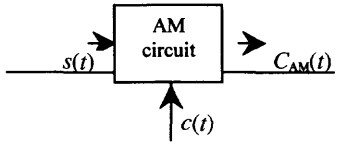

Figure 12.3 An amplitude-modulation system.

This can be easily graphed to verify that indeed it represents an amplitude-modulated signal as illustrated in Figure 12.2. Further, it shows that the output has three sinusoidal signals, each with different frequencies. Its frequency spectrum is shown in Figure 12.4. Besides the carrier frequency ω_c, there are two other frequencies $\omega_c \pm \omega_m$. The signal spectrum $\omega_c + \omega_m$ represents the upper side band while $\omega_c - \omega_m$ is the lower side band. Note that each sideband includes the information signal ω_m. When only one of these signals is used to send the information then it is called a *single-sideband* (SSB) AM transmission. On the other hand, complete $c_{AM}(t)$ represents a *double-sideband* (DSB) AM transmission. It is called the *suppressed carrier* AM if the carrier component of $c_{AM}(t)$ is filtered out before transmitting.

Example 12.1: A 100-MHz sinusoidal signal is being used as the carrier for an AM transmission. Its amplitude is 1000 V while the average power is 10 kW. The modulating signal is $s(t) = 3\cos(\omega_1 t) + 2\cos(2\omega_1 t) + \cos(3\omega_1 t)$, where $\omega_1 = 4\pi \times 10^6$ rad/s. The modulation index is 0.15.

(a) Determine the frequency spectrum of modulated signal. Also, find the amplitude of each sinusoidal component, power in the carrier and each pair of sidebands, and the total bandwidth of the AM signal.

(b) Determine peak amplitude and peak instantaneous power of this signal.

Since amplitude of the carrier signal is 1000 V and its power is 10 kW, the proportionality constant that relates the two can be determined. For $P = \alpha V^2$,

$$\alpha = \frac{P}{V^2} = \frac{10000}{1000000} = 0.01$$

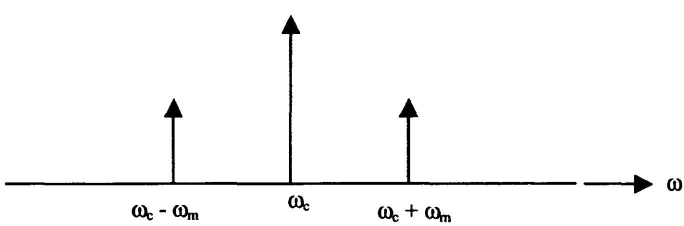

Figure 12.4 Frequency spectrum of $c_{AM}(t)$.