Q: Given the following signal

$$m(t) = 0.75\cos(2000\pi t)$$

is used to FM modulate a carrier

$$s(t)_{FM} = 50\cos\left(2\pi 10^7 t + 3\sin\underbrace{(2000\pi t)}_{2\pi(1000)t}\right)$$

find:

① the peak freq deviation from the carrier and freq sensitivity?

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

$$f_i = 10^7 + 3000\cos(2\pi(1000)t)$$

$$\Delta f = 3000\,Hz = 3\,kHz$$

$$\Delta f = k_f A_m$$

$$3\,kH = k_f(0.75) \Rightarrow k_f = 4000\,Hz = 4\,kHz$$

$$\beta = \frac{\Delta f}{f_m} = \frac{3\,kHz}{1\,kHz} = 3$$

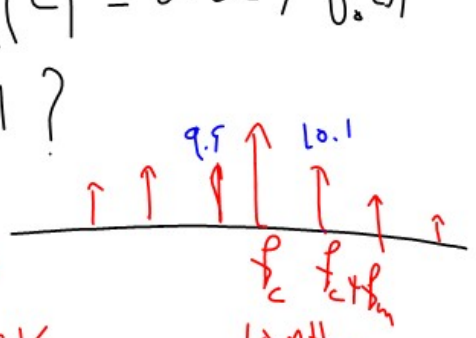
② Compute the total power of $s(t)$?

$$P_{av} = \frac{1}{2}A_c^2 = \frac{1}{2}(50)^2 = 1250\ W$$

③ find the power of the signal at 10MHz given that

$J_0(1) = 0.76$, $J_0(2) = 0.22$, $J_0(3) = -0.26$

$J_0(4) = -0.39$?



$$P_{10MHz} = \overline{J_0(3)}^2 \cdot P_{av}$$

$$= (-0.26)^2 \cdot 1250$$

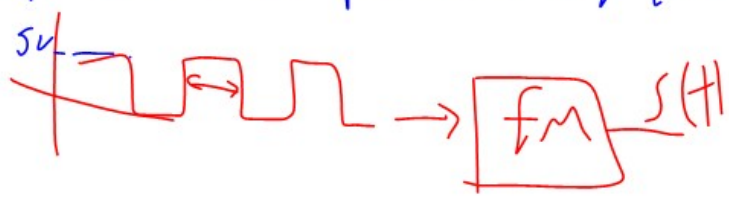
$$= 84.5\ W$$

$$P_{10MHz}\% = \frac{84.5}{1250} =$$

④ find the approx B_T

$$B_T \approx 2(3kH) + 2(1kH) = 8000\,Hz$$

Q: A periodic square wave with 50% duty cycle freq modules an FM transmitter such that the peak angle deviation = 6. assume the square wave has a peak amplitude of 5V. and period of 10 ms.



① find peak freq deviation?

$$\Delta f = B f_m = 6\left(\frac{1}{10\,kHz^{-1}}\right) = 600\ Hz$$

② find freq sensitivity?

$$K_f = \frac{\Delta f}{A_m} = \frac{600}{5} = 120$$

③ sketch the spectrum give $f_c = 30$ MHz and using Bessel table?

$J_0(6) = 0.150$, $J_1(6) = -0.277$

$J_2(6) = -0.249$; $J_3(6) = 0.1148$

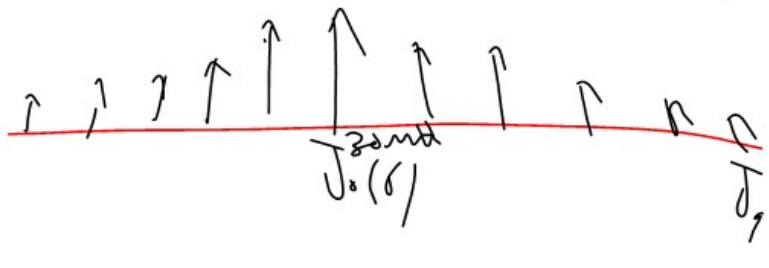
$J_4(6) = 0.3627$, $J_5(6) = 0.2458$

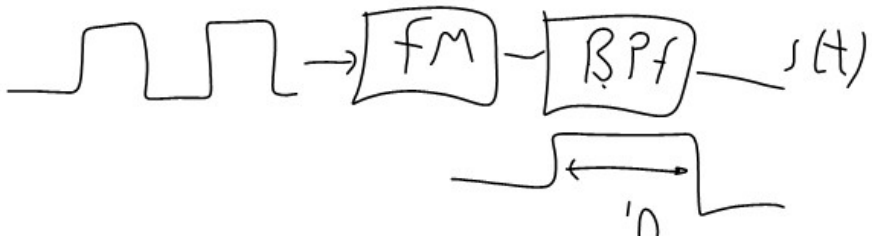
$J_6(6) = 0.24\sim$, $|J_7(6)| > 0.01$

$|J_8(6)| > 0.01$

$|J_9(6)| > 0.01$ ✓

$J_{10}(6) = 0.007 > 0.01$ ✗





$B_T = 2 n_{max} f_m = 2(9)(100) =$