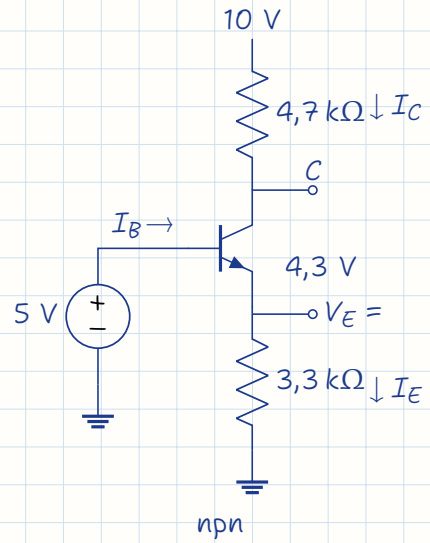
$$I_E = \frac{3{,}3\ V}{3{,}3k} = 1\ mA$$

$$I_E = \frac{1}{\alpha} I_C$$

$$I_C = \alpha I_E = \frac{\beta}{\beta+1} I_E = \frac{100}{101} 1 = 0{,}99\ mA$$

$I_E = I_B + I_C$ $\quad I_B = I_E - I_C = 1\ mA - 0{,}99\ mA = 10\ \mu A$

orj. s. 2



$V_{CE} \cong 0{,}2\ V$

Assume in Active mode

$$I_E = \frac{4{,}3}{3{,}3k} = 1{,}30\ mA$$

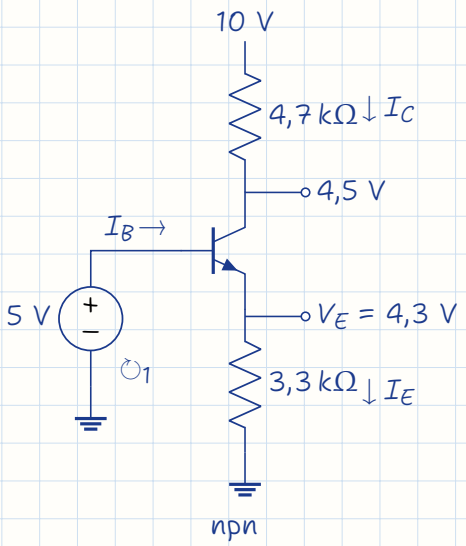
$$I_C = \frac{\beta}{\beta+1} \cdot 1{,}30 = 1{,}287\ mA$$

$$\Rightarrow V_C = 10 - (4{,}7 \times 1{,}287)$$

$$= 3{,}95$$

$V_{BC} = 1{,}05 \overset{?}{\leq} 0{,}4\ V$ ×

Not in active mode



In sat = ?

$V_{CE\,sat} = 0{,}2\ V$

$I_E = 1{,}30\ mA$

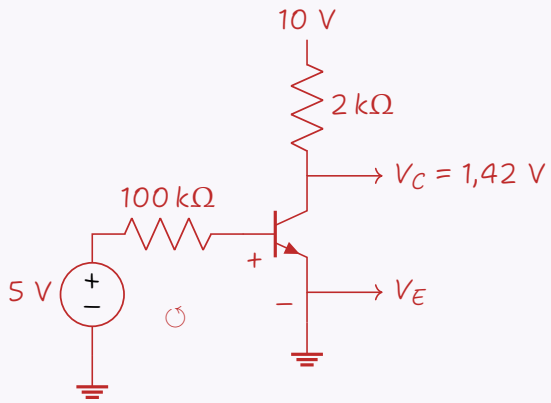
$$I_C = \frac{10 - 4{,}5}{4{,}7k} = 1{,}17\ mA$$

$I_B = 0{,}13\ mA$ //

$$\beta_{sat} = \frac{I_C}{I_B} = \frac{1{,}17}{0{,}13} = 9 \quad //$$

Örnek 2

Calculate all node voltages and branch currents for the circuit below. $V_{BE} = 0{,}7\ V$, $\beta = 99$



$-5 + 100k\,I_B + 0{,}7 = 0$

$I_B = \dfrac{4{,}3}{100k} = 43\ \mu A$

$I_C = \beta \cdot I_B = 4{,}29\ mA$ [1]

orj. s. 3

$V_C = 10 - (4{,}28\ mA \cdot 2\ k\Omega) = 1{,}42\ V$ //

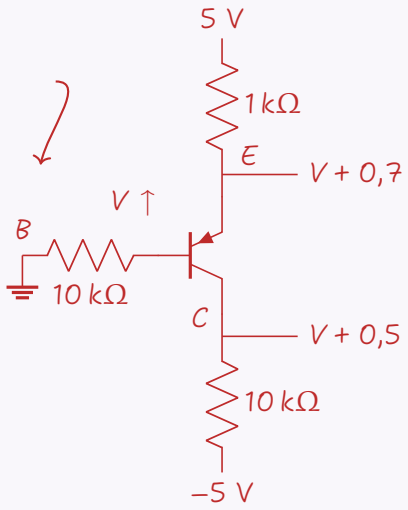
$V_{BC} \le 0{,}4$ ✓

$V_B = 5 - 100k \cdot 43\ \mu A$
$= 5 - 100 \cdot 43$?mA
$= 5 -$?4,3
$= 0{,}7\ V$

Örnek 3

Calculate all branch currents and node voltages

$\beta = 30$



$V_{EC\,sat} = 0{,}2\ V$

Assume in active mode

$-5 + 31\,I_B + 0{,}7 + 10k\,I_B = 0$
$41k\,I_B = 4{,}3\ V$
$I_B = 0{,}11\ mA,\ 110\ \mu A$
$I_C = 3{,}3\ mA$
$I_E \cong 3{,}4\ mA$
$V_C = 28\ V$ not possible

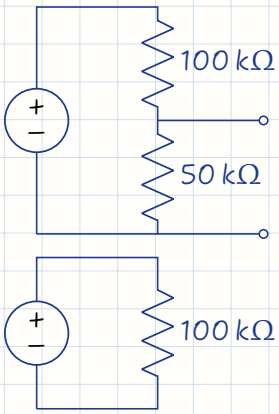
Assume sat

□

orj. s. 4

Şekil: Basılı materyal (kitaptan ekran görüntüsü): *Example 6.10* – Fig. 6.28(a) devresindeki tüm düğüm gerilimlerini ve kol akımlarını bulma sorusu ($\beta = 100$; +15 V, $R_{B1} = 100\ k\Omega$, $R_{B2} = 50\ k\Omega$, $R_C = 5\ k\Omega$, $R_E = 3\ k\Omega$); dijitalleştirilmedi. *(orijinal notta, s. 4)*

[1] Claude notu: $99 \cdot 43\ \mu A \approx 4{,}26\ mA$ olmalı (bu durumda $V_C \approx 1{,}49\ V$).



$V = I \cdot R$

$$V_{oc} = \frac{50 \cdot 15}{150} = \frac{50}{10} = 5\ V$$

$$\frac{15}{100k} = 0{,}15\ mA$$

$$R_{th} = \frac{5\ V}{0{,}15\ mA} \cong 33{,}3\ k\Omega$$

