Q

$$\phi(t) = 100\cos(\overbrace{\omega_c t + \sin\omega_m t + 2\sin(2\omega_m t)}^{\theta})$$

$f_c = 100\,kH$, $f_m = 1\,kHz$

(a) what is Δf from f_c?

$$\Delta f = Max\left(\underbrace{\frac{1}{2\pi}\frac{d\theta}{dt}}_{f_i} - f_c\right)$$

$$\Delta f = max\left(f_m \cos(\omega_m t) + 4 f_m \cos(2\omega_m t)\right)$$

? max $\omega_m t = 0$

$$\Delta f = 5 f_m = 5\,kHz$$

(b) app B_T

$$B_T = 2\Delta f + 2 f_m$$

$$\beta = \frac{\Delta f}{f_m} = \frac{5}{1} = 5 \qquad = 2(5) + 2(1) = 12\,kHz$$

from curve

$$\left.\frac{B_T}{\Delta f}\right|_{\beta=5} = 3 \longrightarrow B_T = 15\,kHz$$

Q2 $f(t) = a\cos(2\pi f_m t)$

$a = 1V$

$f_m = 1kH$

$\phi(t) = 100\cos(2\pi 10^7 t + 4\sin(2000\pi t))$

across a 50Ω load.

(a) Δf?

$f_i = \frac{1}{2\pi}\frac{d\theta}{dt} = f_c + \Delta f\, m(t)$

$f_i = 10^7 + 4000\cos(2000\pi t)$

$\Delta f = 4kHz$

$f_c = 10MHz$

(b) Total avg power of $\phi(t)$?

$P_t = \frac{(100)^2}{2(50)} = 100W$

(c)

$\beta = \frac{\Delta f}{f_m} = \frac{4k}{1k} = 4$

$J_0(4) = -0.4$

$P_0 = P_t \frac{J_0^2(4)}{\sum_n J_n^2(4)} = 100(-0.4)^2 = 16V$