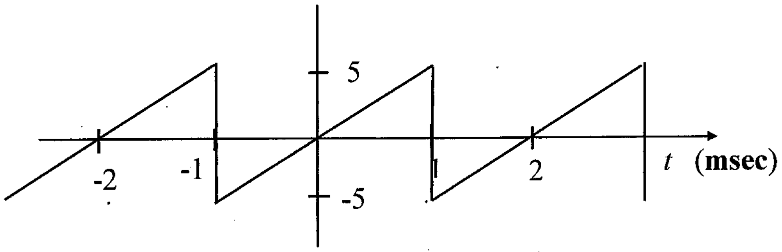
King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE370: Communications Engineering I (102)
Quiz 4: Angle Modulation

Serial #
0
-1 point for no number

Name: KEY ver.2

1. A baseband signal $m(t)$ is periodic saw-tooth signal shown in the figure. If $\omega_c = 2\pi \times 10^6$
   a. Sketch the FM modulated signal with k_f=8000π. (5)
   b. Sketch d$m(t)$/dt and sketch the PM modulated signal with k_p=π/10. *Notice the time is in msec*

(Show your steps & important values)



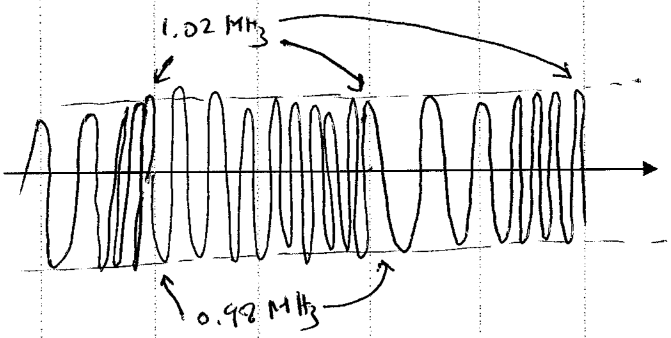
$\omega_i = \omega_c + k_f\, m(t)$

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

$= 10^6 + \dfrac{8000\pi}{2\pi} m(t)$

$f_{i_{max}} = 10^6 + 4000(5) = 1.02$ MHz

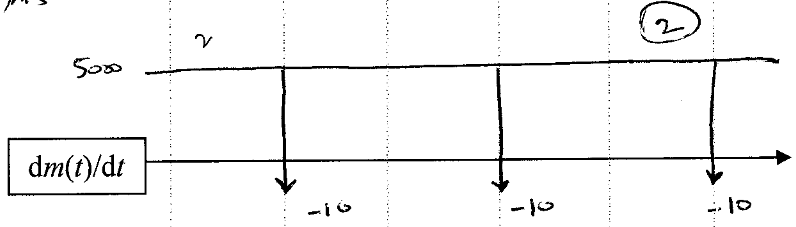
$f_{i_{min}} = 10^6 + 4000(-5) = 0.98$ MHz



$\dfrac{dm(t)}{dt}$, slope $= \dfrac{\Delta y}{\Delta x} = \dfrac{5-(-5)}{(1-(-1))\,ms}$

$= \dfrac{10}{2\,m} = 5000$

(2)



Since we have discontinuty we use the original defintion of PM

$\varphi_{PM}(t) = A\cos(\omega_c t + k_p m(t))$

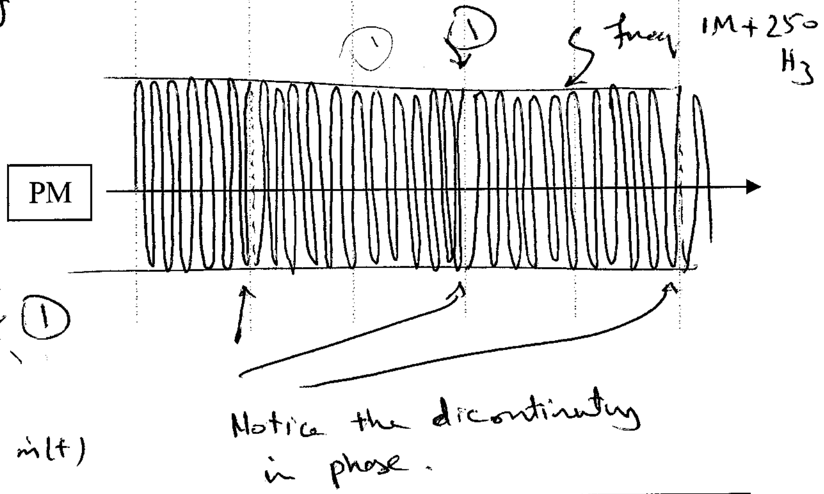
$= A\cos(2\pi \times 10^6 t + \frac{\pi}{10} m(t))$

when $m(t) = 5 \Rightarrow \varphi_{PM}(t) = A\cos(\omega_c t + \frac{\pi}{2})$

when $(m(t) = -5 \Rightarrow \varphi_{PM}(t) = A\cos(\omega_c t - \frac{\pi}{2})$ (1)

There is 180° phase shift.

$\omega_i = \omega_c + k_p \dot{m}(t)$



Good Luck

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$f_i = 10^6 + \dfrac{\pi}{10(2\pi)}\, 5000$

$= 10^6 + 250 \simeq 1000250$ Hz

(1)