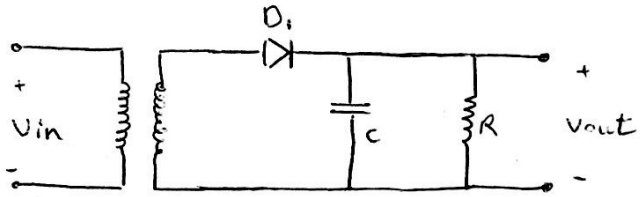
یا لطیف

رضا دیندار
۹۸۱۴۳۰۳
تمرین سری ۴ الف ۱

#1



Design Power with $\begin{cases} V_{out} = 15^V \\ V_{ripple} = 2^V \\ V_{in} = 310^V \\ f = 60\ Hz \\ R = 150\ \Omega \end{cases}$

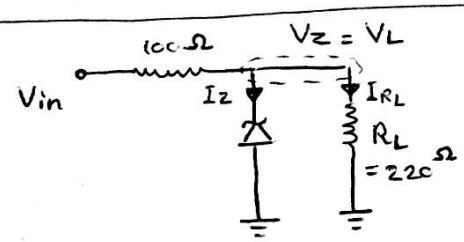
$V_{out} = V_p - V_{D,ON} \Rightarrow V_p = V_{out} + V_{D,ON} = 15 + 0.7 = 15.7^V$

$\Rightarrow V_{ripple} = \frac{V_p - V_{D,ON}}{fRC} \Rightarrow 2 = \frac{15.7 - 0.7}{60 \times 150 \times C} \Rightarrow C = \frac{15}{18 \times 10^3} = 830 \times 10^{-6} = 830\,\mu F$

$PIV = 2V_p - V_{D,ON} = 2 \times 15.7 - 0.7 = 30.7$ $\Rightarrow \frac{n_2}{n_1} = \frac{V_2}{V_1} \Rightarrow \frac{15.7}{310} = 0.05$

$\Rightarrow \begin{cases} n_2 = 1 \\ n_1 = 20 \end{cases}$

#2



$\begin{cases} V_Z = 6.1^V \\ I_{Z,min} = 1^{mA} \\ P_{Z,max} = 500^{mW} \end{cases}$

$P_{Z,max} = I_{Z,max} \times V_Z$

$\Rightarrow I_{Z,max} = \frac{500}{6.1} \simeq 82^{mA}$

If $I_{RL,min} = 0 \Rightarrow \frac{V_{in,max} - V_Z}{100} - I_{RL,min} < I_{Z,max}$

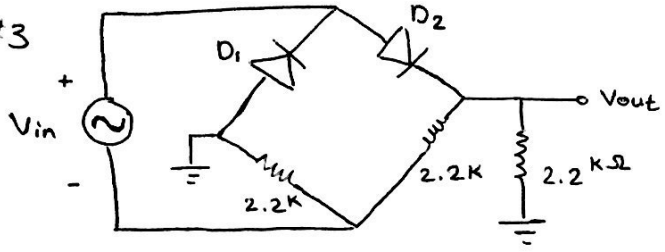
$\Rightarrow \frac{V_{in,max} - 6.1}{100} - 0 < 82 \Rightarrow V_{in,max} < 14.3^V$

$\begin{cases} R_L = 220^\Omega \text{ (const)} \\ V_Z = 6.1^V \text{ (const)} \end{cases} \Rightarrow I_{RL,max} = \frac{V_Z}{R_L} = \frac{6.1}{220} = 0.02^A$

$\Rightarrow \frac{V_{in,min} - V_Z}{100} - I_{RL,max} > |I_{Z,min}| \Rightarrow \frac{V_{in,min} - 6.1}{100} - 0.02 > 1\ mA$

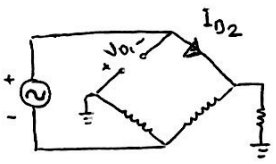
$\Rightarrow V_{in,min} > 8.2^V$ $\Rightarrow$ If $8.2^V < V_{in} < 14.3^V \Rightarrow R_L$ remains 6.1^V

