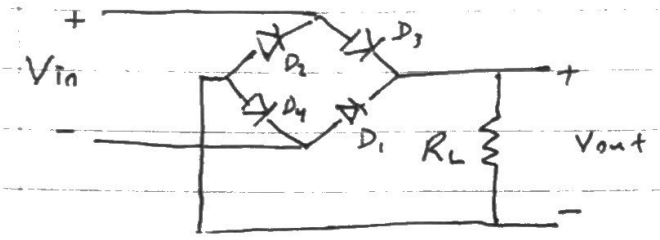
Jonathan Lam
Prof. Shlayan
ECE 241
Electronics I
4/20/20.

Quiz 2.



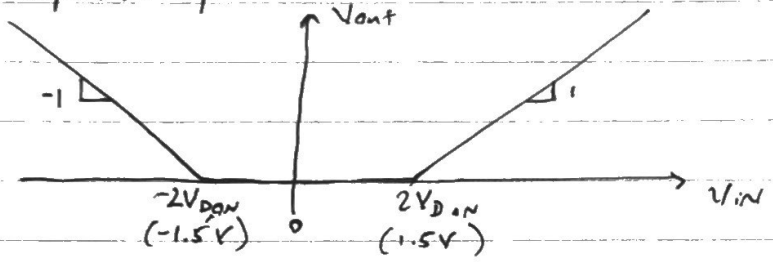
$V_{D\text{ON}} = 750\text{mV}$

$V_{IN} = V_p \cos 2\pi f t$

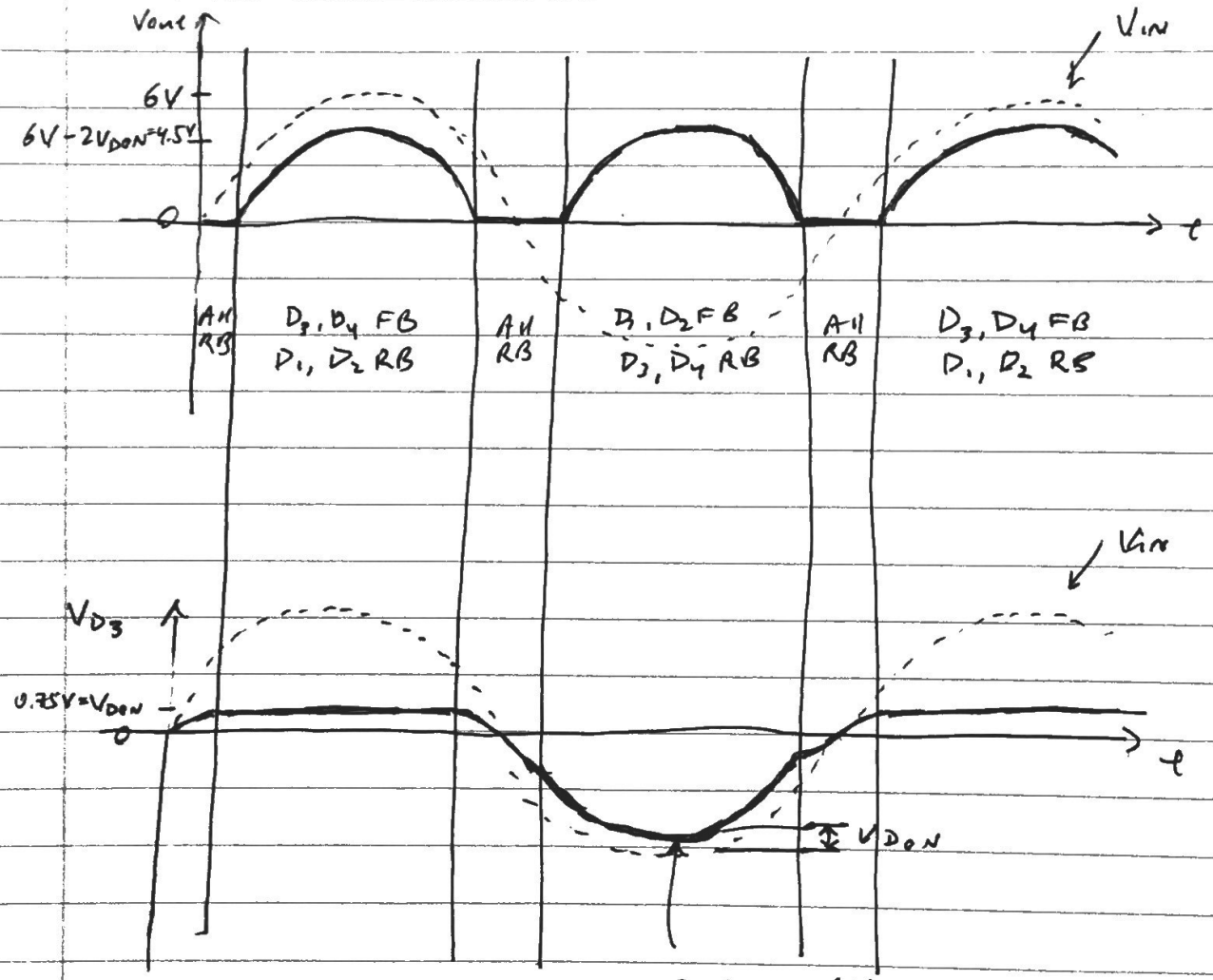
$V_p = 6V$

$f = 60\text{Hz}$.

