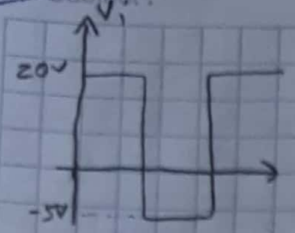
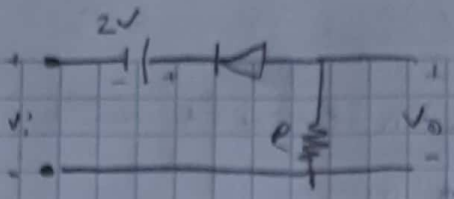
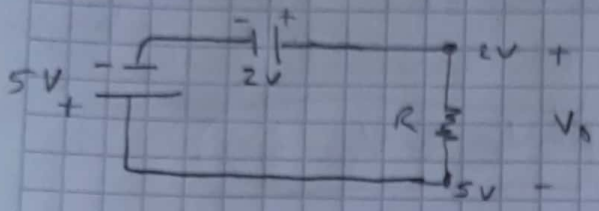
Transistor - Dioda E.Deverder 1

Subject: Date: ..../..../.....

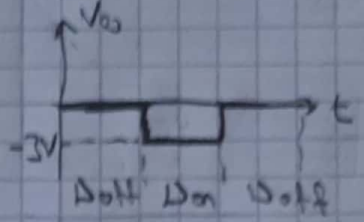
4)







$V_o = -3V$



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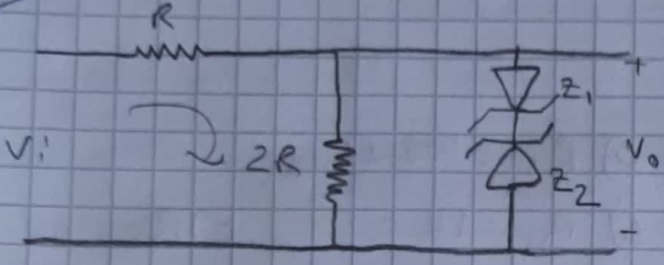
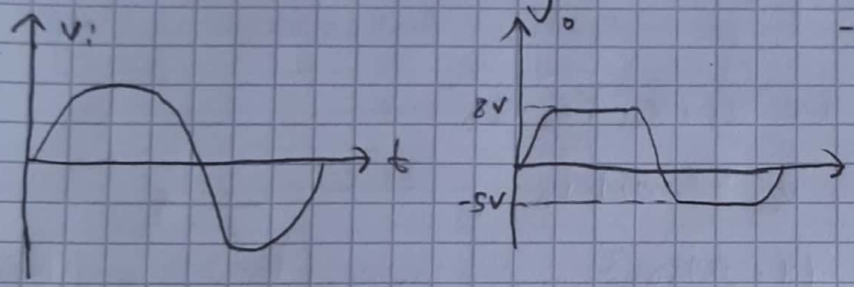


$-15V \leq V_i \leq 15V$

$V_{Z_1} = 5V \quad V_{\gamma_1} = 0V$

$V_{Z_2} = 8V \quad V_{\gamma_2} = 0V$

$V_o = ?$

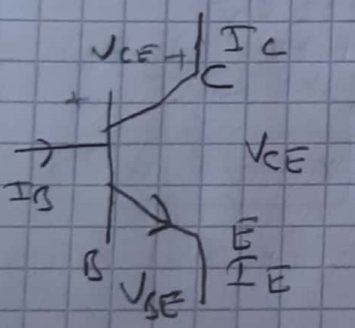


$-V_i + 3R \cdot I = 0$

$2/I = \frac{V_i + 3R}{2}$

$2I = V_o$

$V_o = V_i + 3R$



$I_E = I_B + I_C$

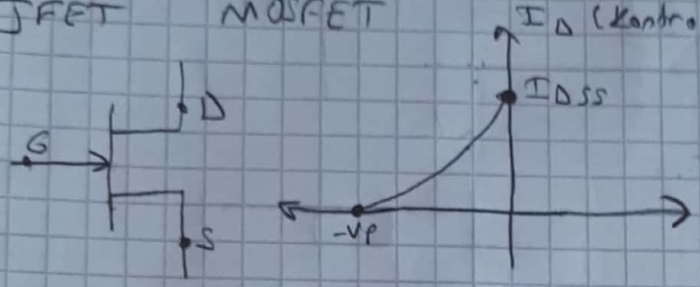
$I_C = \beta \cdot I_B$

$I_E = (\beta + 1) \cdot I_B$

$V_{BE} = 0,7V$

Subject FET < Field Effect Transistor > Date :...../...../.....

JFET MOSFET

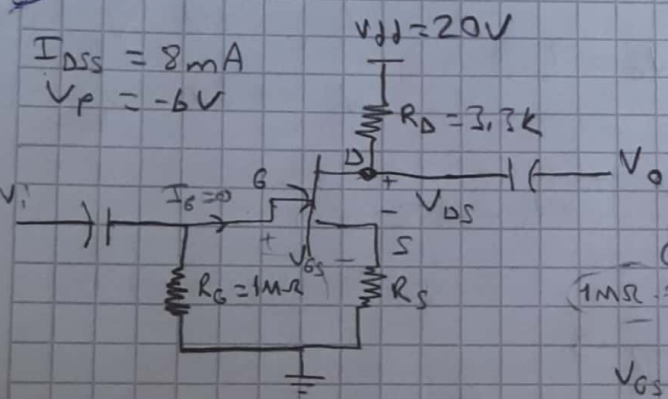


I_{DSS} = Kanal olşun durumda max akım

V_P = Kanalın tamamen kapanmaya neden olan gerilim

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$-V_P \leq V_{GS} \leq 0$$



a) R_S = 100Ω

b) R_S = 1KΩ

c) R_S = 10KΩ

$$1M\Omega \cdot I_G + V_{GS} + R_S \cdot I_D = 0$$

$$V_{GS} = -0,1 \cdot I_D$$

$$I_D = 8 \cdot \left(1 - \frac{0,1 I_D}{6}\right)^2$$

$$I_D = 8 - 0,2666 I_D + 0,00222 I_D^2$$

$$0,00222 I_D^2 - 1,2666 I_D + 8 = 0$$

$$\Delta = b^2 - 4ac$$

$$x_1 = \frac{-b \pm \sqrt{\Delta}}{2a}$$

I_{D1} = 6,40mA ⇒ V_{GS} = -0,64V

I_{D2} = 569mA ✗ Bu olamaz

Subject: Mosfet

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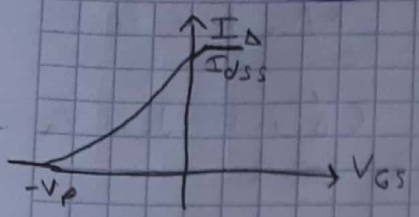
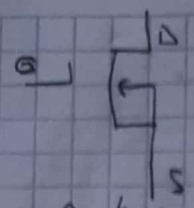
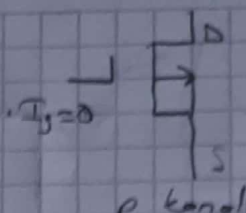


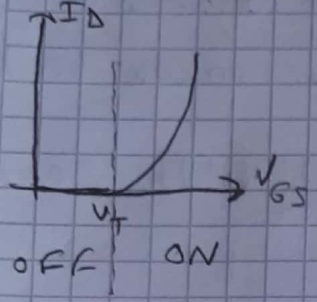


n kanall.



p kanall.

