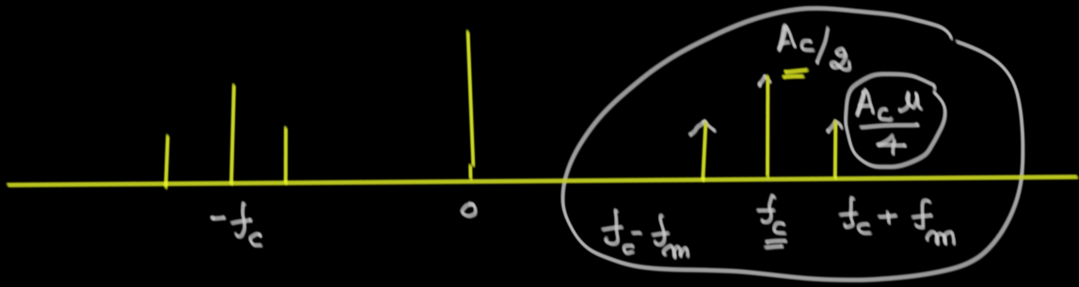


$$BW = 2f_m$$

$$P_t = P_c\left[1+\mu^2/2\right]$$

$$\eta = \frac{\mu^2}{2+\mu^2}$$

Q $s(t) = 20\left[1+0.9\cos 2\pi 10^4 t\right]\cos 2\pi 10^6 t$.

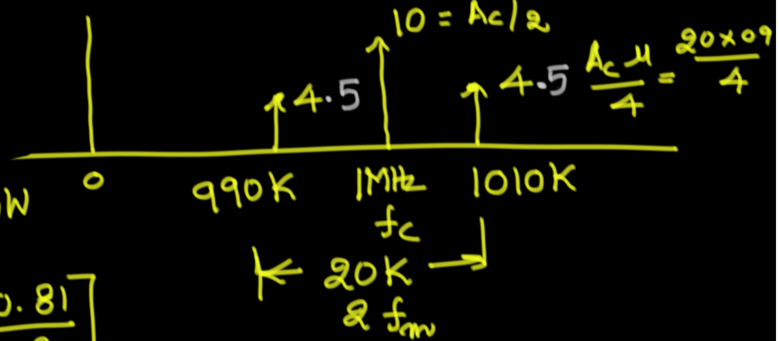
$R = 5\Omega$. Sketch the spectrum, BW, P_t & η?

Sol $s(t) = A_c\left[1+\mu\cos 2\pi f_m t\right]\cos 2\pi f_c t$

$A_c = 20V$ $\mu = 0.9$ $f_m = 10\,KHz$

$f_c = 1MHz$

$$P_c = \frac{A_c^2}{2R}$$



$$P_c = \frac{(20)^2}{2\times 5} = 40W$$

$$P_t = 40\left[1 + \frac{0.81}{2}\right]$$

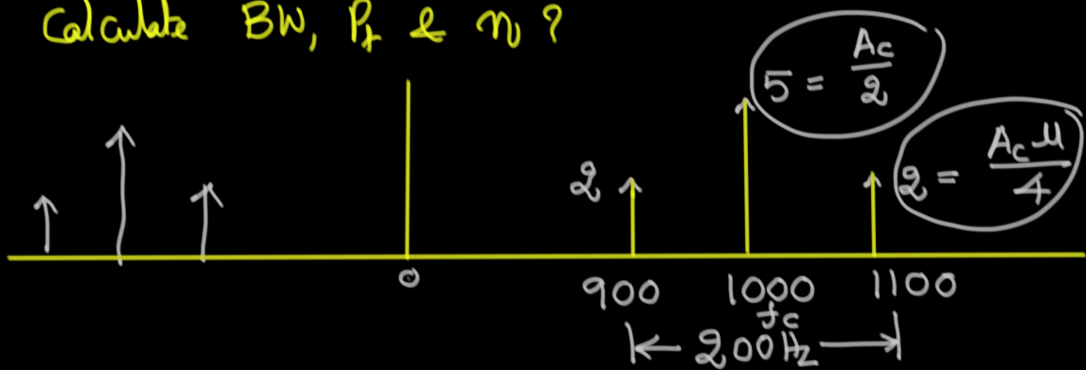
$$P_t = 56.2 \text{ watts}$$
$$= \underline{\underline{40}} + \underline{\underline{8.1 + 8.1}}$$

$$\eta = \frac{0.81}{2.81} =$$

$$\eta = \frac{P_{SB}}{P_t} = \frac{16.2}{56.2} =$$

Q $S(t) = \underline{\underline{4}} \cos \underset{900}{\underline{\underline{1800}}}\pi t + \underline{\underline{10}} \cos \underline{\underline{2000}}\pi t$
$+ \underline{\underline{4}} \cos \underline{\underline{2200}}\pi t$

Calculate BW, P_t & η ?



