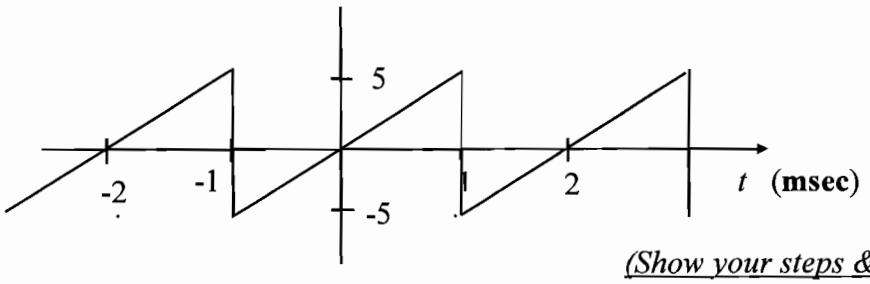
King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE370: Communications Engineering I (072)
Quiz 4: FM Modulation
Dr. Ali Muqaibel

Serial # 0

-1 point for not writing your serial #

Name: KEY Sec. 3

1. A baseband signal $m(t)$ is periodic sawtooth signal shown in the figure.
   a. Sketch the FM modulated signal if $\omega_c = 2\pi \times 10^6$, and k_f=4000π. 4
   b. If PM is to be used what is the maximum value for k_p. 2



(Show your steps & important valus)

$\omega_i = \omega_c + k_p m(t)$

$f_i = f_c + \frac{k_f}{2\pi} m(t)$

$= 10^6 + 2000\, m(t)$

$(f_i)_{max} = 10^6 + 2000(5) = 1010000\ Hz = 1.01\ MHz$

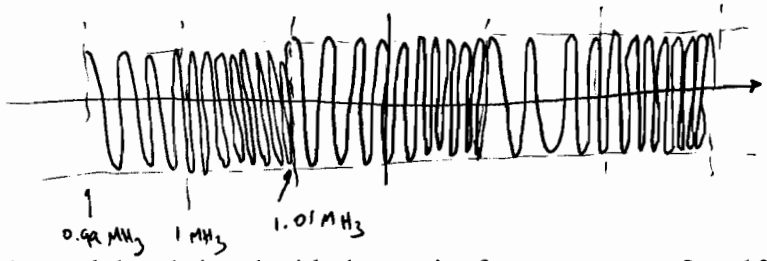
$(f_i)_{min} = 10^6 + 2000(-5) = 990000 = 0.99\ MHz$

$-\pi \leq k_p m(t) \leq \pi$

$k_p < \frac{\pi}{m(t)_{peak}}$

$k_p < \frac{\pi}{5}$

$\left(\frac{\pi}{5}\right)$ is the max value of k_p



2. An angle-modulated signal with the carrier frequency $\omega_c = 2\pi \times 10^6$ is described by the equation

$$\varphi_{EM}(t) = 5\cos(\omega_c t + 20\sin 1000\pi t + 10\cos 4000\pi t)$$

, estimate the bandwidth of the modulated signal.

① $BW = 2(\Delta f + B)$ (① ①)

$B = 2000\ Hz$ max freq.

$\Delta f = (20\ 1000\pi\ 1000\pi t + 40000 \sin 4000t)$ ← since the two frequencies are unrelated the peaks will meet at one point.

$= 20000\pi + 40000 =$

$BW = 2(20000\pi + 40000 + 4000) = 213600$ rad/sec

$= 34012.7$ Hz

①

Good luck!