V_{GS} vars. sistem ON
" yoksa " OFF



$$I_D = k(V_{GS} - V_T)^2$$

$V_{GS} > V_T$ için geçerli

8)

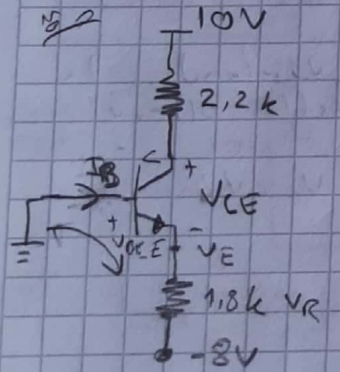
$$I_B = \frac{9 - 0,6}{470} = 0,017mA \qquad I_C = \beta \cdot I_B$$

$$I_C = 0,89mA$$

$$\frac{9 - V_{CE}}{4,7k} = 0,89$$

$$V_{CE} = 9 - 0,89 \cdot 4,7 = 4,8V$$

9)



$\alpha = 1$ $V_{BE} = 0,7V$ $V_{CE} = ?$

$$I_E \cdot 1,8k + 0,7V - 8V = 0$$

$$I_E = \frac{7,3}{1,8} = 4,05mA$$

$$I_E = (\beta + 1) \cdot I_B$$

$$4,05 = 2 \cdot I_B$$

$$2,025mA = I_B$$

$$V_C = 10 - 2,2 \cdot 2,025$$

$$V_C = 5,45V$$

V_E - (-8) = V_R

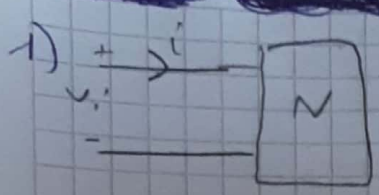
$V_E = V_R - 8$

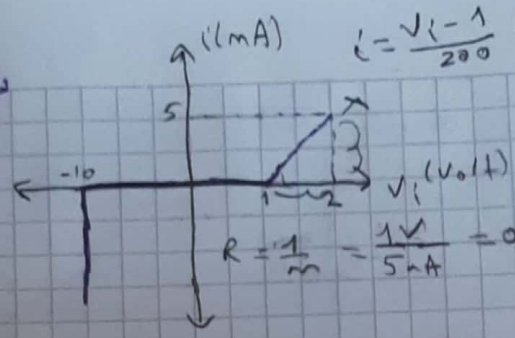
$= 1,8 \cdot 4,05 - 8$

$V_E = 0,71V$

$V_{CE} = V_C - V_E = 5,45 - 0,71 = 4,74$

$V_{CE} = 4,74V$

1) 



$i = \frac{v_i - 1}{200}$ A

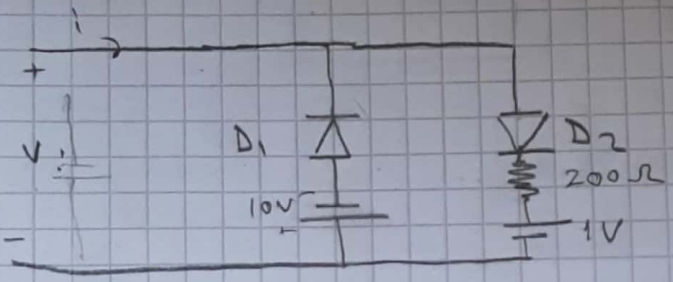
N devresini tasarlayınız.

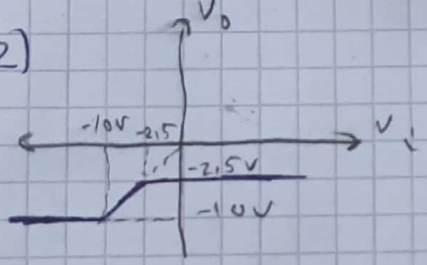
(Diyot: ideal $V_a = 0V$)

$R = \frac{1}{m} = \frac{1V}{5mA} = 0{,}2k = 200\Omega$

($i - v_i$)

* İki kırılma noktası olduğundan iki anahtarlama olacaktır.
* -10V'un altındaki durumlar için akım $-\infty$'a doğru gitmektedir. Bu akımı kaynak tarafında bir direnç sınırlar ancak burada yok.
* 1V üzerinde iletime geçen diyodun aldığı kolda 200Ω'luk direnç var.



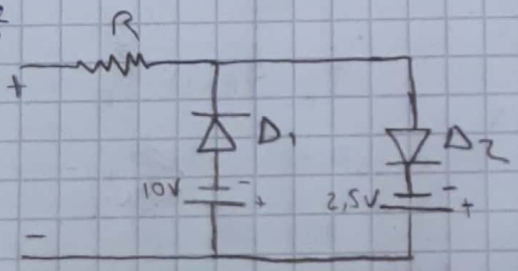
2) 

a) Bu durumu tasarlayın ve çiziniz.

b) Tasarladığınız devrenin girişine

$v_i = 5 + 20\sin\omega t$ V uygulandığında çıkışın değişimini bilgekli olarak çiziniz.

