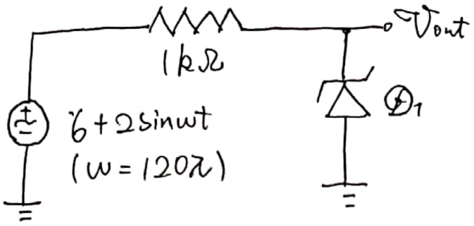
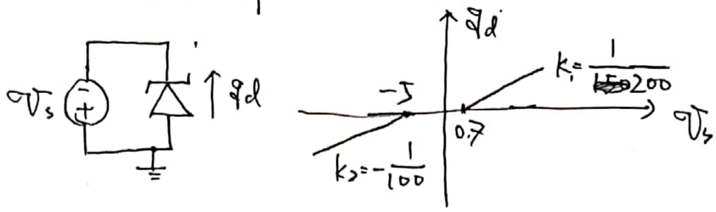
Problem #1 (diode circuit)



The I-V curve of the diode circuit D_1



Plot the diagram of V_{out}.

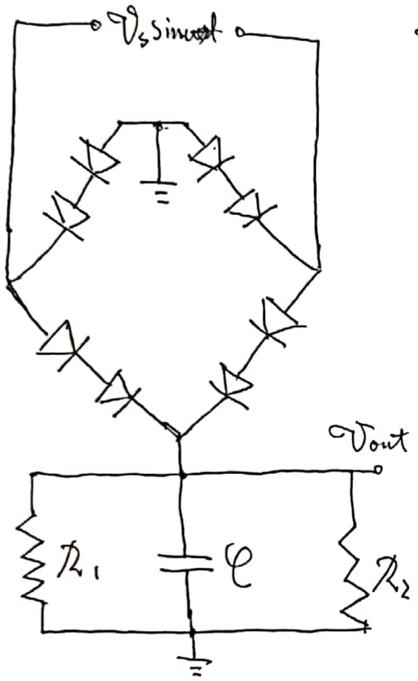
$R_{on}=200$, $R_z=100$

$R_z=100$ $V_{out}=\begin{cases} 0 & V_{in}\in[4.5,\ \cancel{4}] \\ \frac{6+2\sin\omega t-5}{1100}\times100+5 & V_{in}\in[5,8] \end{cases}$

Prob. #2. (Rectifier): Suppose the turn-on voltage of all the diodes are V_{on} and the are no inner resistance in them. Find

(1) I_{dc} (2) P_{iv}. (suppose $R_1, R_2 C \gg T$).

(3) Discuss could the circuit work if the inner resistance of diodes are comparable with R_1 or R_2 (Just a thinking problem and do not require in exam



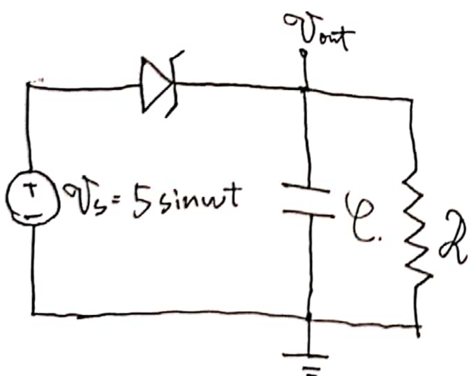
I ($I_{dc}=\frac{V_s-4V_{on}}{R_1 \parallel R_2}$; $P_{iv}=V_s-2V_{on}$)

II. It will not work since the V_{out} is too small)

Reason: $R_{load} \ll R_{on}$

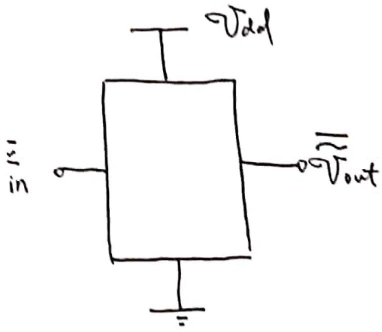
Prob #3 (Rectifier)

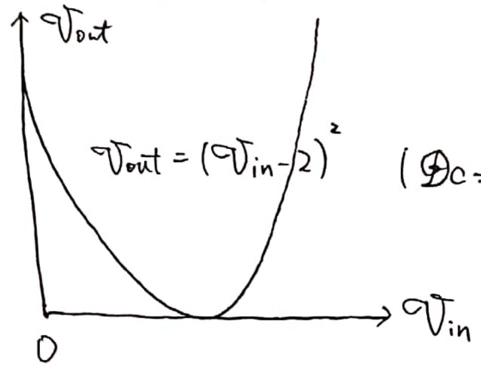
For the diode in the circuit, $V_{on}=0.7V$ and $V_Z=5V$, Plot the curve of V_{out} and V_{on} in the same graph. ($R\cdot C \gg T$, T is the period of V_s)



Mention that you need to show the relationship between V_{out} and V_{on} when you plot the diagram.

