1) An audio signal of 1 kHz is used to amplitude modulate a carrier of 600 kHz. Determine side band frequency and BW required.

Soln

$f_m = 1\,kHz$

$f_c = 600\,kHz$

$f_{LSB} = f_c - f_m = 600K - 1\,kHz = 599\,kHz$

$f_{USB} = f_c + f_m = 600K + 1\,kHz = 601\,kHz$

$BW = 2f_m = 2 \times 1\,kHz$

$= \underline{2\,kHz}$

2) A 400 W carrier is modulated to a depth of 75%. Calculate total power in modulated wave.

Soln

$\mu = 0.75$

$P_c = 400\,W$

$$P_t = P_c\left(1 + \frac{\mu^2}{2}\right)$$

$$= 400\left(1 + \frac{(0.75)^2}{2}\right)$$

$$= \underline{512.5}\ W$$

3) A carrier of 2MHz has 1KW of its power amplitude modulated with a sinusoidal signal of 2KHz. The depth of modulation is 60%. Calculate the sideband freq, signal bandwidth, power in side bands and total power in the modulated wave.

Soln.

$f_c = 2MHz$

$f_m = 2KHz$

$\mu = 0.6$

$P_c = 1KW$

$f_{LSB} = f_c - f_m = 2M - 2K$

$= 1998000 Hz$

$f_{USB} = f_c + f_m = 2M + 2K$

$= 2002000 Hz$

$BW = 2f_m = 2 \times 2KHz$

$= 4KHz$

$P_{USB} = \cancel{P_c} \; \cancel{+} \; \frac{P_c \mu^2}{4} = \frac{1K \times (0.6)^2}{4}$

P

$= 0.09K$

$= 90W$

$P_t = P_c + 2P_{USB}$

$= 1kW + 2(90)$

$= 1180KW$

4) For an AM signal $V_{AM} = 10(1 + 0.5 \sin 6280t) \sin(62.8 \times 10^6 t)$, calculate upper and lower side band freq, amplitude of each side band and Bandwidth.

Soln

$A_c = 10$

$\mu = 0.5$

$W_c t$, $W_c = 2\pi f_c t$

$\frac{W_m}{2\pi} = 1000Hz$

$f_m = 1000Hz = 1KHz$

$f_c = 10MHz$

$\frac{W_c}{2\pi} = 10MHz$

$f_{LSB} = f_c - f_m$

$= 9.999 MHz$

$BW = 2f_m$

$f_{USB} = f_c + f_m$

$= 10M + 1KHz$

$= 10.001 MHz$

$= 2 \times 1KHz = 2KHz$

Amplitude of each side band

$= \frac{A_c \mu}{2} = \frac{10(0.5)}{2} = 2.5V$

5) The rms value of a carrier voltage is 100 V. After amplitude modulation by a sinusoidal audio voltage, the rms value 110 V, calculate modulation index.

Soln

$A_c = 100\ V$

$A_c + A_m = 110\ V.$

$A_m = 10\ V.$

$\mu = \frac{A_m}{A_c} = \frac{10}{100} = 0.1$ //.

Limitation of AM.

1) Noisy reception : Mainly dependant on Amplitude, and amplitude disturbance are many.

2) Low efficiency : Most of useful power is in sidebands, An AM wave has low sideband power

Eg:- $\mu = 100\% = 1$

Max. efficiency $= 33.33\%$

Practically efficiency will be less than 33.33%.

Carrier conveys no information

Only $1/3^{rd}$ of total transmitted power is allotted to sideband.

3) Lack of audio quality : Audio sigs that are AM modulated dos poor audio quality.

4) Low ~~freq~~ spectrum efficiency : Real information is contained in sidebands, To improve spectral efficiency, suppress carrier & eliminate one sideban

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Q. The total power content of AM signal is 2·64 KW at $\mu = 80\%$. Determine the power content of carrier and each side band.

Solu.

$$2.64 \times 10^3 = P_c\left(1 + \frac{(0.8)^2}{2}\right)$$

$$P_c = 2\,KW$$

$$P_{USB} = P_{LSB} = \frac{\mu^2 P_c}{4}$$

$$= \frac{(0.8)^2 \times \cancel{2}K}{\cancel{4}\,2}$$

$$= (0.4)^2 \times K$$

$$= 0.32\,KW$$