第5章: 5.3

5.3 (1) u_2正半周期 VD_1 VD_2导通　　VD_3 VD_4截止

$$\begin{cases} u_{D_1}=u_1-u_0 \\ u_{D_2}=-(u_1-u_0) \end{cases} \qquad \begin{cases} i_1=g(u_1-u_0) \\ i_2=-g(u_1-u_0) \end{cases}$$

$$u_{o正}=i_0R_L=R_L(i_1-i_2)=2gR_L(u_1-u_0)\cdot K^+$$

u_2负半周期 VD_3 VD_4导通

$$\begin{cases} i_3=g(-u_1-u_0) \\ i_4=g(u_1+u_0) \end{cases}$$

$$u_{o负}=R_L(i_3-i_4)=-2gR_L(u_1+u_0)K^-$$

$$u_0=u_{o正}+u_{o负}$$

$$=2gR_Lu_1(K^+-K^-)-2gR_Lu_0(K^++K^-)$$

$$\therefore u_0=\frac{2gR_L(K^+-K^-)}{1+2gR_L} \qquad (\because K^++K^-=1)$$

(2) $$u_{o正}=2g_1R_L(u_1-u_0)K^+$$

$$u_{o负}=-2g_2R_L(u_1+u_0)K^-$$

$$u_0=u_{o正}+u_{o负}$$

$$=2g_1R_L(u_1-u_0)K^+-2g_2R_L(u_1+u_0)K^-$$

$$=2R_L(g_1K^+-g_2K^-)u_1-2R_L(g_1K^++g_2K^-)u_0$$

$$u_0=\frac{2R_L(g_1K^+-g_2K^-)}{1+2R_L(g_1K^++g_2K^-)}u_1$$

VD_1: $u_1+u_2-u_0$

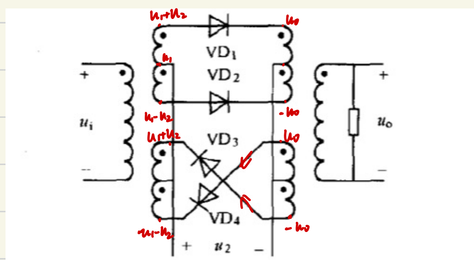
$VD_2=u_1-u_2+u_0$

VD_3: $-(u_1+u_2+u_0)$

$VD_4=-(u_1-u_2-u_0)$

(3) u_2正半周期 VD_1和VD_4导通

$$\begin{cases} u_{D_1}=u_1+u_2-u_0 \\ u_{D_4}=-(u_1-u_2-u_0) \end{cases} \qquad \begin{cases} i_1=g(u_1+u_2-u_0) \\ i_4=-g(u_1-u_2-u_0) \end{cases}$$



$$u_{o正}=R_L(i_1-i_4)=2gR_L(u_1-u_0)K^+$$

u_2负半周期 VD_2和VD_3导通

$$\begin{cases} i_2=g(u_1-u_2+u_0) \\ i_3=g(-u_0-u_1-u_2) \end{cases}$$

电流方向一致

$$u_{o负}=R_L(i_3-i_2)=-2gR_L(u_0+u_1)K^-$$

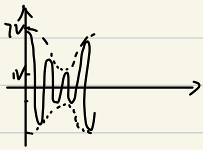
$$u_0=u_{o正}+u_{o负}=2gR_L(u_1-u_0)K^+-2gR_L(u_0+u_1)K^-$$

$$=2gR_L(K^+-K^-)u_1-2gR_L(K^++K^-)u_0$$

$$u_0=\frac{2gR_L(K^+-K^-)}{1+2gR_L}u_1$$

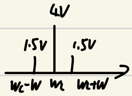
第六章: 6.1 6.3 6.8 6.13 6.15

6.1 (1) $V_{max}=4\times(1+0.75)=7V$ $V_{min}=4\times(1-0.75)=1V$



(2) $u_{AM}(t)=4\cos(2\pi\times10^7 t)+1.5\cos[(2\pi\times10^7-2\pi\times10^4)t]+1.5\cos[(2\pi\times10^7+2\pi\times10^4)t]$ V

令 $\omega_c=2\pi\times10^7$ rad/s $\omega=2\pi\times10^4$ rad/s



(3) $B=\frac{2\omega}{2\pi}=20kHz$

(4) $\eta=\frac{P_m}{P_c+P_m}=\frac{m^2\overline{S^2(t)}}{1+m^2\overline{S^2(t)}}=\frac{(\frac{3}{4})^2\times\frac{1}{2}}{1+(\frac{3}{4})^2\times\frac{1}{2}}\approx22\%$

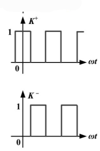
6.3 $u_{AM}(t)=8(1+\frac{1}{8}\cos(12\pi\times10^3)t+\frac{3}{8}\cos(20\pi\times10^3)t+\frac{1}{8}\cos(28\pi\times10^3)t)\cos(2\pi\times10^6 t)$ V

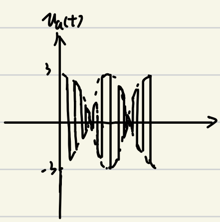
$P=\frac{1}{2}\times8^2+\frac{1}{2}\times[(\frac{1}{8})^2+(\frac{3}{8})^2+(\frac{1}{8})^2]\times8^2\times\frac{1}{2}=34.75W$

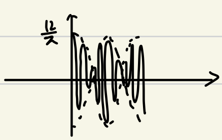
6.8 (1) $u_a(t)=S(t)[K^+(\omega_0 t)-K^-(\omega_0 t)]$

K^+、K^- 为开关函数，如右图所示

$$\begin{cases} K^+(\omega_2 t)=\frac{1}{2}+\frac{2}{\pi}\cos\omega_2 t-\frac{2}{3\pi}\cos3\omega_2 t+\cdots+(-1)^{n-1}\frac{2}{(2n-1)\pi}\cos(2n-1)\omega_2 t \\ K^-(\omega_2 t)=\frac{1}{2}-\frac{2}{\pi}\cos\omega_2 t+\frac{2}{3\pi}\cos3\omega_2 t-\cdots+(-1)^{n}\frac{2}{(2n-1)\pi}\cos(2n-1)\omega_2 t \end{cases}$$





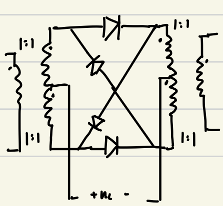


$u_o(t)=u_a(t)*h(t)$ 由于 $\omega_0\gg\Omega_{max}$ 且 $BW>2\Omega_{max}$

$=\frac{12}{\pi}\cos(\Omega_{max}t)\cos(\omega_0 t)$ $H(j\omega)$ 滤波后只保留 $\cos\omega_0 t$ 成分

$=\frac{6}{\pi}[\cos(\Omega_{max}+\omega_0)t+\cos(\omega_0-\Omega_{max})t]$

(2)



6.13 $u(t)=s_1(t)\cos wt-s_2(t)\sin wt$

$y_1(t)=u(t)\cos wt=s_1(t)\cos^2 wt-s_2(t)\sin wt\cos wt$

$=\frac{1}{2}s_1(t)+\frac{1}{2}\cos 2wt-\frac{1}{2}s_2(t)\sin 2wt$

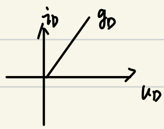
低通后 $u_{o1}(t)=\frac{1}{2}s_1(t)$

$y_2(t)=u(t)\sin wt=s_2(t)\sin^2 wt-s_1(t)\sin wt\cos wt$

$=\frac{1}{2}s_2(t)-\frac{1}{2}s_1(t)\sin 2wt-\frac{1}{2}s_2(t)\cos 2wt$

低通后 $u_{o2}(t)=\frac{1}{2}s_2(t)$

6.15 (1) 对于二极管有: $i_D=\begin{cases}g_D u_D & u_D>0\\ 0 & u_D<0\end{cases}$



$u_D=u_i-u_o$

$\cos\varphi=\frac{u_o}{U_m}$ U_m为$b(t)$为输入电压幅度

$I_o=I_p\alpha(\varphi)=g_D(U_m-u_o)\alpha(\varphi)=g_D U_m\frac{\sin\varphi-\varphi\cos\varphi}{\pi}$

且 $u_o=I_oR$

联立得: $\frac{u_o}{R}=g_D U_m\frac{\sin\varphi-\varphi\cos\varphi}{\pi}\Rightarrow\cos\varphi=g_D R_o\frac{\sin\varphi-\varphi\cos\varphi}{\pi}$

$\Rightarrow\frac{\pi}{g_D R_o}=\tan\varphi-\varphi$

当g_D和R_o足够大时 $\tan\varphi\approx\varphi+\frac{\varphi^3}{3}$ (泰勒展开)

$\therefore\varphi=\sqrt[3]{\frac{3\pi}{g_D R_o}}$

(2) $K_D=\frac{U_o}{U_m}=\cos\varphi$

(3) ∵不失真 则 $K=1$

$\tau=R_oC_o$

不失真条件为 $\left|\frac{du_o(t)}{dt}\right|\geq\left|\frac{db(t)}{dt}\right|$

$\because b(t)=V_i(1+m\cos\Omega_{max}t)$

$\frac{db(t)}{dt}=-V_i m\Omega_{max}\sin\Omega_{max}t$

对于某一峰值时刻t_1 $u_o(t)=V_i(1+m\cos\Omega_{max}t_1)\cos\varphi\, e^{-\frac{t-t_1}{\tau}}$ RC电路放电

$\tau=R_oC_o$ 则 $\left|\frac{du_o(t)}{dt}\right|_{t=t_1}=\frac{V_i\cos\varphi}{\tau}(1+m\cos\Omega_{max}t_1)$

而 $\left|\frac{db(t)}{dt}\right|_{t=t_1}=V_i m\Omega_{max}\sin\Omega_{max}t$

$\therefore\frac{V_i\cos\varphi}{\tau}(1+m\cos\Omega_{max}t_1)\geq V_i m\Omega_{max}\sin\Omega_{max}t_1$

$\Rightarrow\cos\varphi-m\sqrt{\cos^2\varphi+\tau^2\Omega_{max}^2}\geq 0\Rightarrow m\leq\left[1+\left(\frac{\tau\Omega_{max}}{\cos\varphi}\right)^2\right]^{-\frac{1}{2}}$