$R = 1\Omega$

$A_c = 10V$

$\frac{A_c \mu}{4} = 2 \rightarrow A_c \mu = 8$

$\mu = 0.8$ ✓

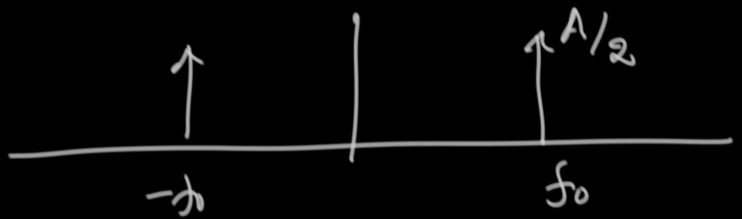
$P_c = \frac{A_c^2}{2R} = \frac{10^2}{2 \times 1} = \underline{\underline{50}}W$

$\eta = \frac{0.64}{2.64} =$

$\eta = \frac{16}{66} =$

$P_t = 50\left[1 + \frac{0.64}{2}\right] = 66W = \underline{\underline{50}} + \underline{\underline{8W + 8W}}$

$A \cos 2\pi f_0 t \leftrightarrow \frac{A}{2}\left[\delta(f - f_0) + \delta(f + f_0)\right]$



$c(t) = 5 \cos 2\pi 10^6 t \quad m(t) = 2 \cos 4\pi 10^3 t$

to generate an AM signal with a $\mu = 0.5$.

① BW, P_t & η

② $\dfrac{P_{SB}}{P_c}$

$A_c = 5 \quad f_c = 1\,\text{MHz}$

$A_m = 2 \quad f_m = 2\,\text{KHz}$

$BW = 4\,\text{KHz}$

$P_c = \dfrac{5^2}{2 \times 1} = 12.5\,W$

$$P_t = 12.5\left[1 + \frac{0.25}{2}\right]$$

$$\frac{P_{SB}}{P_c} = \frac{\cancel{P_c}\,\mu^2/2}{\cancel{P_c}} = \frac{\mu^2}{2} = \frac{1}{8} = 0.125$$

$$P_{SB} = 0.125\,P_c$$

$$P_{SB} = 12.5\%\,P_c$$

$c(t) = 5\cos 2\pi 10^6 t \quad m(t) = 4\cos 2\pi 10^3 t$

to generate an AM signal. cal. BW & Power

Sol

$A_c = 5 \quad f_c = 1\,MHz$

$A_m = 4 \quad f_m = 1\,KHz \quad BW = 2\,KHz$

$P_c = \frac{5^2}{2\times 1} = \underline{\underline{12.5\,W}}$

$\mu = \frac{A_m}{A_c} = \frac{4}{5} = 0.8$

$P_t = 12.5\left[1 + \frac{0.64}{2}\right]$

$\mu = K_a A_m =$

$\underline{\underline{K_a}} = \frac{1}{A_c} =$

Q An AM tx radiates 80W when the Carrier is not modulated. The carrier is now modulated and $\mu = 1$. Det. total power radiated?

$m(t) = 0$

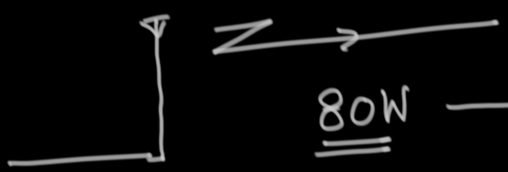
$\mu = 0$

Sol

$$P_t = P_c\left[1 + \frac{\mu^2}{2}\right]$$

$\mu = 0$

$$P_t = P_c = 80W$$



$80W \longrightarrow 120W = 80W + 40W \to 50\%$

$\mu = 0 \longrightarrow \mu = 1$

$$P_c = 80W$$

$$P_t = 80\left[1 + \frac{1^2}{2}\right] = 120W$$

When 'μ' increased from '0' to '1'

Power increase by 50%

$$P_t = P_c\left[1 + \frac{\mu^2}{2}\right]$$

$\mu = 0 \rightarrow \underline{\underline{P_t}} = \underline{\underline{P_c}}$

$\mu = 1 \rightarrow P_t = \underset{\downarrow \; 50\%}{\underline{\underline{1.5}}} P_c$

$\mu = 0 \rightarrow P_t = P_c$

$\mu = 0.707 \rightarrow P_t = \underline{\underline{1.25}} P_c$

MI increases

from $\mu \rightarrow \underline{\underline{0}} \rightarrow \underline{\underline{0.707}}$

When μ increased from '0' to 0.707

Power $\uparrow$ by 25%

$\underline{\underline{\mu = 0}} \longrightarrow \underline{\underline{\mu = 1}}$

$50\,W \longrightarrow 75\,W$

$400\,W \longrightarrow 600\,W$

$\underline{\underline{\mu = 0}}$ $\mu = \underline{\underline{0.707}}$

$50\,W$ $62.5\,W$

$400\,W$ $\underline{\underline{500\,W}}$

Q. An AM tx radiates 50W when the carrier is modulated by a sinusiodal signal and $\mu = 0.707$.

① Det η, P_c & P_{SB}

② Det. Peak amp of the carrier before mod and after modulation?

$P_t = 50W$

$\mu = 0.707$

$A_c \cos 2\pi f_c t$

$$\eta = \frac{\mu^2}{2+\mu^2} = 20\%$$

$$P_c = 80\% \, P_t = 40W = \frac{A_c^2}{2 \times 1} \rightarrow A_c^2 = 80$$

$$P_{SB} = 20\% \, P_t = 10W$$

$$A_c = \sqrt{80}$$

$$A_c \simeq 9V$$

$$A_c \cos 2\pi f_c t$$

$$S(t) = A_c [1 + \mu \cos 2\pi f_m t] \cos 2\pi f_c t$$

$$\boxed{\begin{aligned} V_{max} &= A_c [1 + \mu] \\ V_{min} &= A_c [1 - \mu] \end{aligned}}$$

$$= 9 [1 + 0.707]$$