Prob #4 (General Amplifier). For the following Amplifier, find V_{out}.



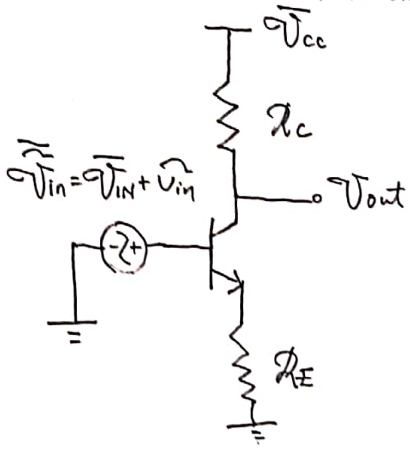


(DC-sweep curve)

(1) $V_{in} = 1 + 0.1\sin(120\pi t)$

(2) Discuss at which point, it's ~~hardest~~ the most difficult to approximate the Amplifier into a small-signal model if the DC input voltage $\overline{V_{IN}}$ remains a constant. (I. $\overline{V_{in}} = 1$ II. $\overline{V_{in}} = 2$ III. $\overline{V_{in}} = 3$)

Prob #5: For the following circuit, $I_S = 1\times10^{-16}$, $\beta = 100$, $V_A = 100$.



(1). Suppose $\overline{V_{IN}} = 0.7V$, $V_{cc} = 3V$, $R_C = R_E = 5000\Omega$

Find the value of g_m, r_o, r_π

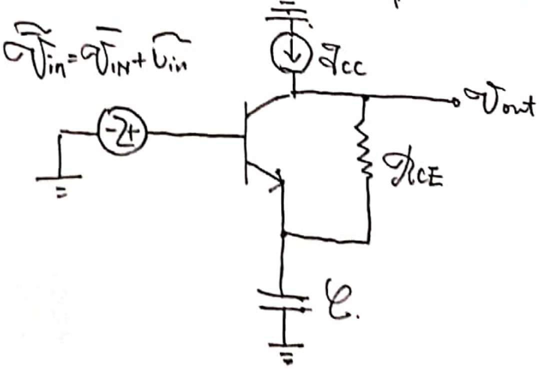
(Hint: Suppose the node voltage E is V_E).

(2) Calculate the small signal gain $A_v = \frac{\hat{v}_{out}}{\hat{v}_{in}}$

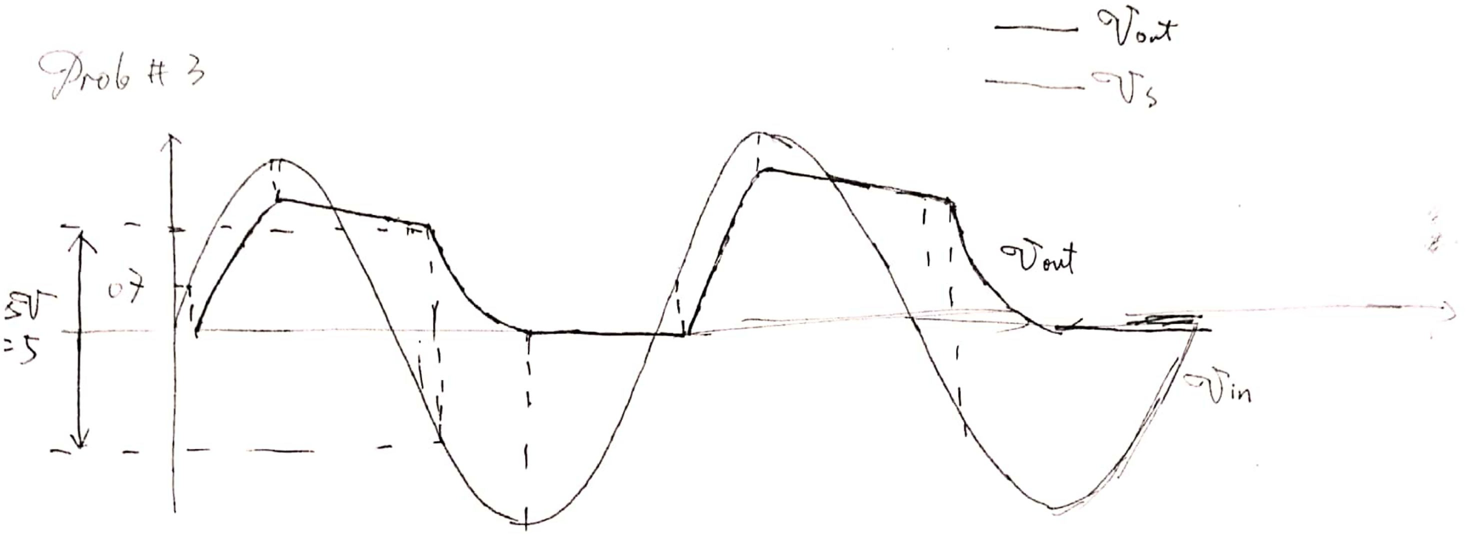
(You do not need to find the value, only need to derive the expression with g_m, r_π, r_o).