$-10V \leq v_i \leq -2{,}5V \quad v_o = v_i$

* 

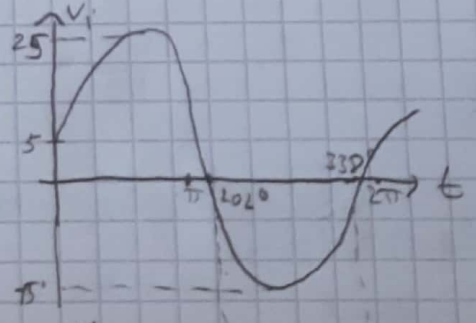
$5 + 20\sin\omega t = -2{,}5$

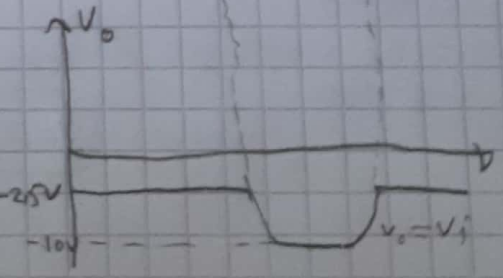
$\sin\omega t = -\frac{7{,}5}{20}$

$\omega t_1 = \text{ores}\sin\left(-\frac{7{,}5}{20}\right) = -22$

$180 - (-22) = 202°$

$\omega t_2 = 360 - 22 = 338$





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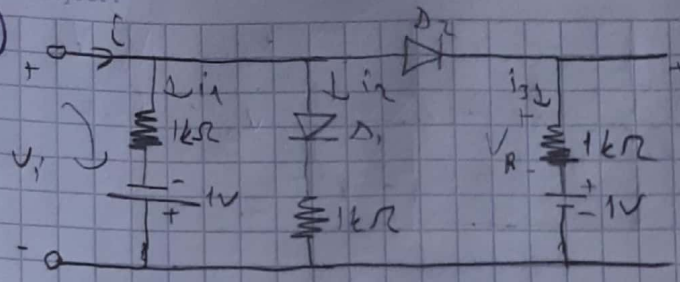
3)



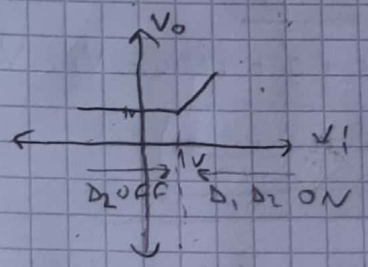
a) $i - V_i$

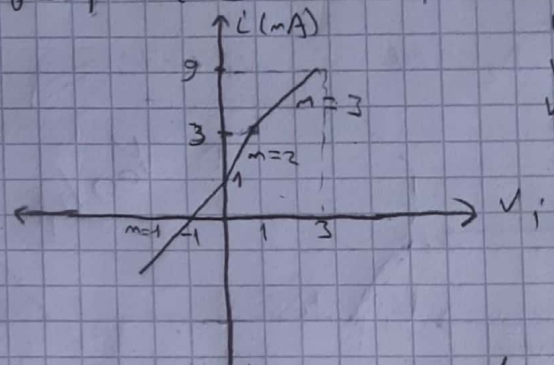
b) $V_o - V_i$

$V_i < 0$ D_1 OFF ve D_2 OFF $V_o = 1V$ $i = \frac{V_i + 1}{1}$ $m = 1$

$V_i > 1$ D_1 ON ve D_2 OFF $V_o = 1V$ $i = V_i + 1 + \frac{V_i}{1} = 2V_i + 1$ $m = 2$

$0 < V_i < 1$ D_1 ON ve D_2 ON $V_o = V_i$ $i = V_i + 1 + V_i + V_i - 1 = 3V_i$ $m = 3$





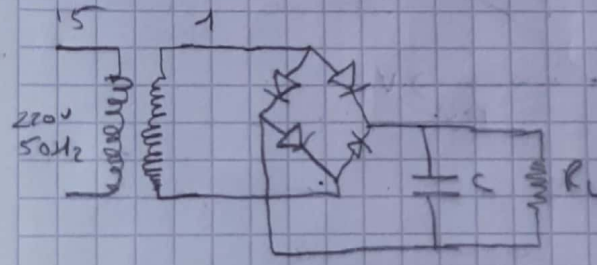
$i = 3V_i$

$V_o = i_3 \cdot 1 + 1$

$V_o = \frac{V_i + 1}{1} + 1$

$V_o = V_i$

4) $R_L = 500\Omega$ olan yük direnci üzerinden geçen akımın ortalama değeri 40mA olacak şekilde besleyecek olan (220V, 50Hz) şebekeden $n = 15:1$ olan bir trafo ile kondansatörlü köprü tipi tam dalga doğrultucu tasarımını gerçekleştiriniz. Tasarımdaki $C = ?$, Dalgalanma sınırı $= ?$, Çıkış gücü $= ?$



$$V_{dc} = V_{max}\left(1 - \frac{1}{2f_0 \cdot R_L \cdot C}\right)$$

a) $V_{max} = \frac{220\sqrt{2}}{15} \cong 20,74\ V$

$20 = 20,74\left(1 - \frac{1}{2 \cdot 100 \cdot 500 \cdot C}\right)$

$V_{dc} = R_L \cdot I_{dc} = 40 \cdot 500 = 20V$

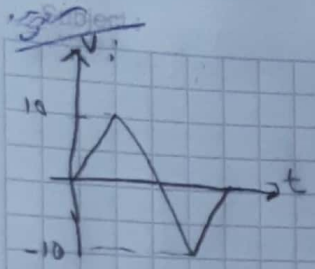
$C = 280\ \mu F$

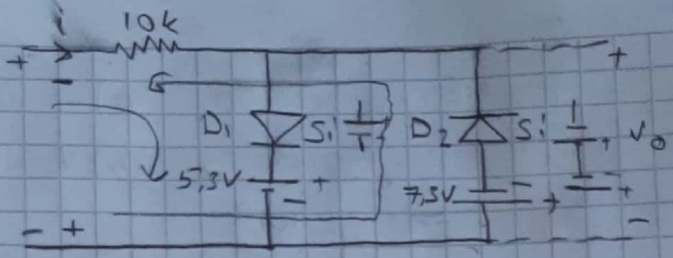
b) $\Delta V = V_m\left(\frac{1}{f R_L C}\right) = \frac{20,74}{100 \cdot 500 \cdot 280 \cdot 10^{-6}} = 1,48V$

c) $P = I_{rms}^2 \cdot R_L = (0,04)^2 \cdot 500 = 0,8\ W$

$S_i = 0,7V$

Date: ..../..../....





$V_i - V_o$ grafiği

$i - t$ " ?

