Problem 4.21

For convenience of the discussion, we assume time-domain symmetry around the origin $t = 0$. Accordingly, in theory, the signal produced by the amplitude limiter component of the band-pass limiter due to $s_1(t)$ consists of an infinite sequence of harmonically related angle-modulated components with two properties:

- The components are centered on odd multiples of the carrier frequency f_c.
- The components have progressively decreasing amplitudes.

Typically, the carrier frequency f_c of an FM signal is large compared to the transmission bandwidth B_T of the FM signal. It follows therefore that provided this condition is satisfied, that is, f_c is large enough compared to B_T, then the filter component of the band-pass limiter will effectively suppress all the spectral components coming out of the limiter except for the one component centered on f_c.

In light of these observations that are intuitively satisfying, we may now state that if f_c is large enough compared to B_T, then the output $s_2(t)$ produced by the band-pass limiter in response to the input $s_1(t)$ is defined by the FM signal

$$s_2(t) = A \cos\left[2\pi f_c t + 2\pi k_f \int_0^t m(\tau)d\tau\right]$$

where the amplitude A is a constant.