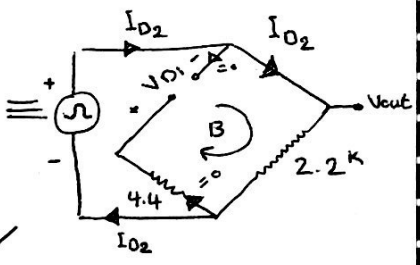
#3



$\begin{cases} V_{in} = 40^{V} \\ \text{plot out-put Voltage ?} \\ PIV = ? \end{cases}$

$V_{in} > 0 \rightarrow \begin{cases} D_2 : ON \rightarrow I_{D_2} > 0 \rightarrow \text{—} \\ D_1 : off \rightarrow V_{D_1} < 0 \rightarrow \text{— o —} \end{cases}$



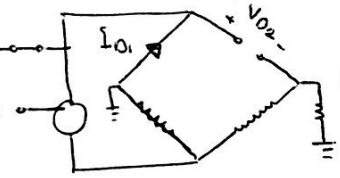


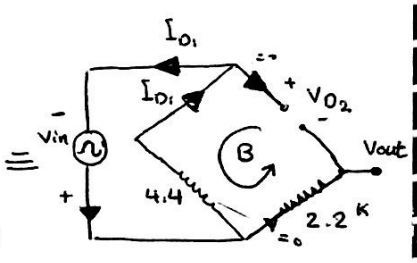
$\Rightarrow$ KVL : $-V_{in} + 2.2^{K} \times I_{D_2} = 0 \xrightarrow{V_{in}=40^{V}} I_{D_2} = \frac{40^{V}}{2.2^{K}} = 18^{mA} > 0$ ✓

KVL in B : $+V_{D_1} + 2.2 \times I_{D_2} + 4.4 \times 0 = 0 \Rightarrow V_{D_1} = -18^{mA}(2.2^{K\Omega}) = -39.6 < 0$ ✓

$\Rightarrow \boxed{V_{out} = V_{in} = 40^{V}\ (AC)}$

$V_{in} < 0 \rightarrow \begin{cases} D_1 : ON \rightarrow I_{D_1} > 0 \rightarrow \text{—} \\ D_2 : off \rightarrow V_{D_2} < 0 \rightarrow \text{— o —} \end{cases}$

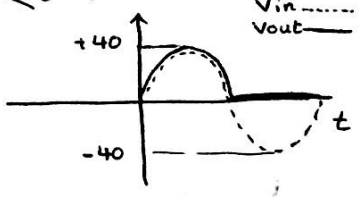




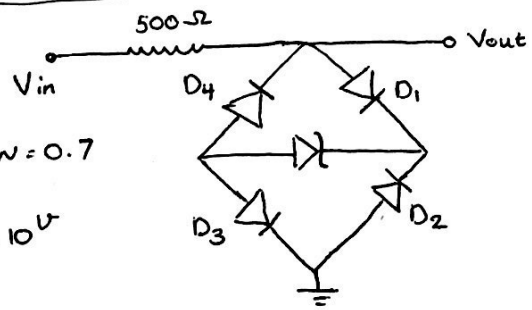
KVL : $-V_{in} + 4.4 \times I_{D_1} = 0 \Rightarrow I_{D_1} = 9^{mA} > 0$ ✓

KVL @ B : $4.4(-I_{D_1}) + 2.2 \times 0 - V_{D_2} = 0 \Rightarrow V_{D_2} = -40^{V} < 0$ ✓

$\Rightarrow \boxed{V_{out} = 0} \Rightarrow \begin{cases} \text{if } V_{in} > 0 \rightarrow V_{out} = V_{in} \\ \text{if } V_{in} < 0 \rightarrow V_{out} = 0 \end{cases}$