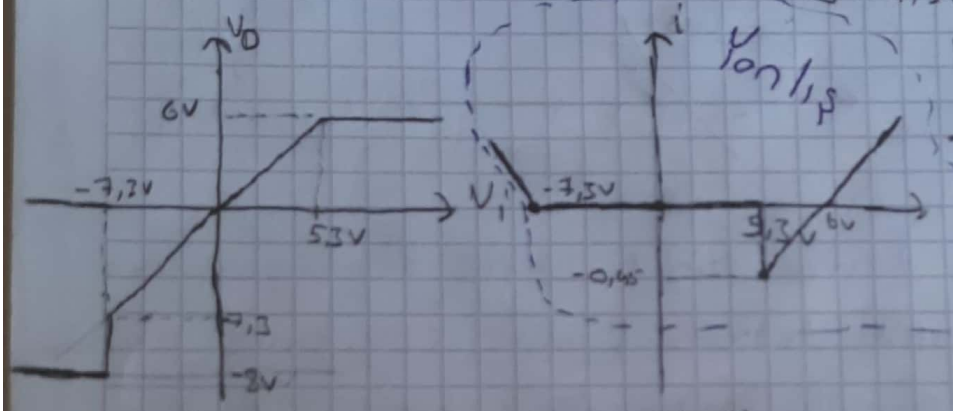
D_1 ve D_2 OFF $\quad -7,3 < V_i \leq 5,3 \quad V_i = V_o$ $\quad i = 0 \quad V_i = V_o$

D_1 ON D_2 OFF $\quad V_i > 5,3V \quad 10i + 0,7 + 5,3 = V_i \quad V_o = 6V$

$$i = \frac{V_i - 6}{10}$$

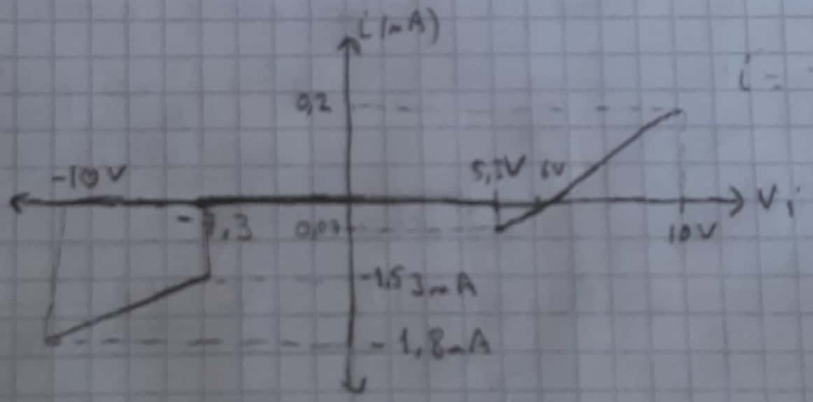
D_1 OFF D_2 ON $\quad V_i < -7,3 \quad 7,3V + 0,7 + 10i = V_i \quad V_o = -8V$

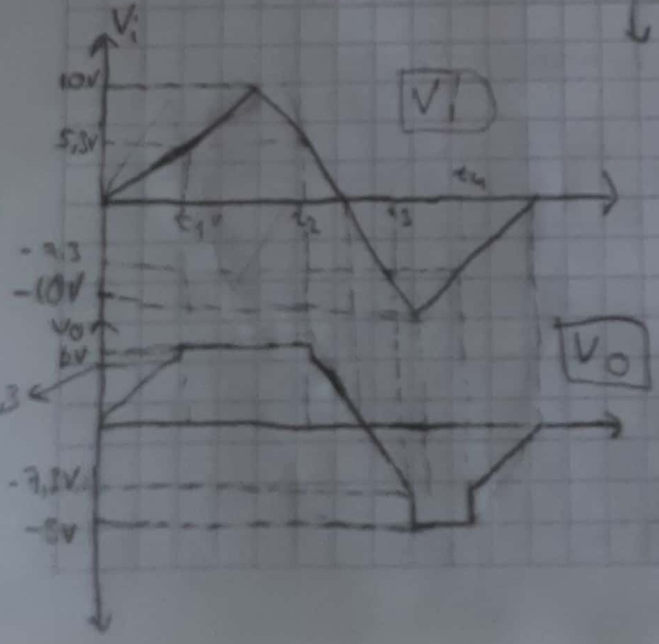
$$i = \frac{V_i - 8}{10}$$



$10i - 8 = V_i$

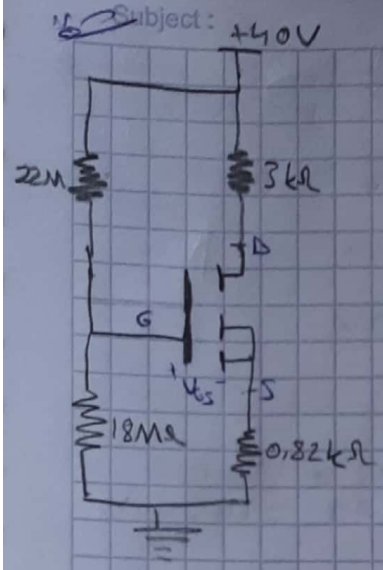
$$i = \frac{V_i + 8}{10}$$

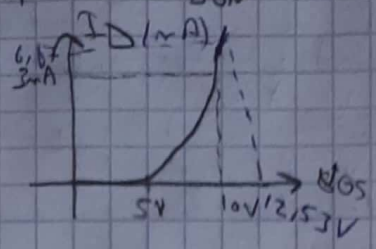




Subject : Date : /

$V_T = 5V \quad I_{DON} = 3mA \quad V_{GSon} = 10V \quad I_{DQ}, V_{DSQ}$ ve V_{GS} Q = ?



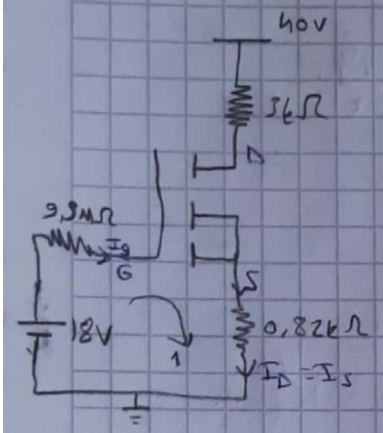


$$k = \frac{I_D}{(V_{GS}-V_T)^2} = \frac{3}{(10-5)^2} = \frac{3}{25} = 0,12$$

Devrenin thevinini alınsın

$$R_{TH} = 22M\Omega // 18M\Omega = \frac{22 \cdot 18}{40} = 9,9M\Omega$$

$$V_{TH} = \frac{40}{40M} \cdot 18M = 18V$$



① = $-18 + 9,9M \cdot 0 + V_{GS} + I_D \cdot 0,82 = 0$

$V_{GS} = 18 - I_D \cdot 0,82$

$I_D = 0,12 (V_{GS} - 5)^2$

$I_D = 0,12 (18 - I_D \cdot 0,82 - 5)^2$

$I_D = 0,12 (13 - I_D \cdot 0,82)^2$

$I_D = 0,12 (0,6724 I_D^2 - 21,32 I_D + 169)$

$I_D = 20,28 - 2,5584 I_D + 0,0806 I_D^2$

$0,0806 I_D^2 - 3,55 I_D + 20,28 = 0$

$I_{D1} = 6,67mA$ $\quad V_{GS} = 18 - 6,67 \cdot 0,82 = 12,53$

$I_{D2} = 37,324mA$ $\quad V_{GS} = 12,53V$

$V_{DS} = V_D - V_S$ $\quad V_{DS} = 40 - 3,82 \cdot I_D$

$V_{DS} = 14,5V$

$V_D = 40 - 3 \cdot 6,67 = 20$

$V_S = 0,82 \cdot 6,67 = 5,46$

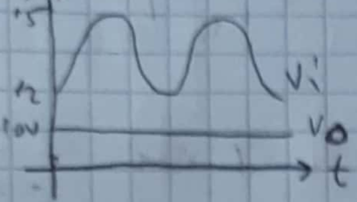
$14,54V$

$V_{DS} = 14,54V$

Raitoal 4
Lacdek Q5F2 Mantar...

