

## NUMERICAL PROBLEMS IN AMPLITUDE MODULATION

1. How many AM stations can be accommodated in a 100 KHz bandwidth if the highest frequency of the message signal is 5 KHz?
2. A 500 W carrier is to be modulated to 90% level. Determine the total transmitted power.
3. An AM broadcast station is allowed to operate at a maximum power of 50KW and 95% modulation. How much of its transmitted power is intelligent?
4. A transmitter with a 10KW carrier transmits 11.2 KW when modulated with a single sine wave. Calculate the modulation index. If the carrier is simultaneously modulated with another sine wave at 50% modulation, calculate the total transmitted power.
5. If a 1000 KHz carrier wave is modulated by an audio signal varying between 10 and 500 Hz, What is i) the frequency span of sideband ii) the maximum upper side frequency iii) the minimum lower side frequency iv) the frequency range of the channel
6. An audio signal  $15 \sin 2\pi (1500t)$  amplitude modulates a carrier  $60 \sin 2\pi (100000t)$ .
  - i) Construct all the signals
  - ii) Determine the modulation index and percentage modulation
  - iii) What are the frequencies of audio signal and the carrier?
  - iv) What frequencies would show up in the spectrum analysis of the modulated wave?
7. The oscillator of a conventional DSB-AM transmitter is modulated by an audio signal from 100 Hz to 10KHz. What is the frequency range occupied by the sidebands, carrier frequency and bandwidth if the tuned circuit of the oscillator employs a 100  $\mu$ H coil and 100 pF capacitor. Sketch the frequency band diagram.

**IMPORTANT RESULTS AND FORMULAS**

1. If the maximum frequency content in message signal is  $f_m$  then the bandwidth occupied by

Conventional AM signal (DSB-FC signal) =  $2f_m$

DSB-SC signal =  $2f_m$

SSB signal =  $f_m$

This is due to the fact that in analog communication systems, the message signal  $m(t)$  is assumed to be a lowpass signal with frequency content that extends from  $f=0$  to upper upper frequency limit, say  $B$  or  $f_m$ . The bandwidth  $B$  or  $f_m$  depends upon the type of analog signal.

For eg. audio=4KHz, video=6MHz

2. If transmitted power =  $P_t$ , modulation index =  $m$ , carrier power =  $P_c$  then the total transmitted power in a conventional AM system is given as,

$$P_t = P_c (1 + m^2/2)$$

3. If the maximum frequency of the message =  $f_{max}$ , minimum frequency of the message =  $f_{min}$  and carrier frequency =  $f_c$  then

Frequency span of the sideband =  $f_{max} - f_{min}$

Maximum upperside frequency =  $f_c + f_{max}$

Minimum upperside frequency =  $f_c + f_{min}$

Maximum lowerside frequency =  $f_c - f_{min}$

Minimum lowerside frequency =  $f_c - f_{max}$