Prob #6: Suppose ($\beta \neq \infty$ && $V_A \neq \infty$), Find A_v using r_π, r_o & g_m.

(Suppose ω is high)



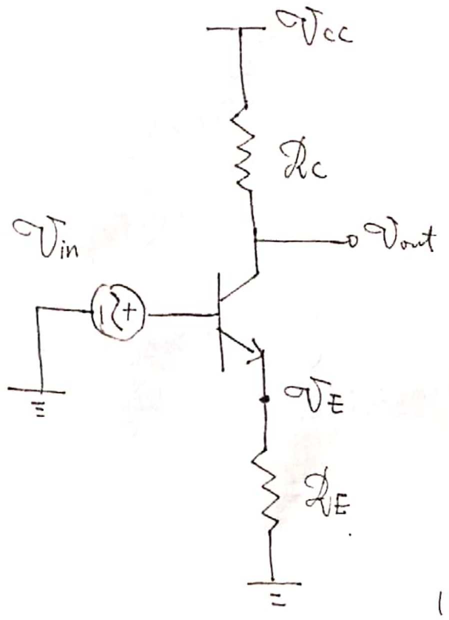
Prob #3



Prob #4 (1) $V_s = 1 - 0.2\sin 120\pi t$

(2). $V_{in} = 2$ is the most difficult.

Prob #5.

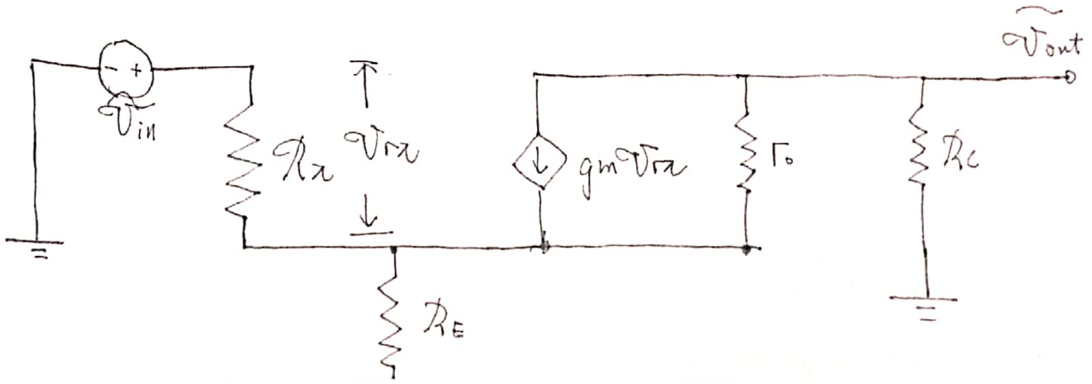


(1) Suppose $\bar{V}_E$, then we have

$$
\begin{cases}
\bar{V}_{CC} - \bar{V}_{out} = I_C \cdot R_C \\
\bar{V}_E - 0 = I_E \cdot R_E \\
I_C = I_S\left[\exp\left(\frac{q(\bar{V}_{in} - \bar{V}_E)}{kT}\right) - 1\right]\left(1 + \frac{\bar{V}_{out} - \bar{V}}{V_{AF}}\right. \\
I_E = I_B + I_C \\
I_C = \beta \cdot I_B
\end{cases}
$$

$\Rightarrow$ Solution

(2) Small signal model:



Prob #6. Small signal model :