$12V \leq V_i \leq 15V$ $V_o = 10V$ $I_{z\,min} = 5mA$ $R_L = 100\Omega$

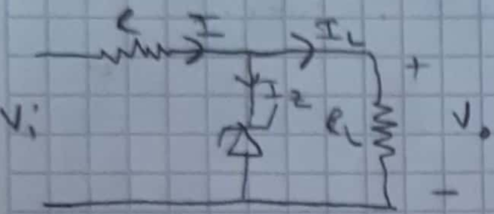
yukarıdaki regülatör devresindeki verilenler bunlardır. Devre elemanlarını belirleyiniz. $R \to ?$ $Z \to V_z ?$ $D_z = ?$ $P_z = ?$



min değerler için

$V_i = 12V$ için $V_o = V_z = 10V$

$I_L = \frac{10V}{100\Omega} = 100mA$



$I = I_z + I_L = 5 + 100 = 105mA$

V_R min

$R = \frac{12-10}{105} = \frac{2}{105} = 19\Omega$

P_z süre max değerlere göre hesaplanır

$V_{i\,max} = 15V$ $I = \frac{V_R}{R} = \frac{5}{19} \cong 263\,mA$

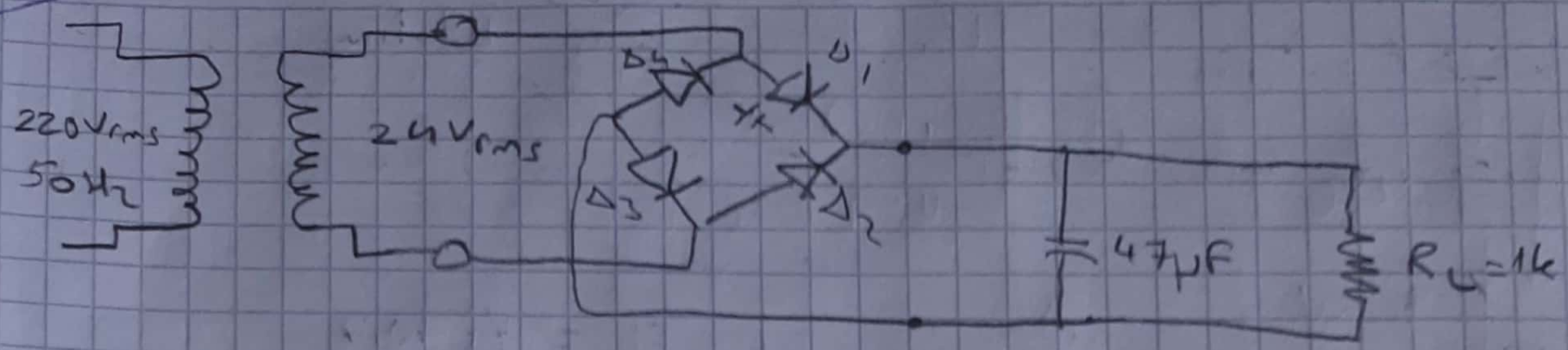
$I_z = I - I_L = 263 - 100 = 163mA$

$V_z = 10V$ $5mA - 163mA$ aralığında bir zenere ihtiyaç var.

$P_z = V_z \cdot I_{z\,max} = 10 \cdot 163\,mA = 1,63$ watt

$P_z = 1,63$ watt

Diyotlar Si 0,7V



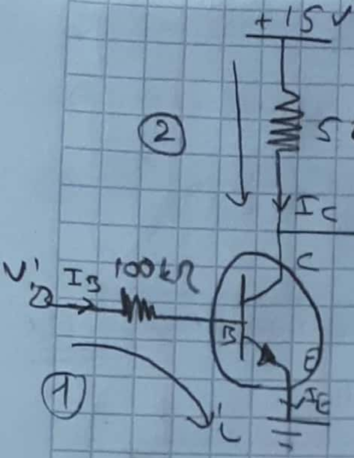
$V_m = 24 \cdot \sqrt{2} \cong 34V$ → diyot çıkışı $34 - 1,4$ (2 diyot) $= \underline{\underline{32.6V}}$

Filtre çıkışından elde edilecek çıkış gerilimi:

$$V_{dc} = V_m \left(1 - \frac{1}{2 \cdot f \cdot R_L \cdot C}\right)$$

$$V_{dc} = 32.6V \left(1 - \frac{1}{2 \cdot 100 \cdot 1000 \cdot 47 \cdot 10^{-6}}\right)$$

$$= 29,13V$$



$\beta = 100$

$V_{BE} = 0,7V$

V_0 denklemini bulalım.

① çevreden

$-V_i + 100i + V_{BE} = 0$

$i = I_B = \frac{V_i - 0,7}{100}$

② çevreden $\quad V_c = V_0$

$-15 + 5 \cdot I_c + V_c = 0$

$V_c = V_0 = -5I_c + 15$

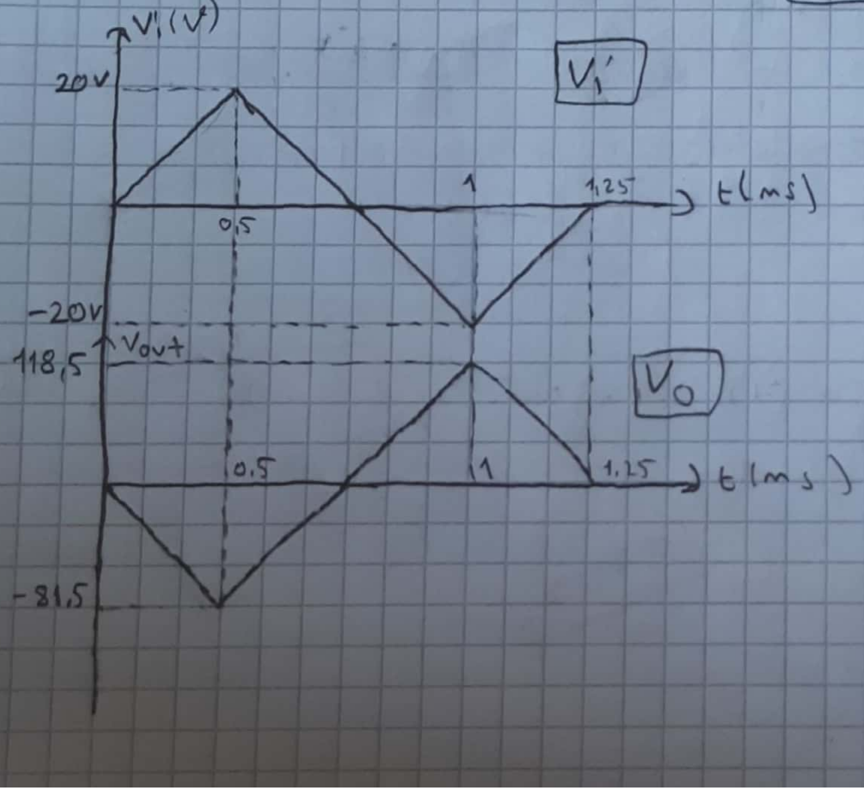
$I_c = \beta \cdot I_B$

$I_c = 100 \cdot \frac{V_i - 0,7}{100}$

$I_c = V_i - 0,7$ (yerine koyarsak)

$V_{out} = -5(V_i - 0,7) - 15$

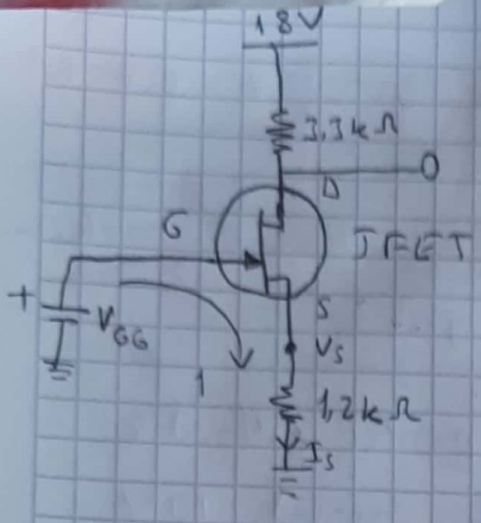
$V_{out} = 18,5 - 5V_i$

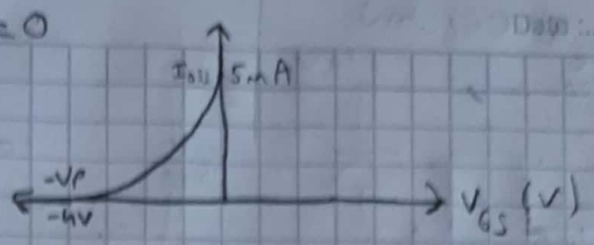


$V_{out} = 18,5 - 20 \cdot 5 = -81,5V$

$V_{out} = 18,5 + 20,5 = 118,5V$

Saatin duygu yoktu
heykel





$$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_P}\right)^2$$

$$I_D = 5\left(1+\frac{V_{GS}}{4}\right)^2 = 5\left[1-\frac{1,2\,I_D}{4}\right]^2$$

(Bu işlemlerden)

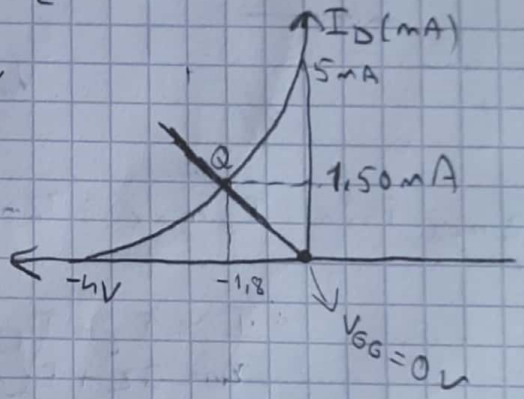
① $-V_{GG} + V_{GS} + I_S \cdot 1,2k = 0$

$$V_{GS} = -I_S \cdot 1,2k$$

$I_S = I_D$ $\quad V_{GS} = -I_D \cdot 1,2k$

$$I_{D1} = 1,50\,mA \quad ✓$$

$I_{D2} = 7,38\,mA$ X



$V_{GS} = -1,5 \cdot 1,2 = -1,8\,V$

$$V_{GS} = -1,8\,V$$

V_S-

$V_S = 1,2 \cdot 1,50 = 1,8\,V$

$V_{GS} = V_G - V_S = V_G - 1,8 = -1,8$

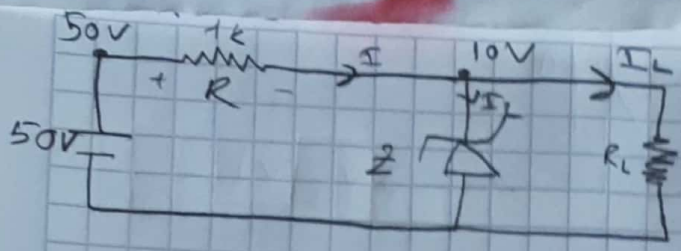
$$V_G = 0\,V$$

$-18 + 3,3 \cdot \underset{\sim 1,5}{I_D} + V_D = 0 \Rightarrow$ $V_D = 13,05$

a) $-4 \le Q \le 0$ arasında olmalıdır yukarıda belirtildiği gibi

b) $V_G = 0V$, $V_S = 1,8\,V$, $V_D = 13,05\,V$

c) Kesim noktası $Q < -4V$



$I_{Zmin} = 0mA$
$I_{Zmax} = 32mA$

a) yük V_Z gerilimini sabit tut. R_L ve I_L = ?

b) Zenerin çekeceği maksimum değer gücü?

* yük zenere paralel olduğu için ve paralel kollardaki gerilim değerleri aynı olduğu için yük üzerinde 10V gerilim istenirse zenerin gerilimi $V_Z = 10V$ olmalıdır.

I_{Zmin} için $I_{Zmin} = 0$ $I = I_L$ olur.

$$I = \frac{50-10}{1} = 40mA$$

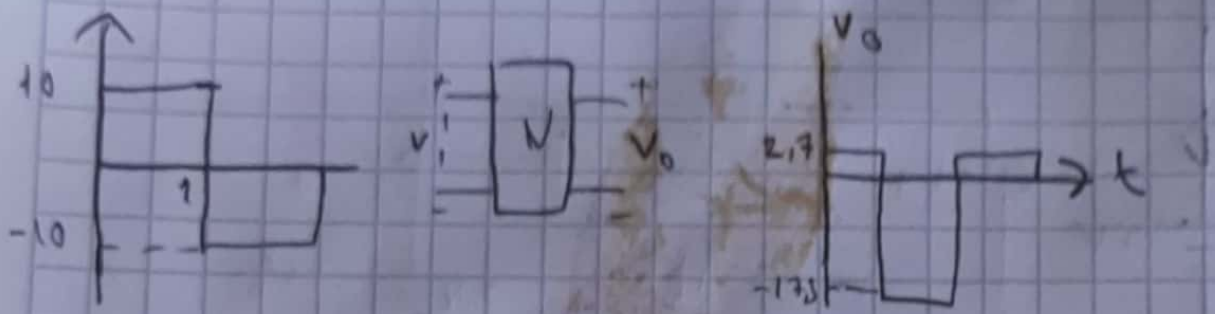
$$R_{Lmin} = \frac{V_Z}{I_L} = \frac{10}{40mA} = 250\Omega$$

I_{Zmax} için $I_{Zmax} = 32mA$

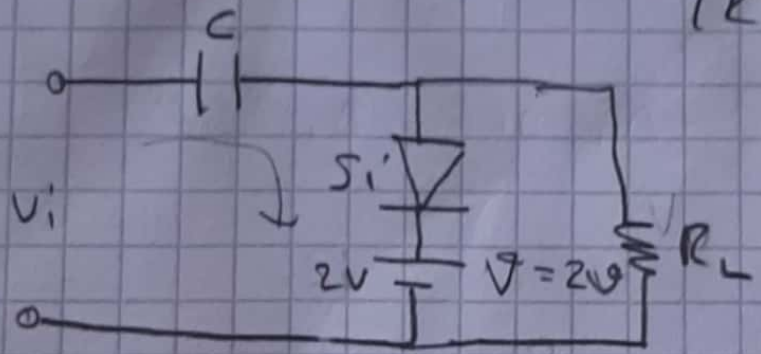
$$I = I_Z + I_L$$
$$40 = 32 + I_L$$
$$I_L = 8mA$$

$$R_{Lmax} = \frac{V_Z}{I_L} = \frac{10}{8mA} = 1,25k\Omega$$

b) Güç $P = I \cdot V = 32 \cdot 10^{-3} \cdot 10 = 320mW$

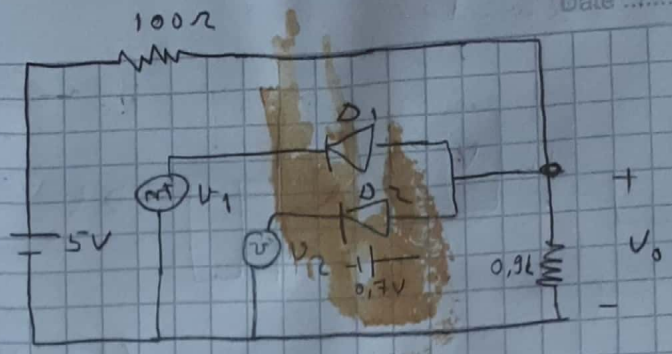


(Kenetleyici devresi

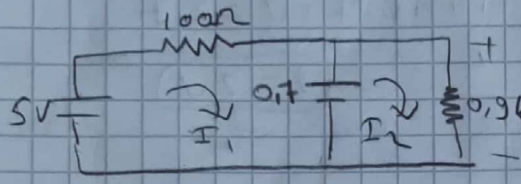


$0 + 0,7 + V = 2,7$

$V = 2V$

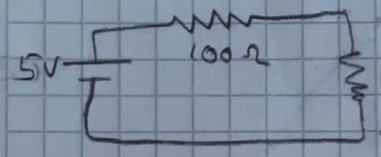


(0-1)ms için $V_1 = 5V$ $V_2 = 0V$ D_1 OFF D_2 ON



$V_o = 0,7V$

(1-2)ms için D_1 OFF D_2 OFF



$V_o = \frac{0,9k}{1k} \cdot 5V = 4,5V$

(2-3) ms için D_1 ON D_2 OFF

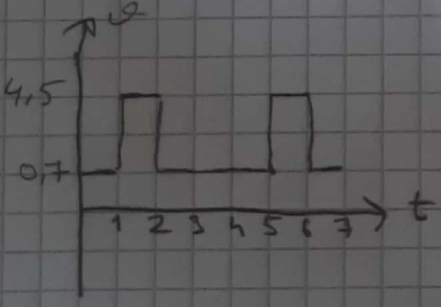
→ Aynı durum $V_o = 0,7V$

(3-4)ms için D_1, D_2 ON

$V_o = 0,7V$

(4-5)ms için D_1 OFF D_2 ON (Boşa diyotsuz) aynı

$V_o = 0,7V$



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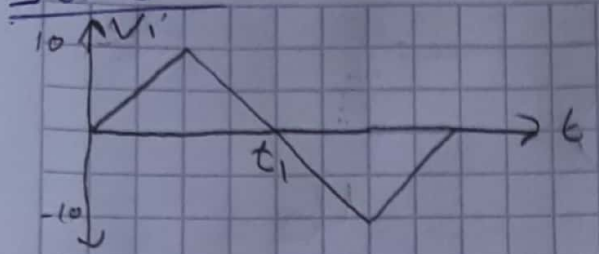
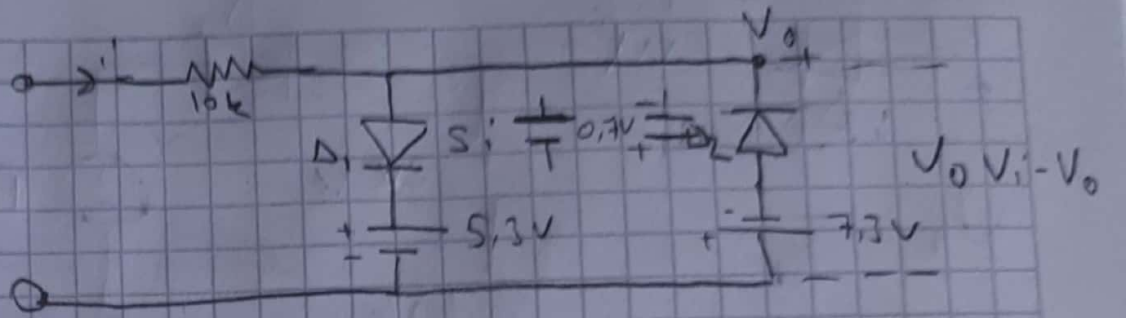


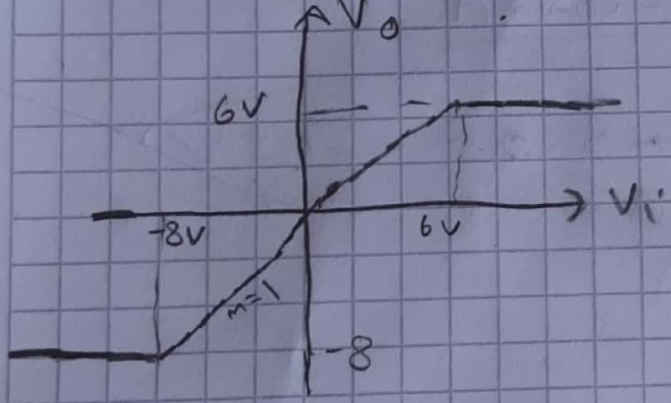


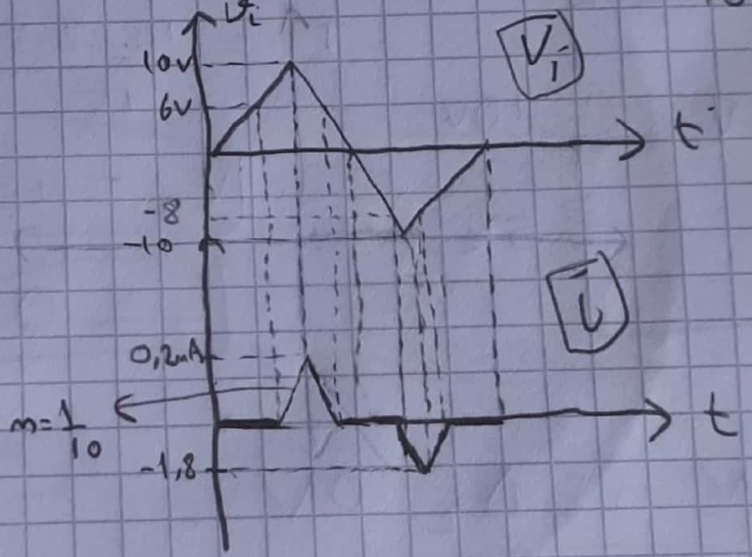
V_o V_i $-V_o$

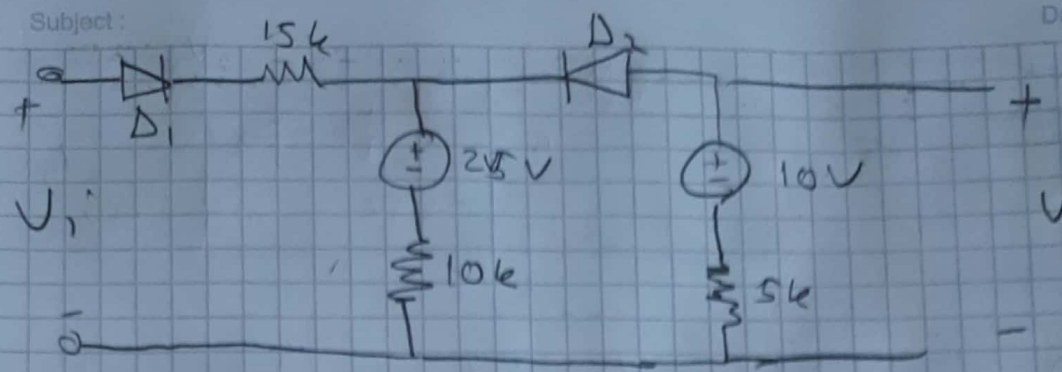
D_1 ON D_2 OFF $V_i > 6V$ $V_o = 6V$ $i = \frac{V_i - 6}{10}$ $m = \frac{1}{10}$

D_1 OFF D_2 OFF $-8 < V_i < 6$ $V_o = V_i$ $i = 0$ $m = 0$

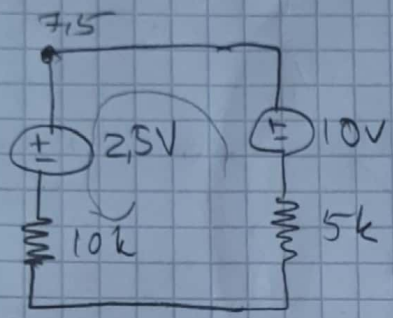
D_1 OFF D_2 ON $V_i < -8$ $V_o = -8V$ $i = \frac{V_i - 8}{10}$ $m = \frac{1}{10}$







D_1 OFF D_2 ON



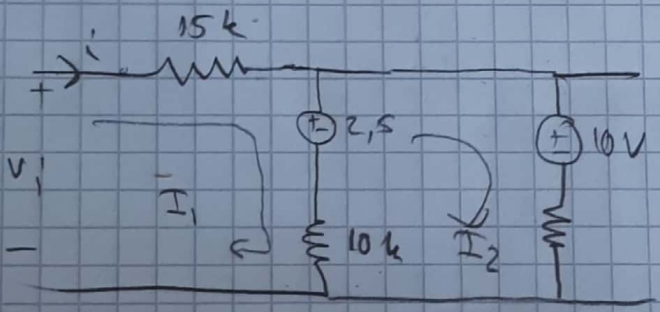
$$I = \frac{10 + 2,5}{15} = 0,5\,mA$$

$$V_0 = 10 - 5 \cdot 0,5 = 7,5\,V$$

$$L = 0$$

D_1 ON D_2 ON

$V_i > 7,5$



I_1 $\quad 15I_1 + 2,5 + 10(I_1 - I_2) = V_i$

$$25I_1 = V_i - 2,5 + 10I_2$$

$$I_1 = \frac{V_i - 2,5 + 10I_2}{25}$$

I_2 $\quad 10 + 5I_2 + 10(I_2 - I_1) = 2,5$

$$+15I_2 - 10I_1 = -7,5$$

$$I_2 = \frac{10I_1 - 7,5}{15}$$

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$$I_2 = \frac{\frac{2}{10}(V_i + 2,5 + 10I_2) - 7,5}{15} = \frac{2V_i + 5 + 20I_2 - 37,5}{75}$$

$2 \quad 12,5$

$$I_2 \cdot 75 = 2V_i - 42,5 + 20I_2$$

$$\boxed{I_2 = \frac{2V_i - 42,5}{55}}$$

$$V_o = 10 + I_2 \cdot 5$$

$$V_o = 10 + \frac{(2V_i - 42,5)}{55} \cdot 5$$

$$\boxed{V_o = \frac{10V_i + 337,5}{55}} \qquad m = \frac{10}{55}$$

$$= \frac{1000 + 337,5}{55} = 12,04$$

D_1 ON D_2 OFF $V_i > 21,25$

$$2,5 + 10I = 10$$

$$\boxed{I = 0,75 mA}$$

$$I = \frac{V_i - 2,5}{25} = 0,75$$

$$V_i - 2,5 = 18,75$$

$$\boxed{V_i = 21,25}$$

$V_i = 21,25V$ üzerine çıkarsa

$$\boxed{V_o = 10V}$$