a) Input/output characteristics



Vout vs. time



$PIV = -6V + V_{D\text{ON}} = -5.25V.$

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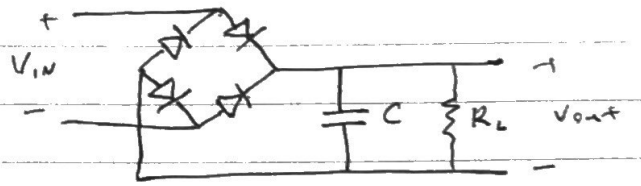
b) $V_{r_{max}} = 0.4V$, $R_L = 50\Omega$, add smoothing cap. in parallel to load.

$V_r = \frac{I_L}{Cf}$

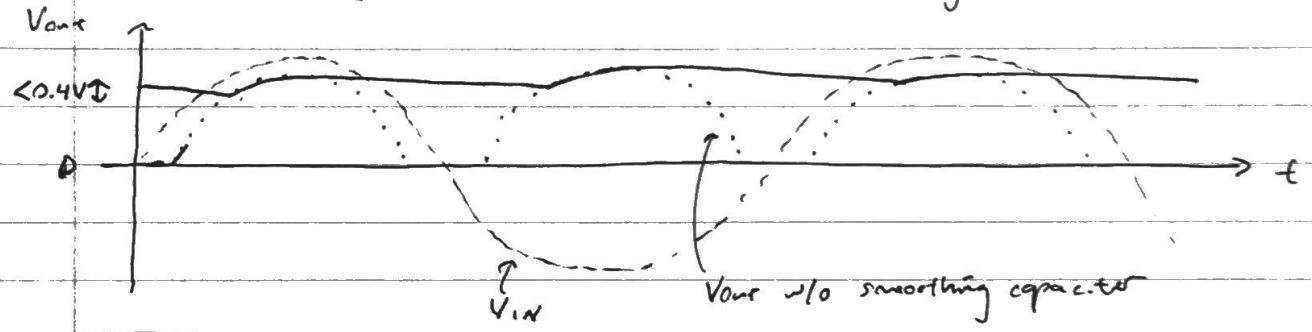


$f = 2 \times 60Hz = 120Hz$

↑ full wave rectifier doubles ripple freq.

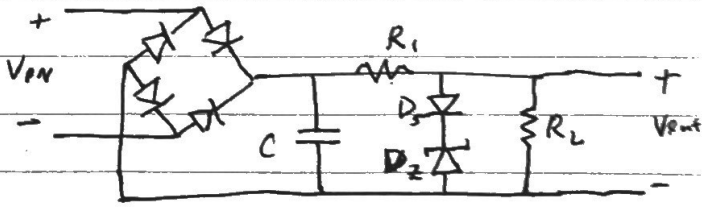
$I_L = \frac{V_L}{R_L} = \frac{V_p - 2V_{D,ON}}{R_L} = \frac{4.5V}{50\Omega} = 90mA$

$C = \frac{I_L}{V_r f} = \frac{90mA}{(0.4V)(120Hz)} = 1.875mF$ (or greater)



c) $R_1 = 100\Omega$, D_5: $V_{D,ON} = 800mV$, D_z: $V_{D_z} = 3.2V$, $r_{d_z} = 5\Omega$.

Calculate line & load regulation.



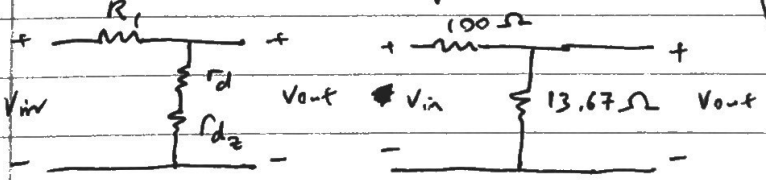
Line regulation:

assume small signal model

(center of ripple) $I_D = \frac{4.3V - 4V}{100\Omega} = 3mA$

$r_d = \frac{V_T}{I_D} = \frac{0.026V}{0.003A} = 8.67\Omega$

approximate w/ small signal model:



$V_{out} = \frac{13.67\Omega}{(13.67+100)\Omega} V_{IN}$

$\Delta V_{out} = \frac{13.67}{113.67} \Delta V_{IN}$

Voltage line regulation $= \frac{\Delta V_{out}}{\Delta V_{in}} = \frac{13.67}{113.67} \times 100\% = 12.03\%$

Load regulation: (assume 50Ω load)

$I_{R_L} = -\Delta I_{D_{loaded}} = \frac{V_{regulated}}{R_L} = \frac{4V}{50\Omega} = 80mA$