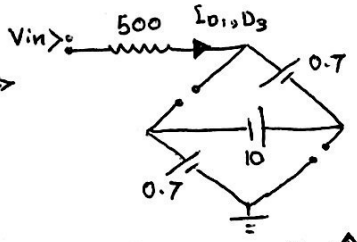


#4

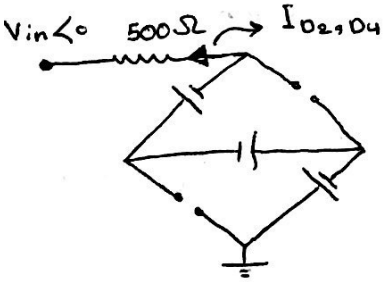


$\begin{cases} V_{D,ON} = 0.7 \\ V_Z = 10^{V} \end{cases}$

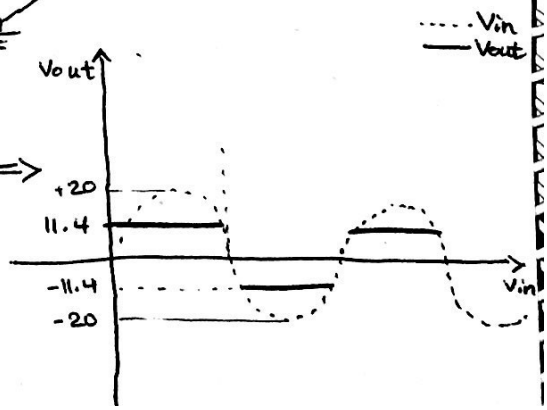
$V_{in} > 0 \rightarrow \begin{cases} D_1, D_3 : ON \rightarrow \text{—|—} \\ D_2, D_4 : off \rightarrow \text{— o —} \end{cases}$



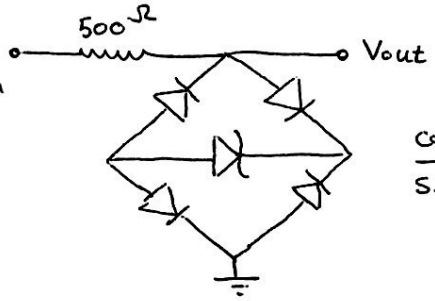
$\Rightarrow V_{out} = 10 + 2 \times 0.7 = 11.4^{V}$



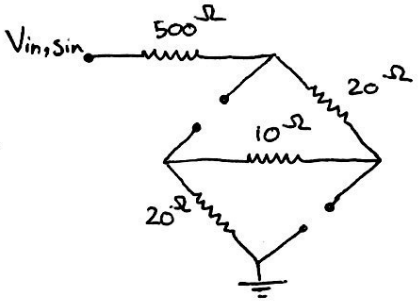
$\Rightarrow V_{out} = -10 - 2 \times 0.7 = -11.4^{V}$



3 مثال b حسب



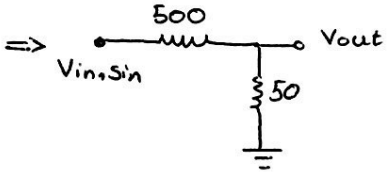
convert to s.s model



$V_{in,Sin} = \pm 10\,mV$

$r_D = 20\,\Omega$

$r_z = 10\,\Omega$



$$\Rightarrow V_{out} = \frac{50}{550} \times 10^{mV} = \frac{1}{11} \times 10^{-2}\,V \simeq 10^{-3}\,V$$

#4

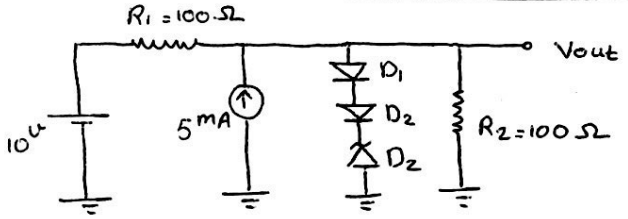
$V_{D,ON} = 0.7$

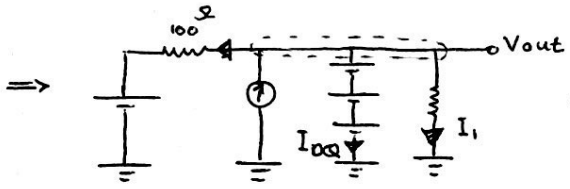
$V_Z = 3.6\,V$

$r_{d,Z} = 1\,\Omega$

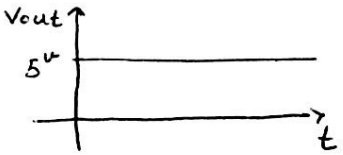
$V_T = 25\,mV$

$V_{in} = 0.01 \sin \omega t\ V$





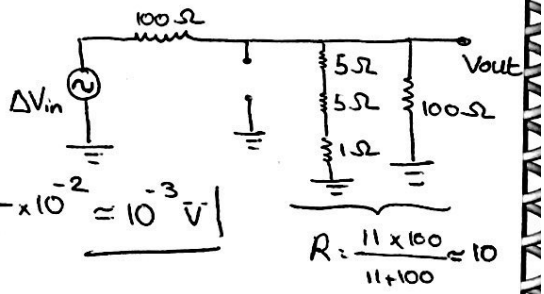
$V_{out} = 2 \times 0.7 + 3.6 = 5\,V$



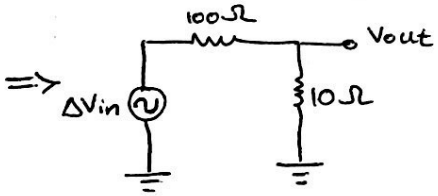
KCL @ Vout : $-5^{mA} + \frac{5-10}{100} + I_{DQ} + \frac{5-0}{100} = 0 \Rightarrow I_{DQ} = 5\,mA$ | Bias Point current

$$r_{d,D_1} = r_{d,D_2} = \frac{V_T}{I_{DQ}} = \frac{25\,mV}{5\,mA} = 5\,\Omega$$

convert to s.s model



$R = \frac{11 \times 100}{11+100} \simeq 10$



$$\Rightarrow V_{out} = \frac{10}{110} \times 10^{mV} = \frac{1}{11} \times 10^{-2} \simeq 10^{-3}\,V$$

#7

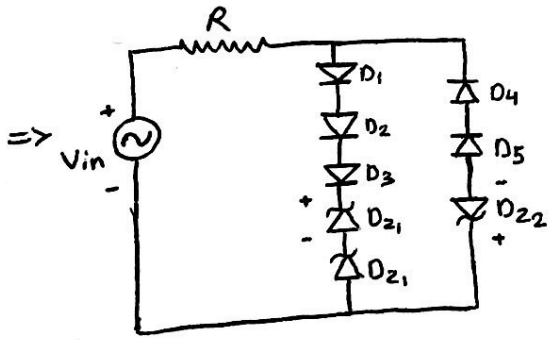
$D_{Z1} = 6.3\,V$

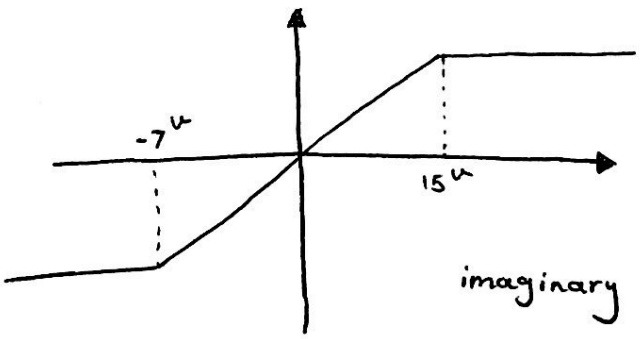
$D_{Z2} = 5.4\,V$

$D = 0.8\,V$

Top cut : $15\,V \longrightarrow 2D_{Z_1} + 3D$

bottom cut : $7\,V \longrightarrow D_{Z_2} + 2D$





imaginary scale ☺