ENEL 471 – Winter 2020
Assignment 8

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Problems
"Communication Systems" 5th edition by Simon Haykin and Michael Moher

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4.13
4.14
4.18

Additional Problems

Problem 1

The carrier $c(t) = 100\cos(2\pi f_c t)$ is frequency modulated by the signal $m(t) = 5\cos(20000\pi t)$, where $f_c = 10^8$ Hz. The peak-frequency deviation is 20 kHz.

1. Determine the amplitude and frequency of all signal components that have a power level of at least 10% of the power of the unmodulated carrier component.
2. From Carson's rule, determine the approximate bandwidth of the FM signal.

Problem 2

The carrier $c(t) = A\cos(2\pi 10^6 t)$ is angle modulated (PM or FM) by the sinusoidal signal $m(t) = 2\cos(2000\pi t)$. The deviation constants are $k_p = 1.5$ rad/V and $k_f = 3000$ Hz/V.

1. Determine β_f and β_p.
2. Determine the bandwidth in each case using Carson's rule.
3. Plot the spectrum of the modulated signal in each case. (Plot only those frequency components that lie within the bandwidth derived in Part 2.)
4. If the amplitude of $m(t)$ is decreased by a factor of 2, how would your answers to Parts 1-3 change?
5. If the frequency of $m(t)$ is increased by a factor of 2, how would your answers to Parts 1-3 change?

Problem 3

The carrier $c(t) = 100\cos(2\pi f_c t)$ is phase modulated by the signal $m(t) = 5\cos(2000\pi t)$. The PM signal has a peak-phase deviation of $\pi/2$. The carrier frequency is $f_c = 10^8$ Hz.

1. Determine the magnitude spectrum of the sinusoidal components and sketch the results.
2. Using Carson's rule, determine the approximate bandwidth of the PM signal and compare the results with the analytical results in Part 1.