$\Delta V_{loaded} = (\Delta I_{loaded})(r_d)$

$= (-80mA)(13.67\Omega)$

$= -1.09V$

load regulation $= \frac{\Delta V_{loaded}}{V_{regulated}}$

$= \frac{-1.09V}{4V} = -27.3\%$

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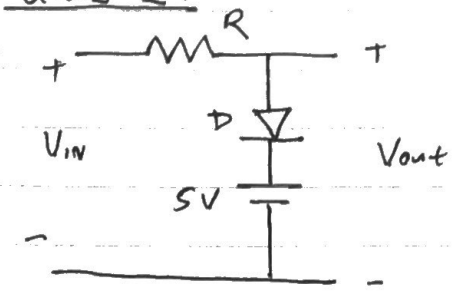
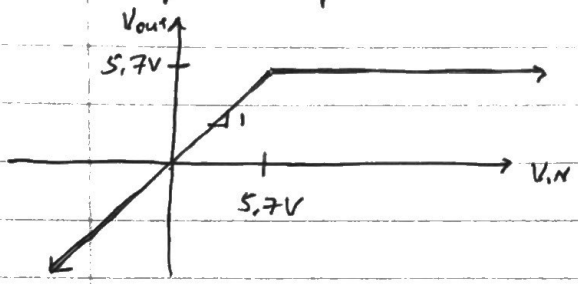
2a)



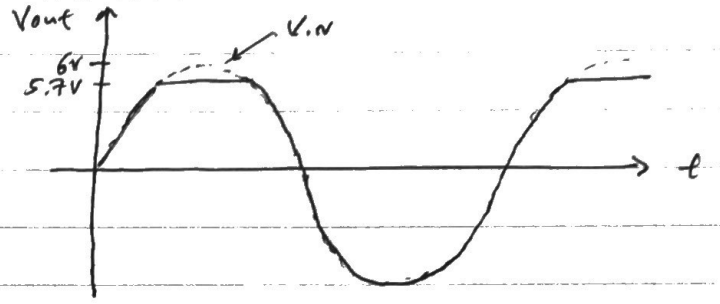
$V_{D,ON} = 0.7V$

$V_{IN} = V_p \cos \omega t$, $V_p = 6V$

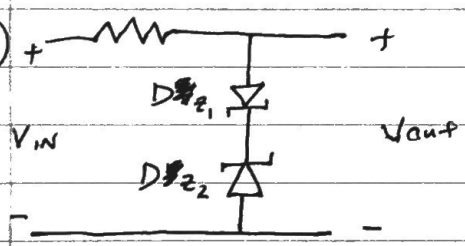
input/output characteristic:



V_{out} vs. time



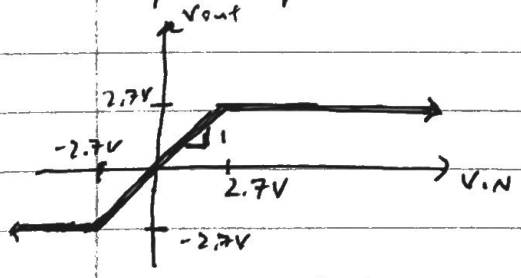
2b)



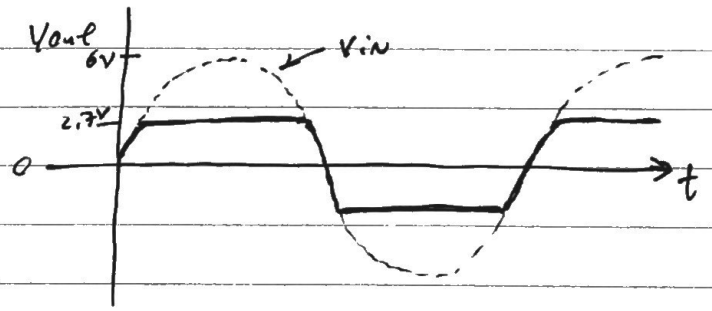
$V_z = 2V$

V_{in} = (same as above)

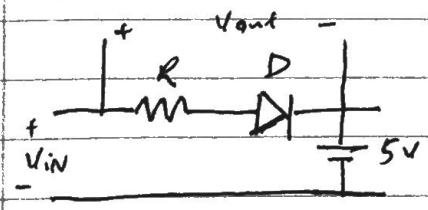
input/output characteristic:



V_{out} vs. time:

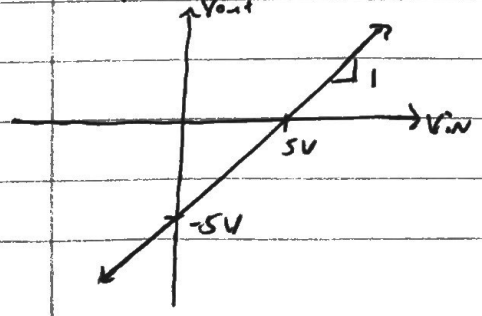


2c)



V_{out} always just $V_{in} - 5V$

input/output characteristic:



V_{out} vs. time: