5-1 (1) 载波 $= A\cos\omega_c t = 100\cos(10^5\pi t)$　　$m = A_m/A = A_m/100 = 0.6$

$m(t) = A_m\cos(2\pi f_m t) = 60\cos(2\pi\times10^3 t) = 60\cos(2\pi\times10^3 t)$

A_m表达式 $= A_m(t)[A+m(t)]\cos10^5\pi t = [100+60\cos(2\pi\times10^3 t)]\cos(10^5\pi t)$

(2) $P_C = \frac{A^2}{2R} = \frac{100^2}{2\times50} = 100W$

$P_{USB} = P_{LSB} = \frac{(mA/2)^2}{2R} = \frac{m^2}{4}\cdot\frac{A^2}{2R} = \frac{m^2}{4}P_C = \frac{0.6^2}{4}\times100 = 9W$

$P_S = P_{USB} = P_{LSB} = \frac{m^2}{2}P_C = 18W$

$P_{AM} = P_C + P_n = (1+\frac{m^2}{2})P_C = 118W$

(3) $\eta_{AM} = \frac{P_n}{P_{AM}} = \frac{18}{118} = \frac{9}{59}$

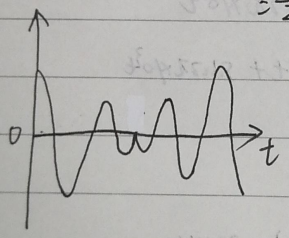
(4) $m=0$时，边带功率为0，总发射功率 $P_{AM} = P_C + P_S = (1+\frac{m^2}{2})P_C = 100W$

5-2. (1) 傅里叶变换：$S_1(\omega) = \pi[\delta(\omega-\Omega)+\delta(\omega+\Omega)] * \pi[\delta(\omega-\omega_c)+\delta(\omega+\omega_c)]$

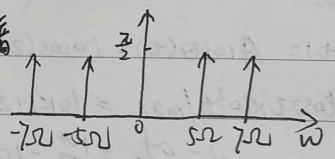
$= \frac{\pi}{2}[\delta(\omega+\Omega+\omega_c)+\delta(\omega+\Omega-\omega_c)+\delta(\omega-\Omega+\omega_c)+\delta(\omega-\Omega-\omega_c)]$

$= \frac{\pi}{2}[\delta(\omega+7\Omega)+\delta(\omega+5\Omega)+\delta(\omega+5\Omega)+\delta(\omega-7\Omega)]$

波形



频谱

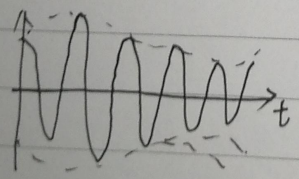


(2) $S_2(\omega) = \pi[\delta(\omega+\omega_c)+\delta(\omega-\omega_c)] + 0.5\times\frac{\pi}{2}[\delta(\omega+5\Omega+\omega_c)-\delta(\omega-5\Omega-\omega_c)+\delta(\omega+5\Omega-\omega_c)$

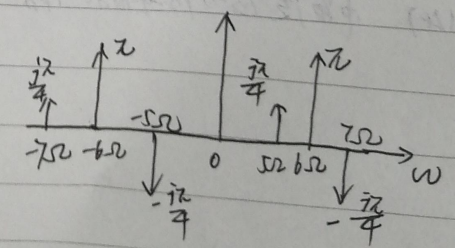
$-\delta(\omega-5\Omega+\omega_c)]$

$= \pi[\delta(\omega+6\Omega)+\delta(\omega-6\Omega)+\frac{\pi}{4}[\delta(\omega+7\Omega)-\delta(\omega-7\Omega)+\delta(\omega-5\Omega)-\delta(\omega+5\Omega)]$

波形



频谱：



5-8. (1). $f_H = 5KHZ$ $B = 2f_H = 2\times 5KHz = 10KHz$

中心频率为 100KHZ

(2) $S_i = 60dB = 10^6$, $d = 70dB = 10^7$

$S_i = S_i / a = 10^{-1} W$

$N_i = 2P_n(f) \cdot B = 2\times 0.5\times 10^{-8}\times 10\times 10^3 = 10^{-4} W$

$\frac{S_i}{N_i} = 1000$

(3). $\frac{S_o}{N_o} = G DSB \frac{S_i}{N_i} = 2\times \frac{S_i}{N_i} = 2000$

(4) $N_o = \frac{1}{2} N_i = 2.5\times 10^{-5} W$

$P_{no}(f) = \frac{N_o}{2f_H} = 2.5\times 10^{-9} W/HZ = \frac{1}{2} P_n(f)$ $|f| \le 5KHZ$

$= 2.5\times 10^{-9} W/HZ$

5-15 (1). $w(t) = 2\pi f(t) = 22\pi\times 10^6 + 22\pi\times 10^4 \cos 22\pi\times 10^3 \pi$

$\theta(T) = \int_{-\infty}^{t} w(\tau) d\tau = 22\pi\times 10^6 t + 10.5\pi\times 10^3 t$

$S_{FM}(t) = A\cos\theta(t) = 10\cos(22\pi\times 10^6 t + 5.5\pi\times 10^4 t$

(2) $\Delta f = |10^4 \cos 22\pi\times 10^3 t|_{max} = 10KHZ$

$m_f = \frac{\Delta f}{f_m} = \frac{10^4}{10^3} = 10$

$B \approx 2(\Delta f + f_m) = 2(10+1) = 22KHZ$

(3) $\Delta f = 10KHZ$

$m_f = \frac{\Delta f}{f_m} = \frac{10^4}{2\times 10^3} = 5$

$B \approx 2(\Delta f + f_m) = 2(10+2) = 24KHZ$

(4). 幅度变为原来的两倍